

# A Lap Around the .NET Ecosystem

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**Barry Luijbregts**

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@AzureBarry

[www.azurebarry.com](http://www.azurebarry.com)

# Who is not from Copenhagen?



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- The .NET Ecosystem: The Big Picture
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- Cloud Design Patterns for Azure: Data Management and Performance
- **The .NET Ecosystem: The Big Picture**
- Microsoft Azure for Developers: What to Use When?
- Microsoft Azure Cognitive Services: The Big Picture

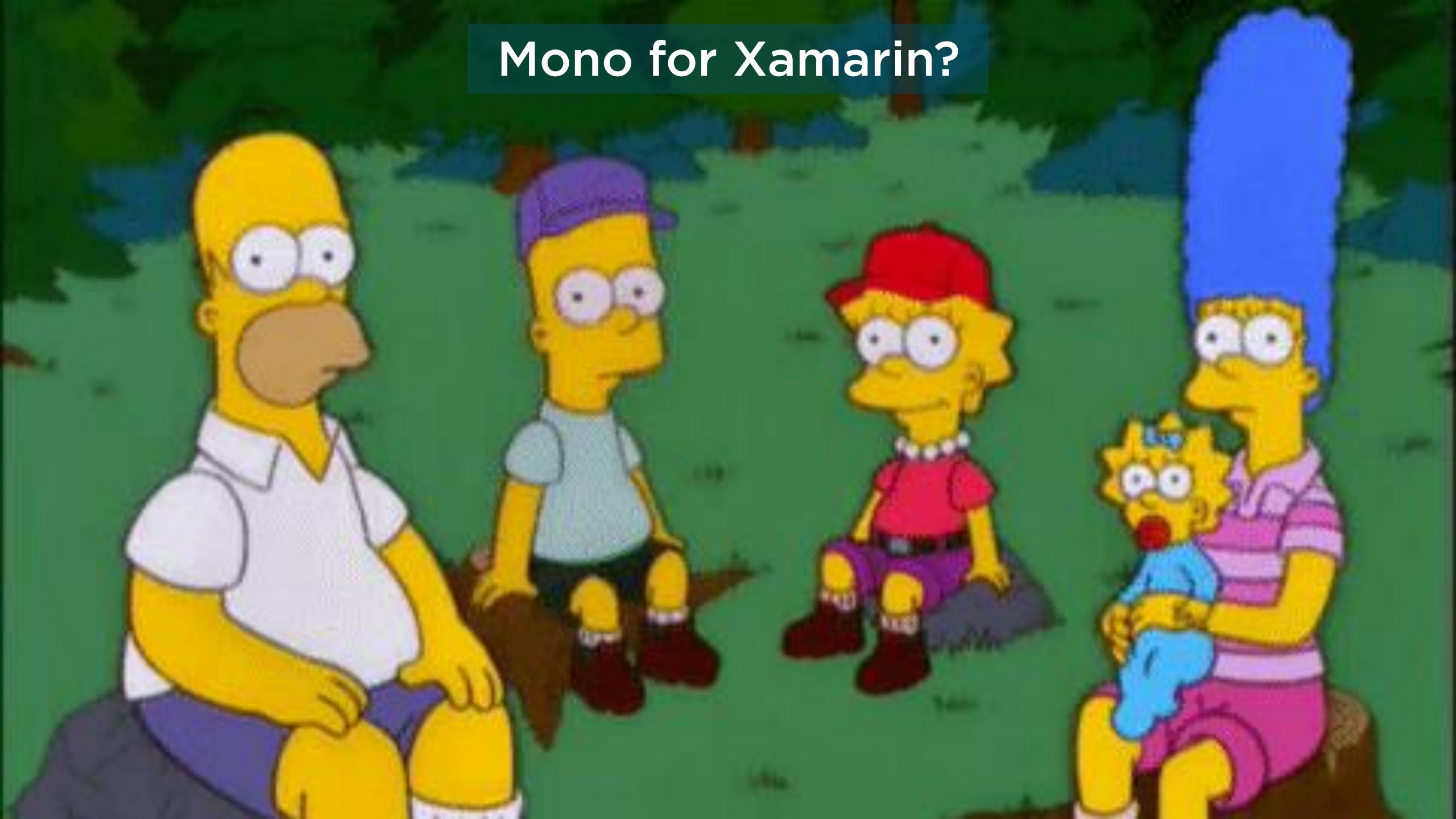
# Survey!

# .NET Framework?



.NET Core?

#MrsMaisel

A scene from the TV show 'The Simpsons' showing the family sitting on a park bench. Homer is on the left, Marge is on the right, and Bart, Lisa, and Maggie are in the middle. Homer has his arms crossed. Marge is wearing a red hat. Bart is wearing a purple cap. Lisa is wearing a pink top and purple pants. Maggie is wearing a blue dress.

Mono for Xamarin?



.NET Standard?

# WinForms or WebForms?

A meme image featuring a man in a white tank top, resting his chin on his hand and looking thoughtful. He is sitting at a desk in an office environment. The text "WinForms or WebForms?" is displayed prominently above him in large white letters.

# The .NET Ecosystem is Confusing

Portable Class Libraries

.NET Framework

.NET Core

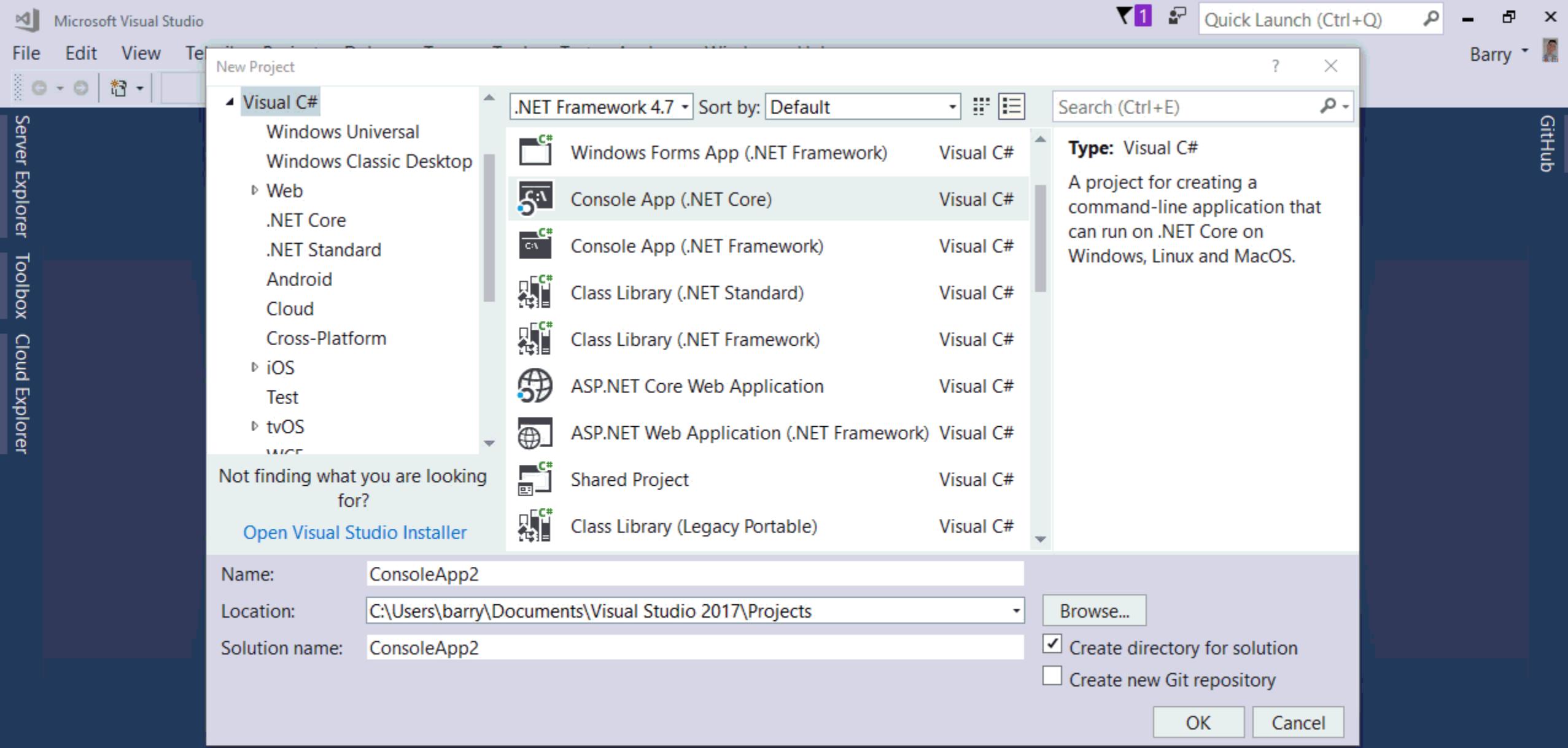
.NET

Roslyn Compiler

February 13, 2002

Base Class Library

.NET Standard



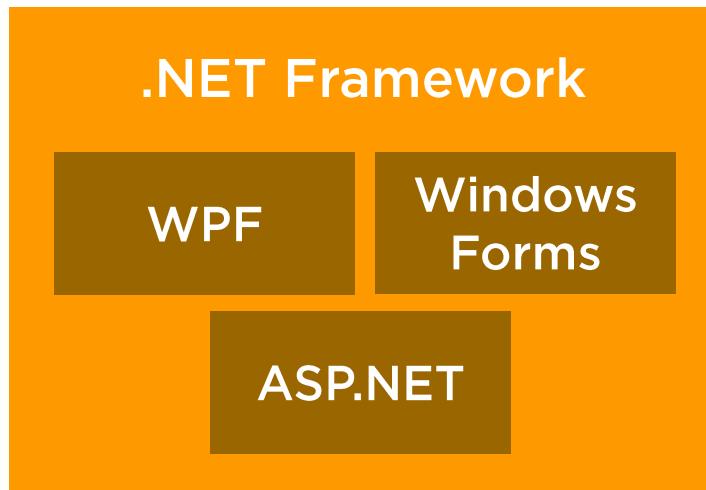
**Dr.  
Phil**



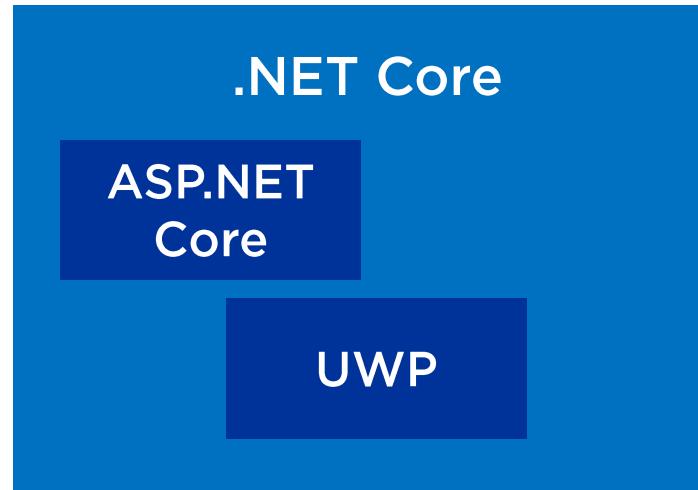
# An Overview of the .NET Ecosystem

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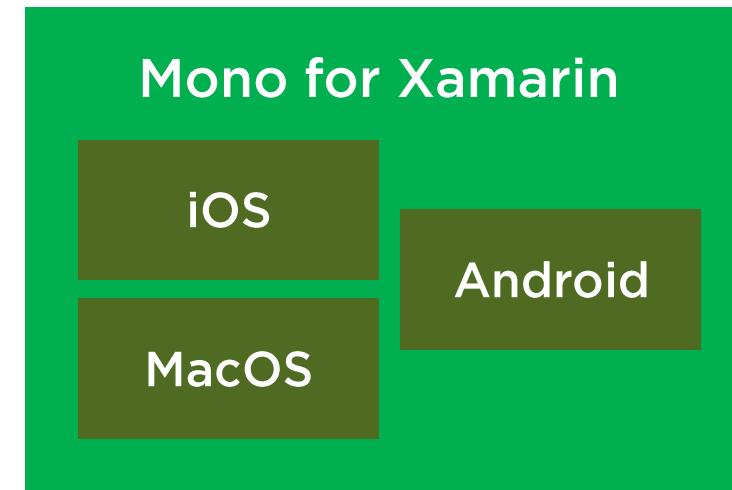
# The .NET Ecosystem



- Windows centric
- Windows specific APIs

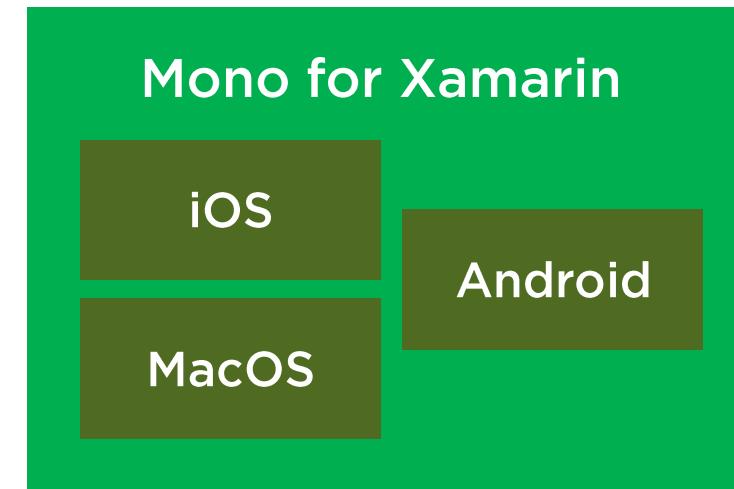
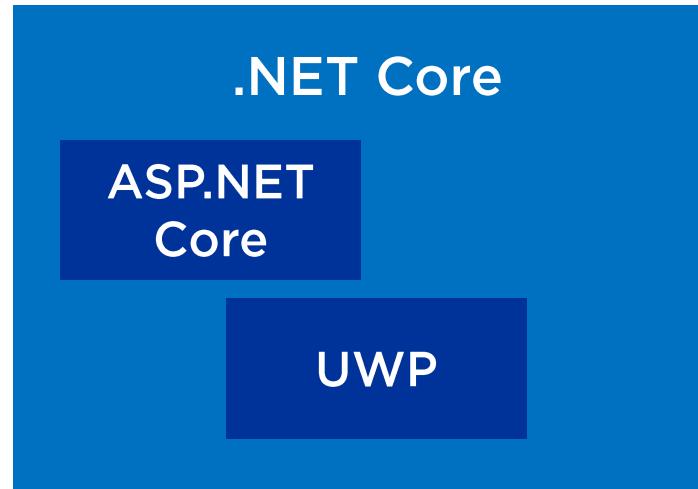
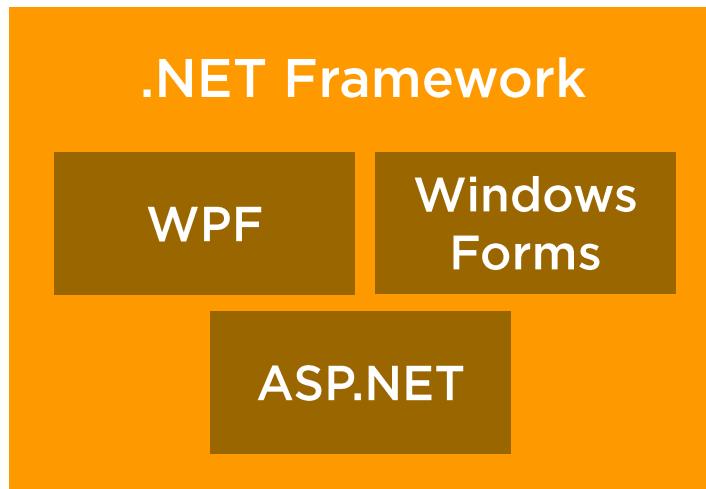


- Cross-platform
- Run side-by-side
- Performance



- Cross-platform
- Specific APIs for
  - iOS
  - Android
  - Xamarin.Mac

# The .NET Ecosystem



.NET Standard Library

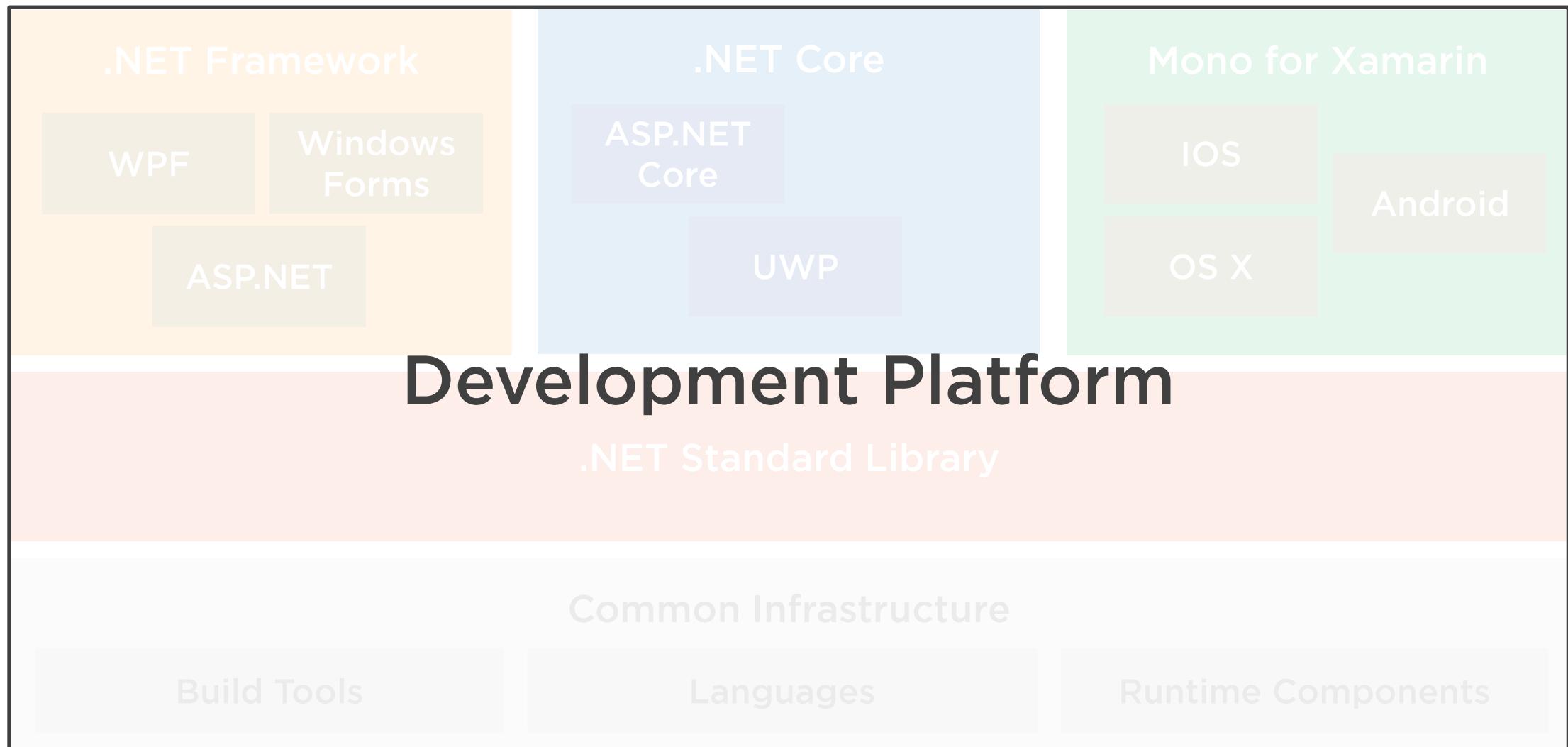
Common Infrastructure

Build Tools

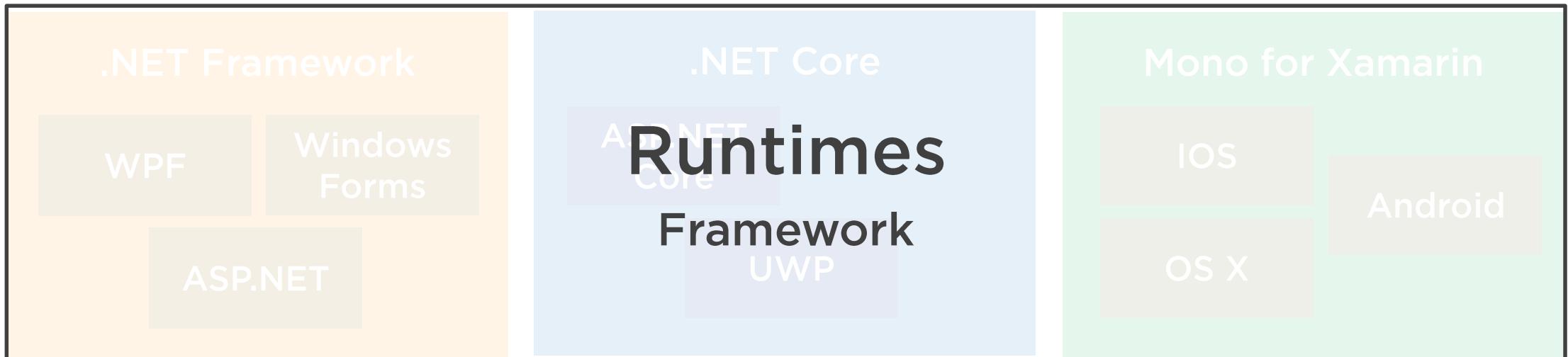
Languages

Runtime Components

# The .NET Ecosystem



# The .NET Ecosystem



.NET Standard Library

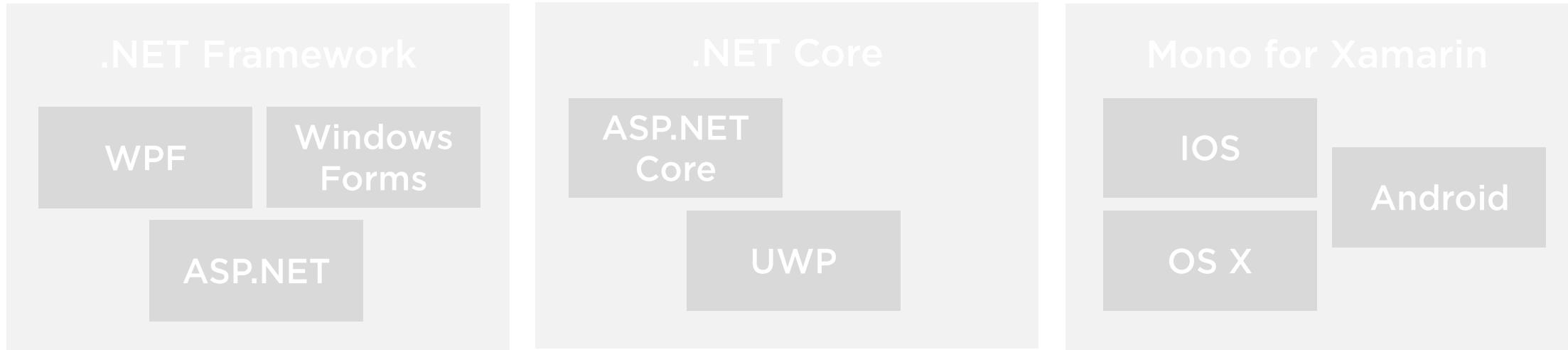
Common Infrastructure

Build Tools

Languages

Runtime Components

# The .NET Ecosystem



**Specification of .NET APIs**  
.NET Standard Library  
Not a physical thing!

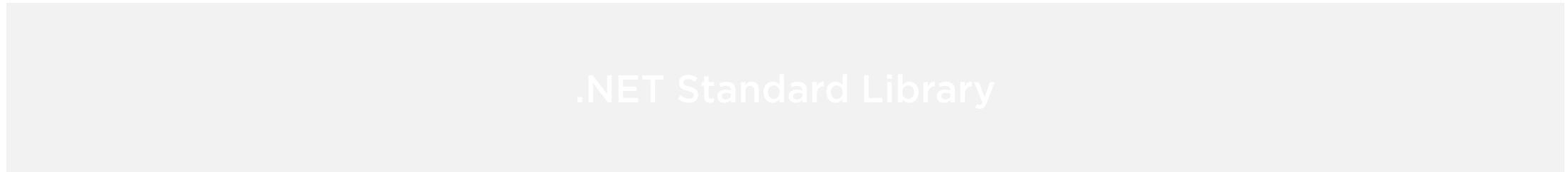
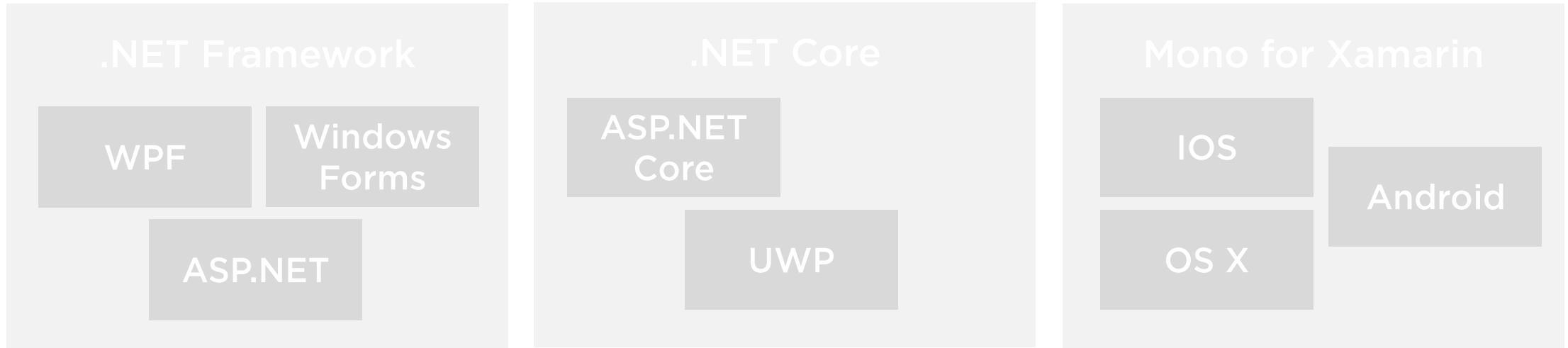
Common Infrastructure

Build Tools

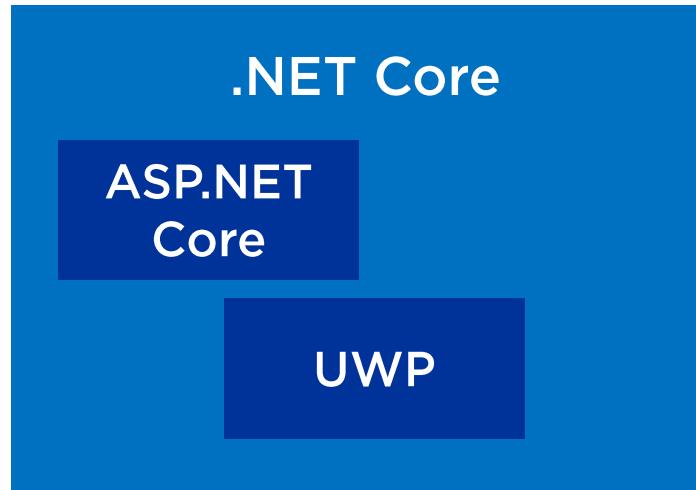
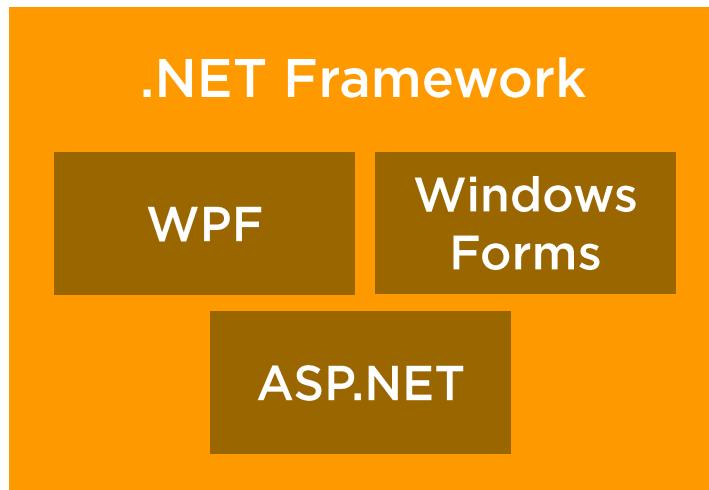
Languages

Runtime Components

# The .NET Ecosystem



# The .NET Ecosystem



.NET Standard Library

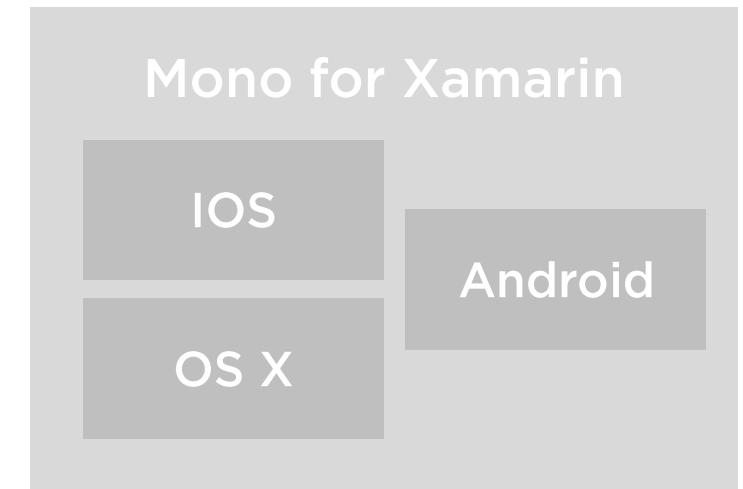
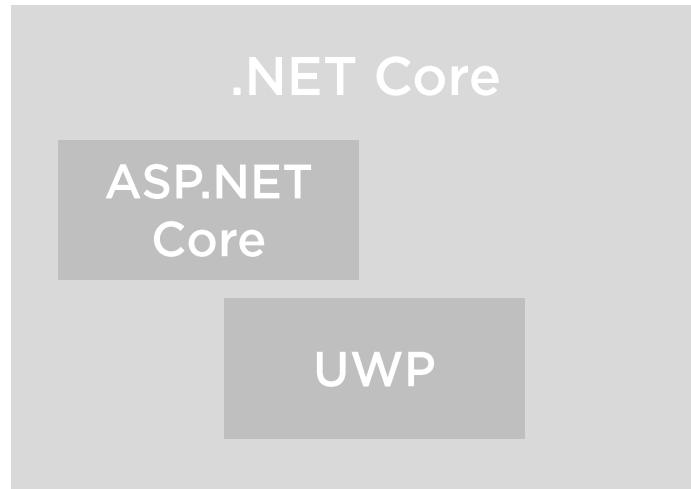
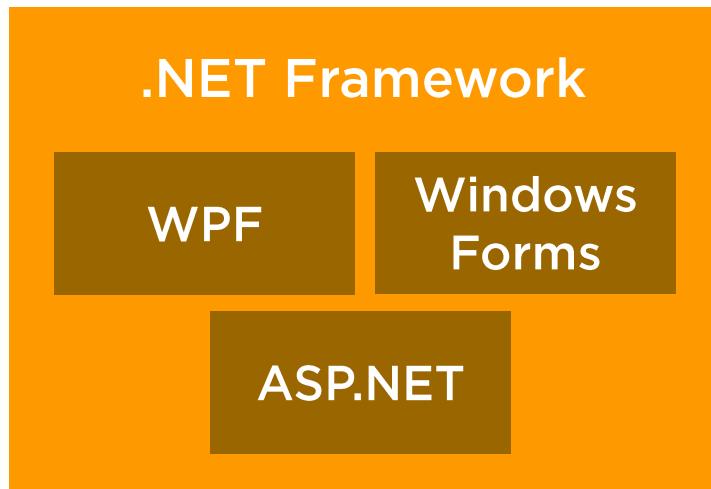
Common Infrastructure

Build Tools

Languages

Runtime Components

# The .NET Ecosystem



.NET Standard Library

Common Infrastructure

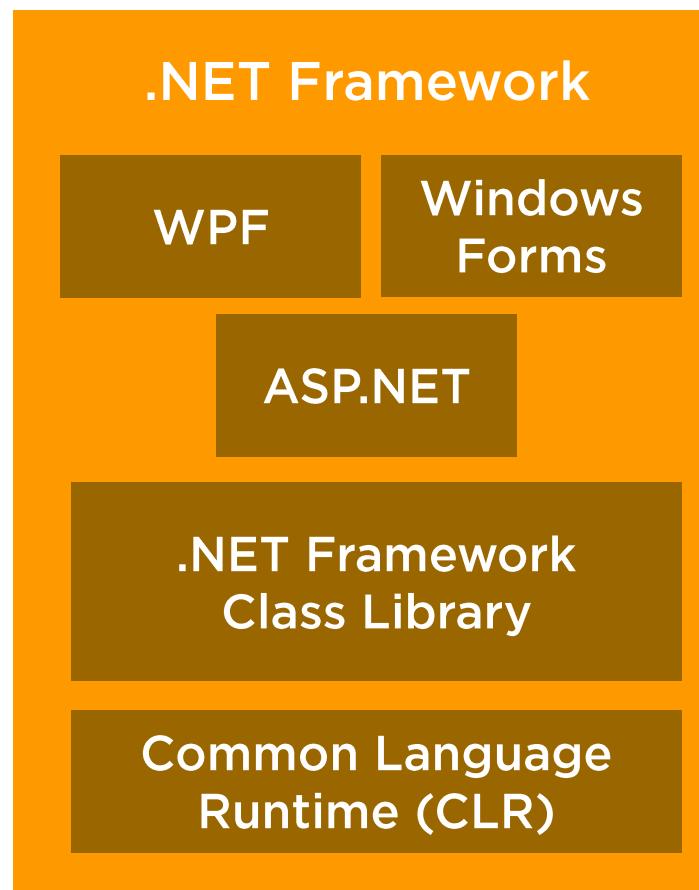
Build Tools

Languages

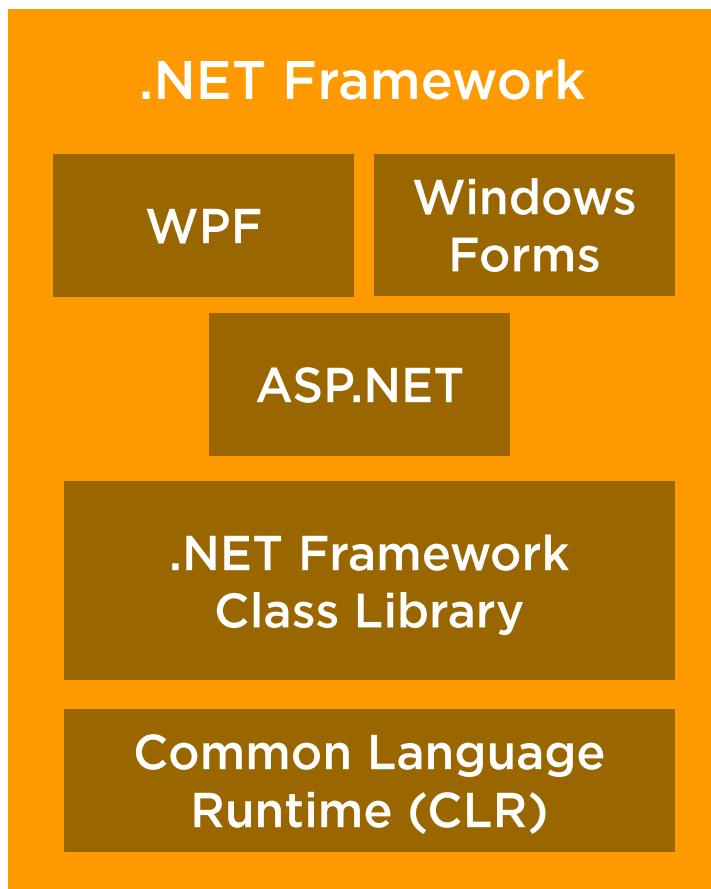
Runtime Components

# The .NET Framework

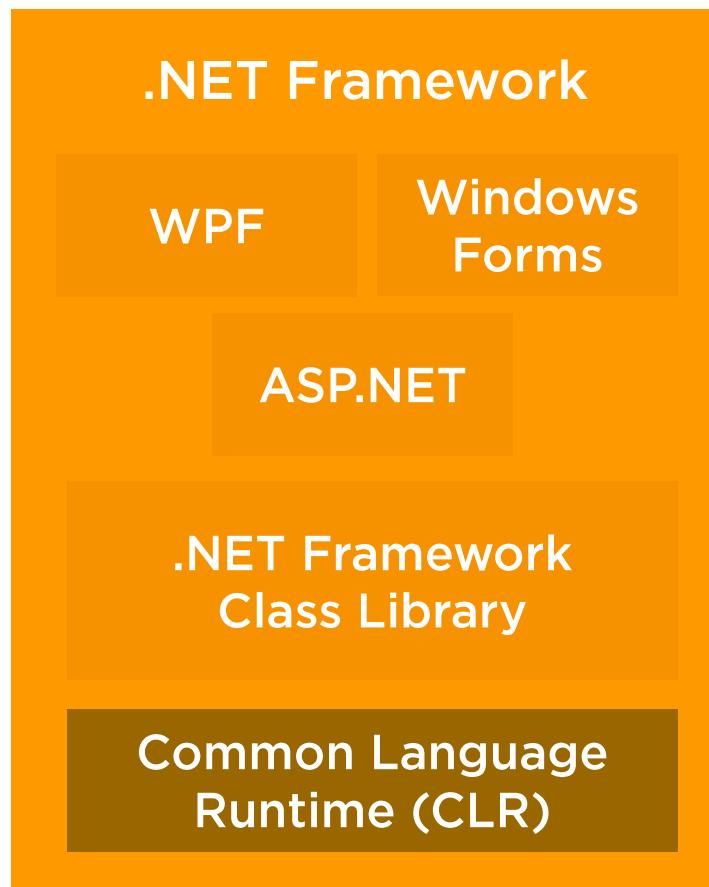
- Released in 2002
- Partly open-source
  - [github.com/microsoft/referencesource](https://github.com/microsoft/referencesource)



# The .NET Framework

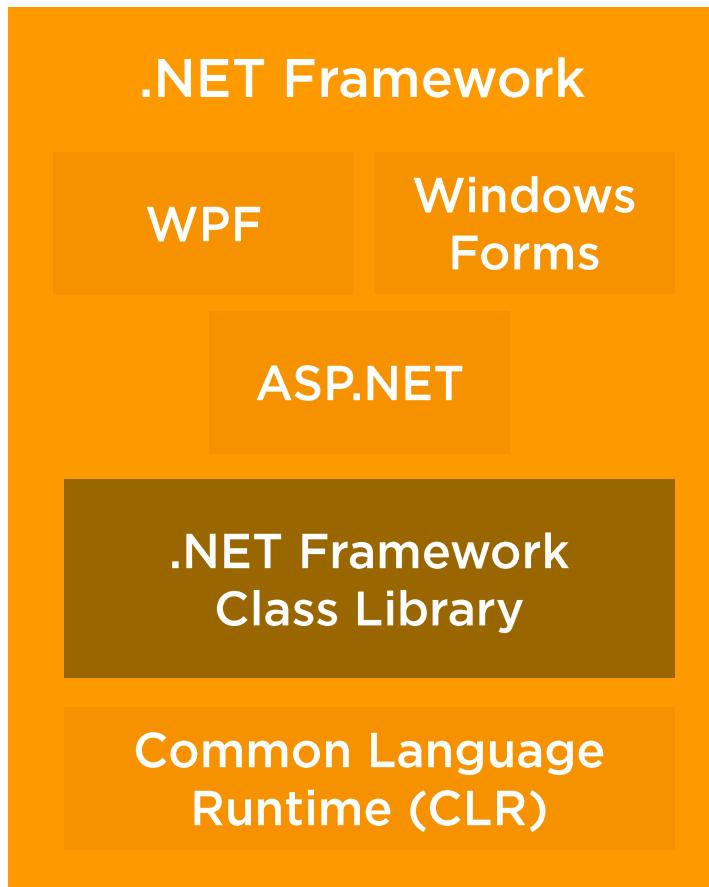


# The .NET Framework



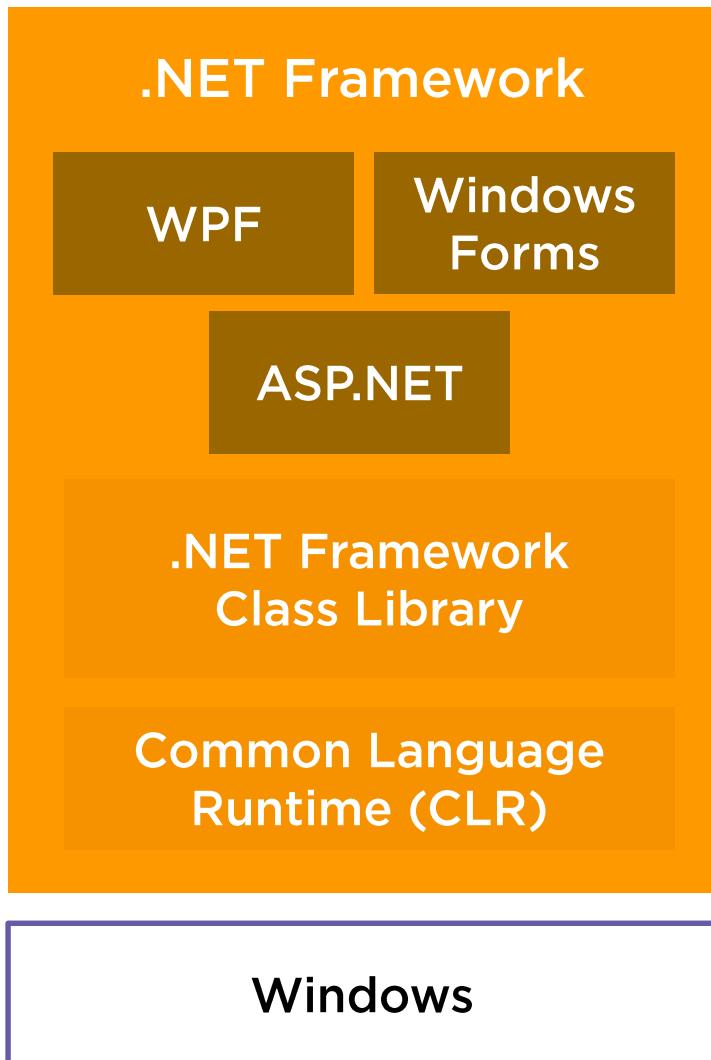
- Run code, Garbage Collection
- C#, VB.NET, F#

# The .NET Framework



- Classes, interfaces and value types that provide capabilities

# The .NET Framework

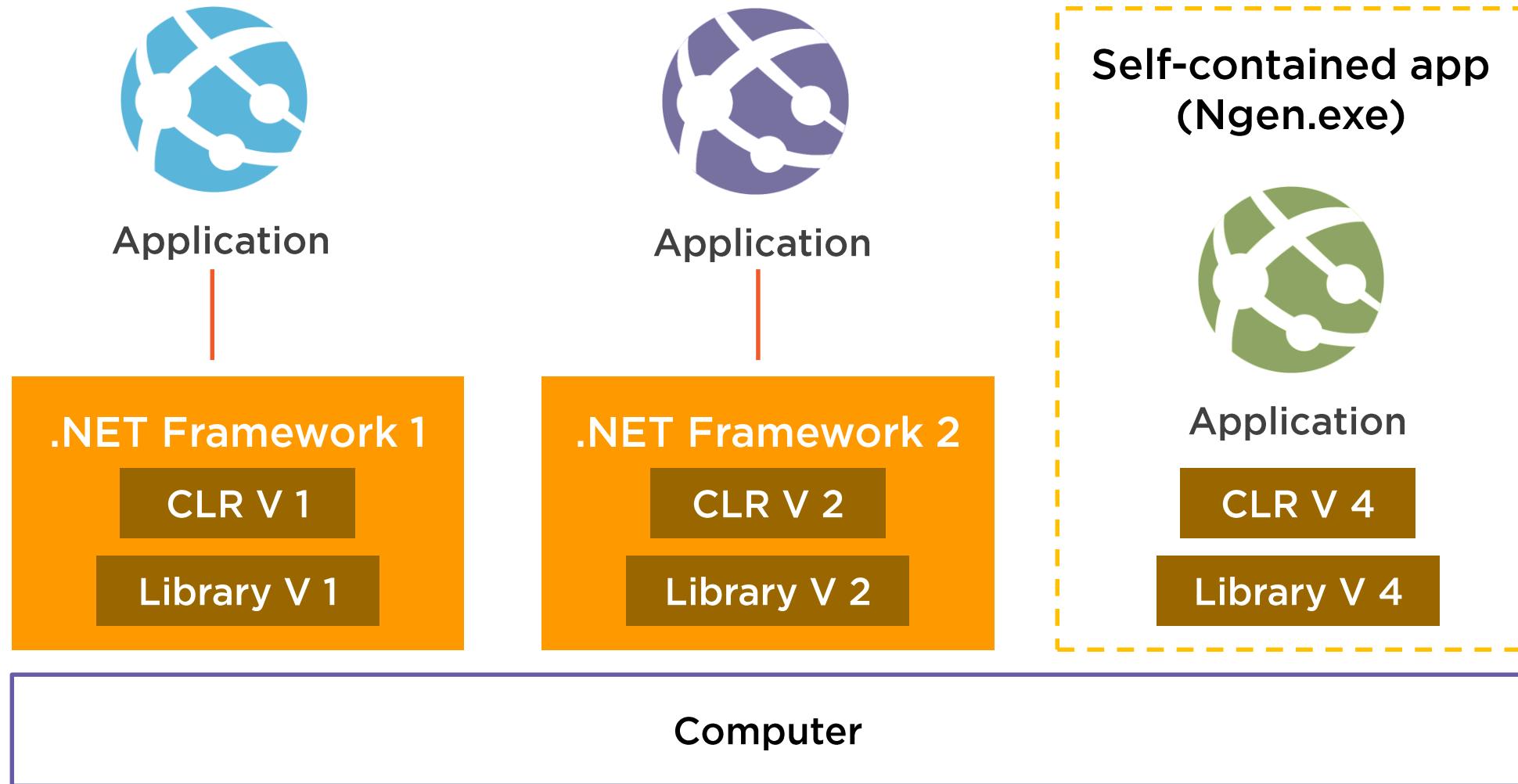


## Workloads (application types)

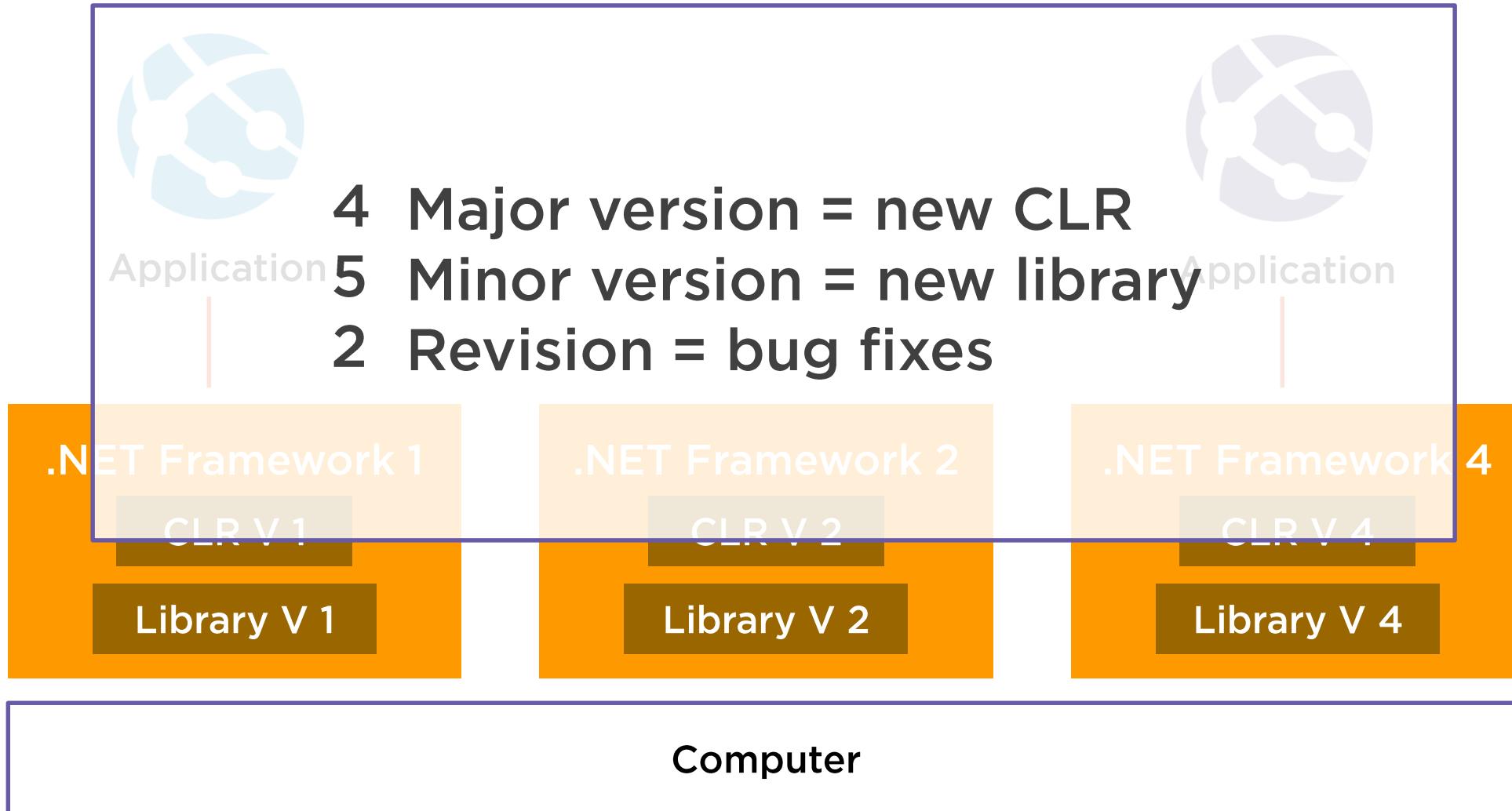
- Console applications
- Windows Communication Foundation (WCF)
- Windows Workflow Foundation (WF)
- Windows Presentation Foundation (WPF)
- Windows Forms
- ASP.NET
  - Forms, MVC, Web API
- Azure (WebJobs, Cloud Services)
- ...

Windows APIs

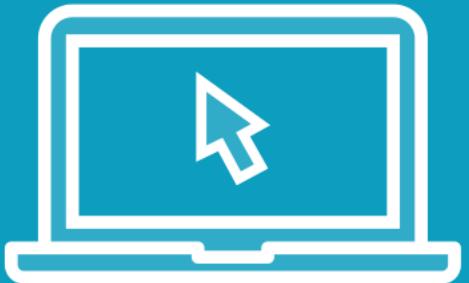
# The .NET Framework



# The .NET Framework



# Demo

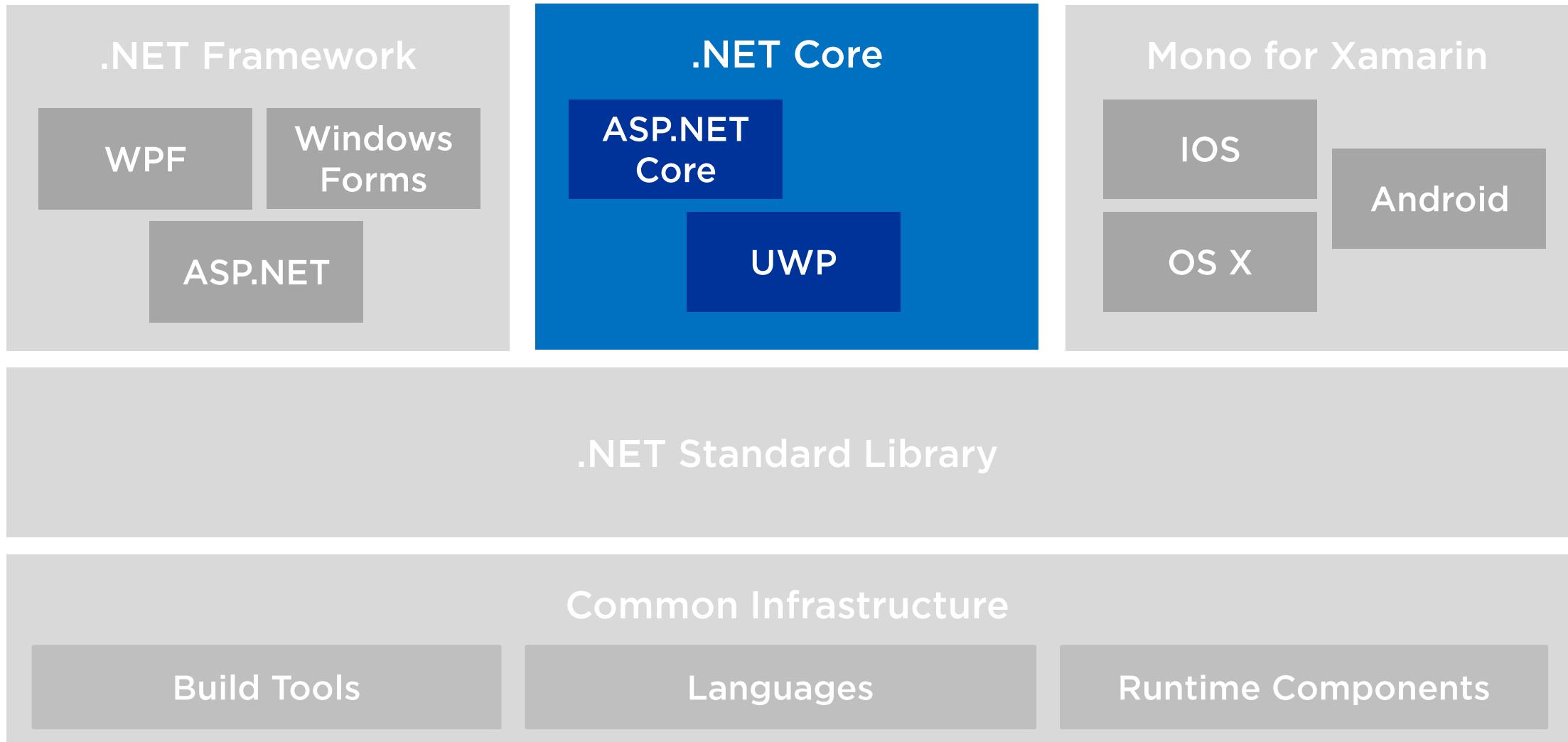


## **Windows Forms project**

- Windows specific

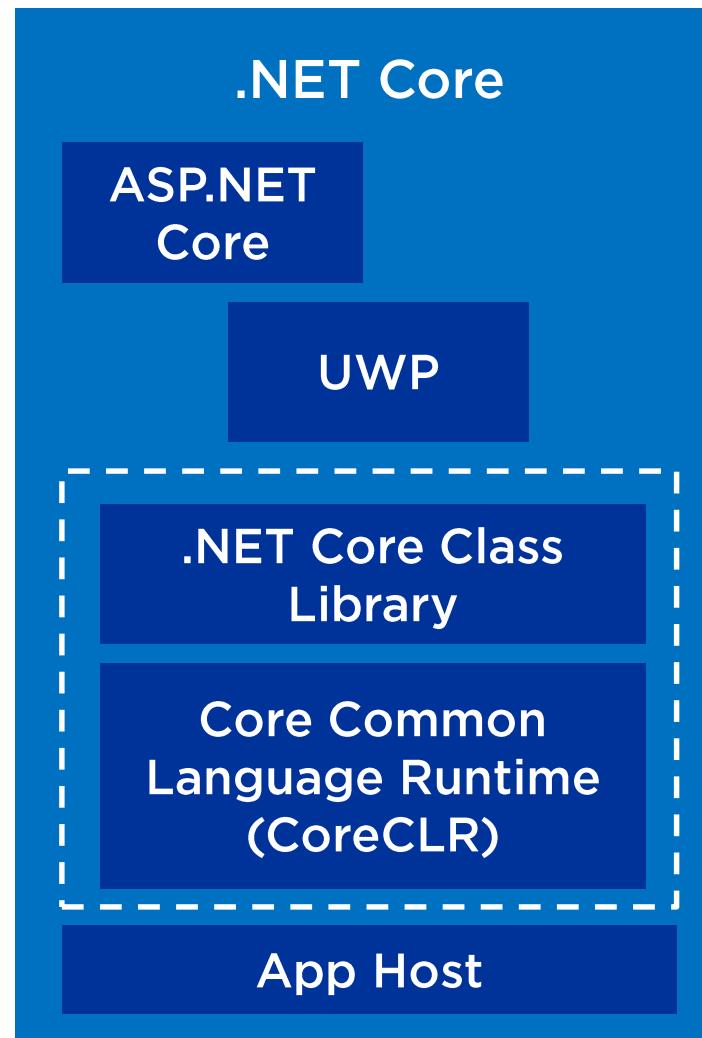
**Where the .NET Framework is installed**

# The .NET Ecosystem

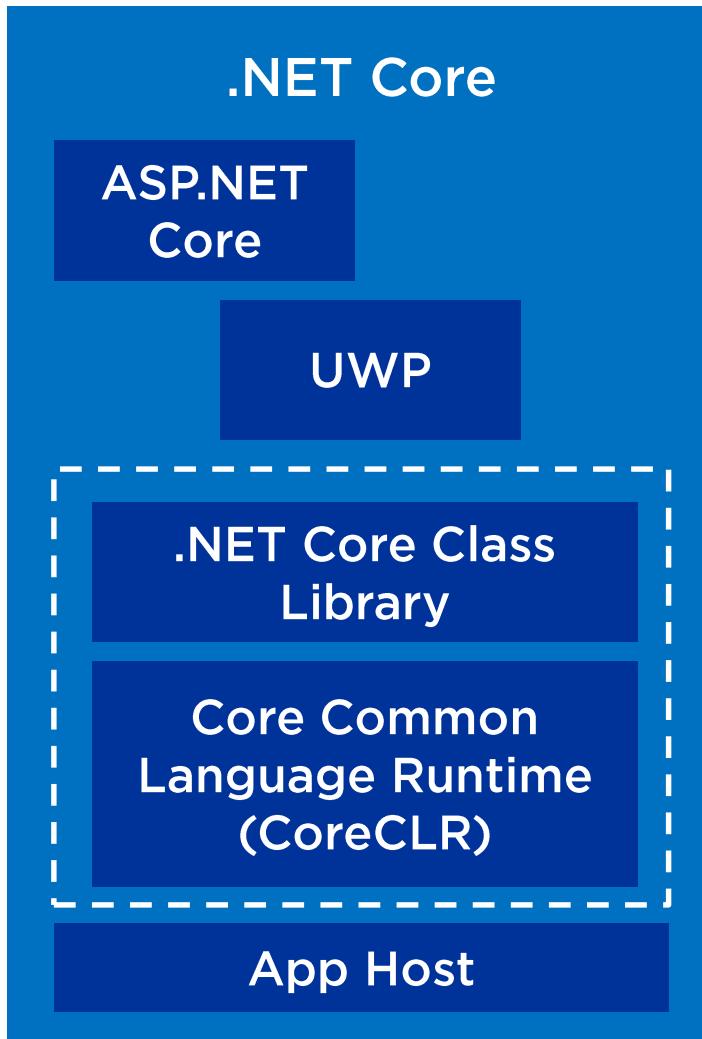


# .NET Core

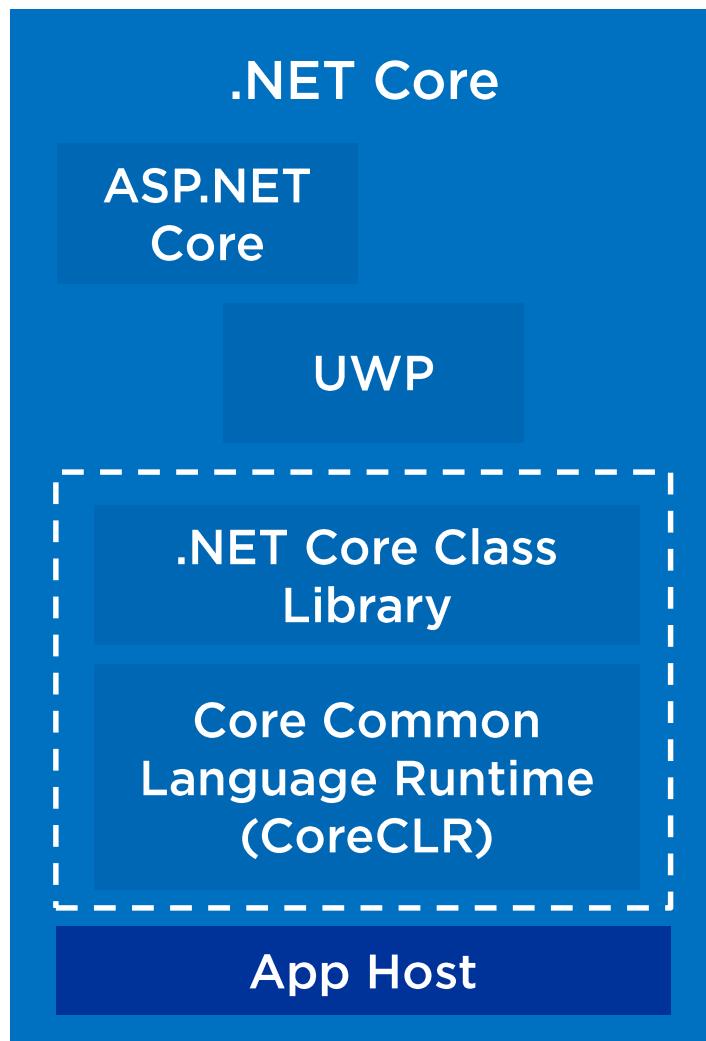
- Released in 2016
- Open source
  - <https://github.com/dotnet/core>



# .NET Core

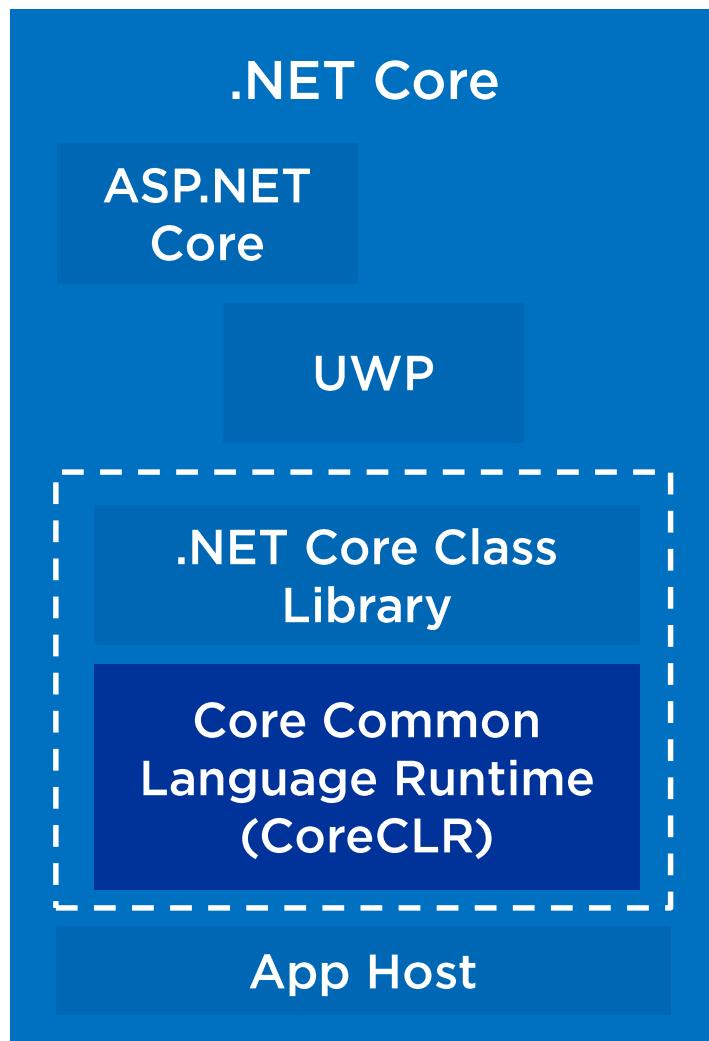


# .NET Core



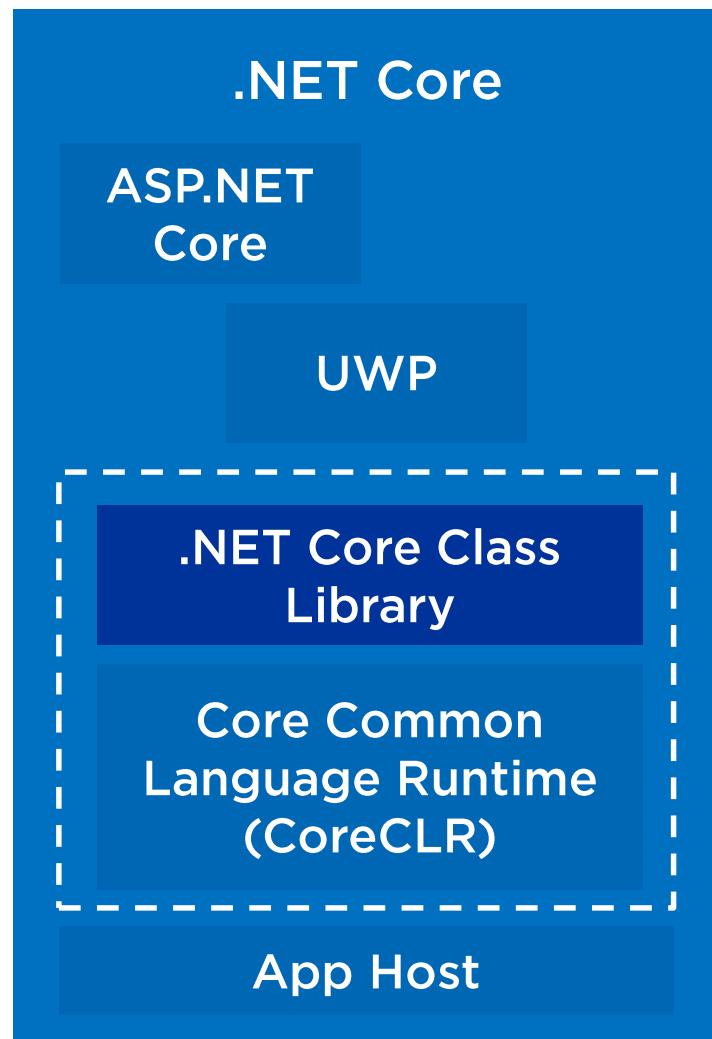
- Hosts the CoreCLR and launches the app

# .NET Core



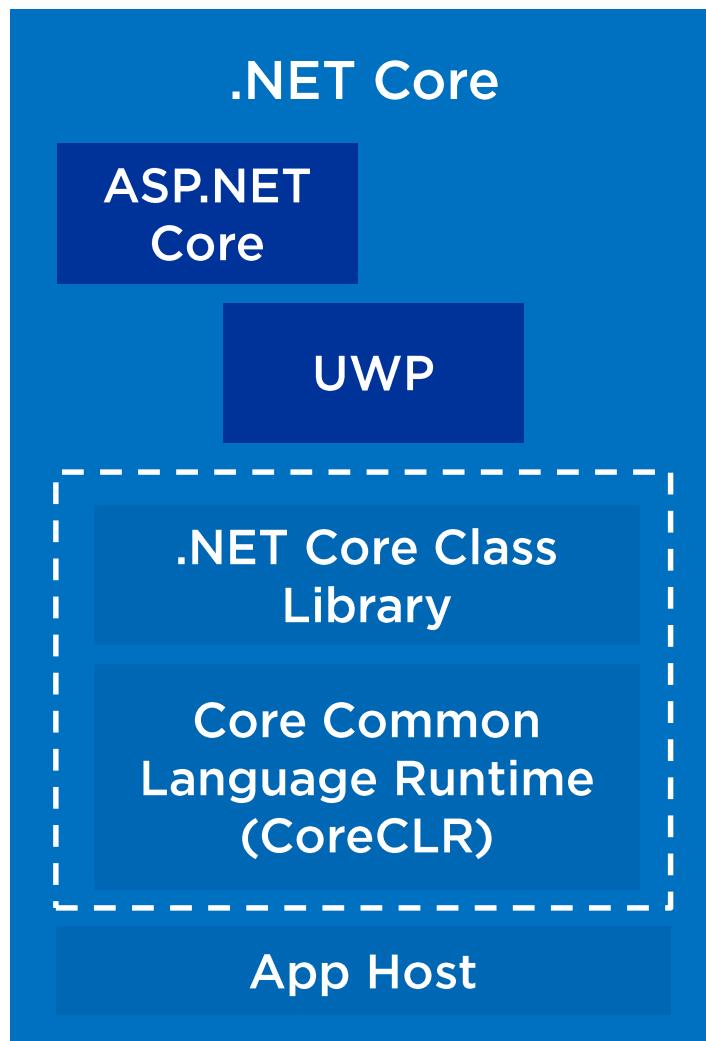
- Assembly loading, Garbage Collection
- C#, VB.NET, F#

# .NET Core



- Classes that provide capabilities
- Subset of the .NET Framework library

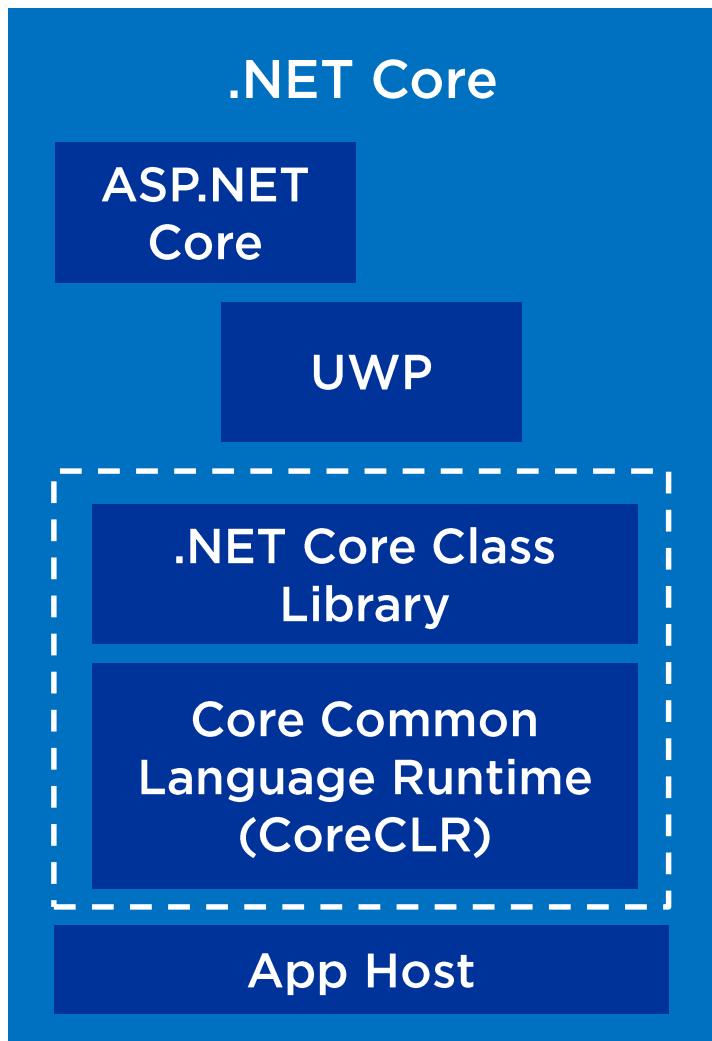
# .NET Core



## Workloads (application types)

- Console applications
- ASP.NET Core
  - MVC
  - API
- Universal Windows Platform Apps
- ...

# .NET Core



# .NET Core

.NET Core

Windows Client

Windows IoT

Ubuntu

FreeBSD

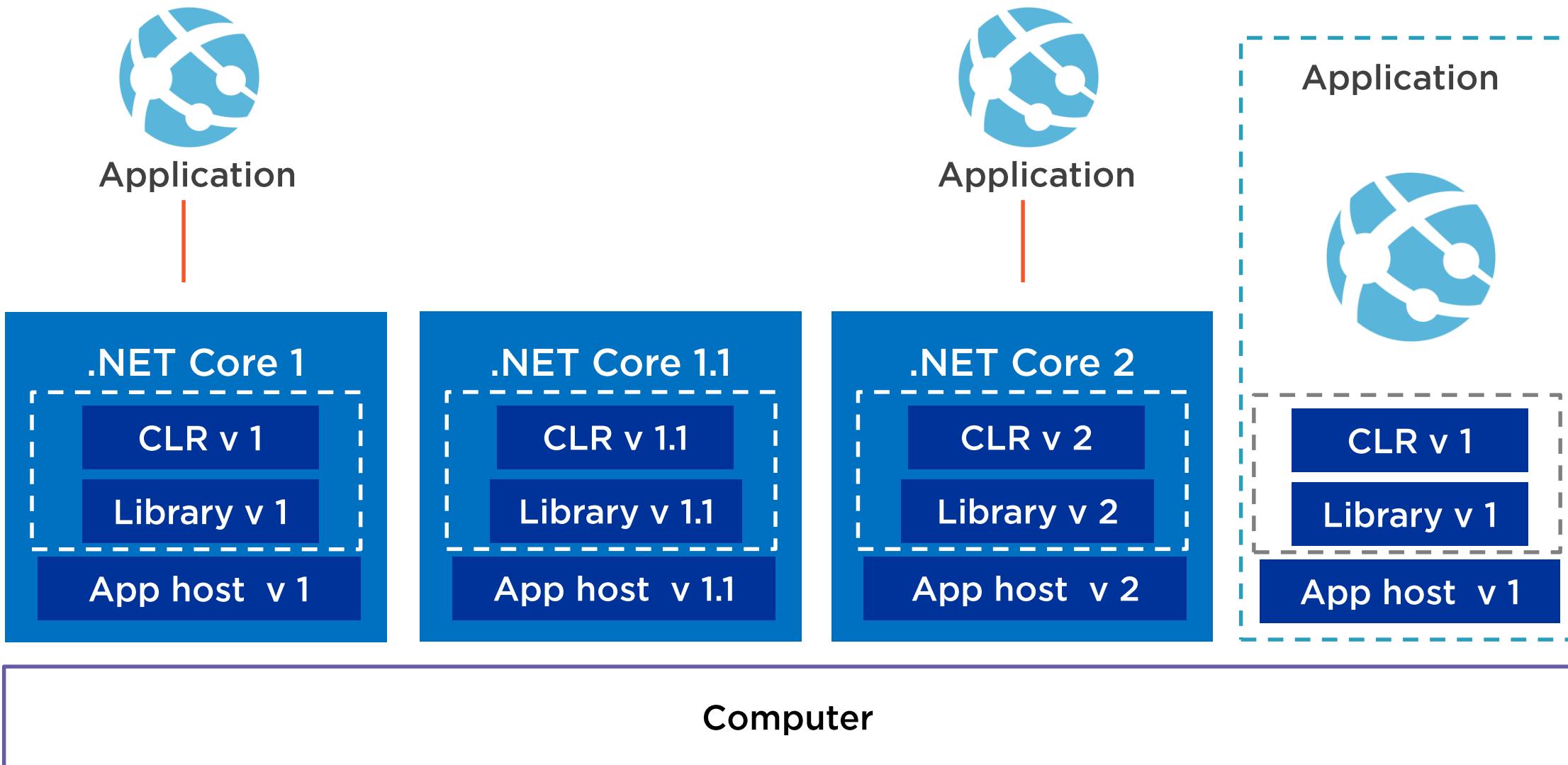
Windows Server

(Red Hat) Linux

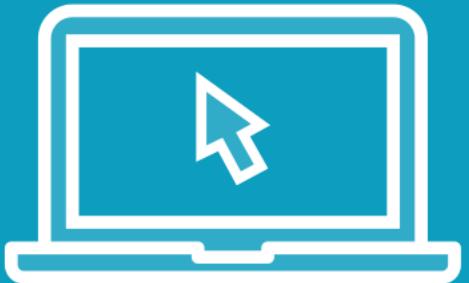
Tizen

Mac OS X

# .NET Core



# Demo



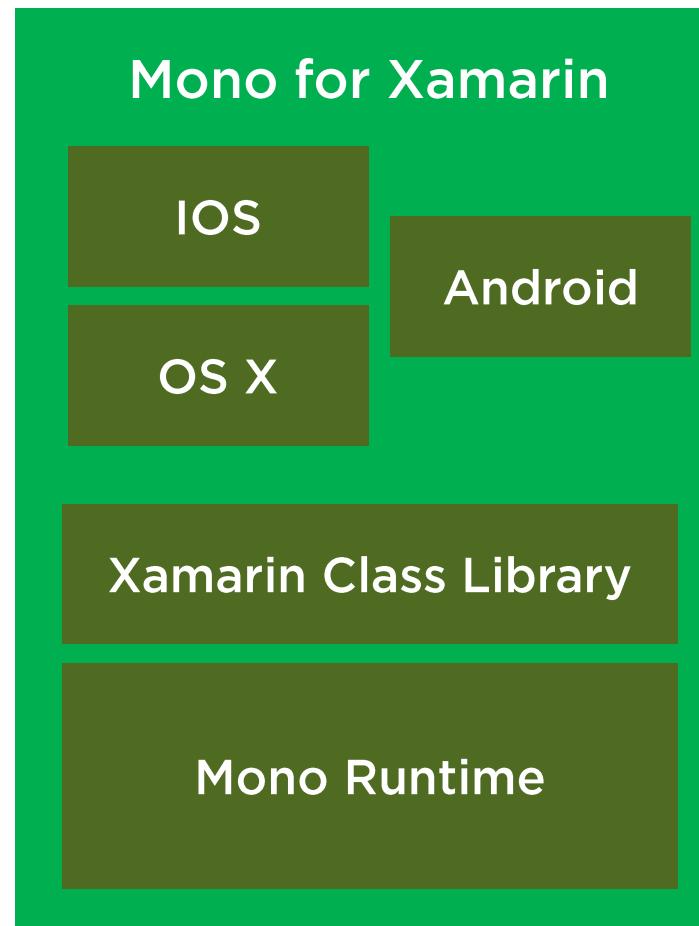
## Simple .NET Core application

- Framework dependent application
- Self-contained application

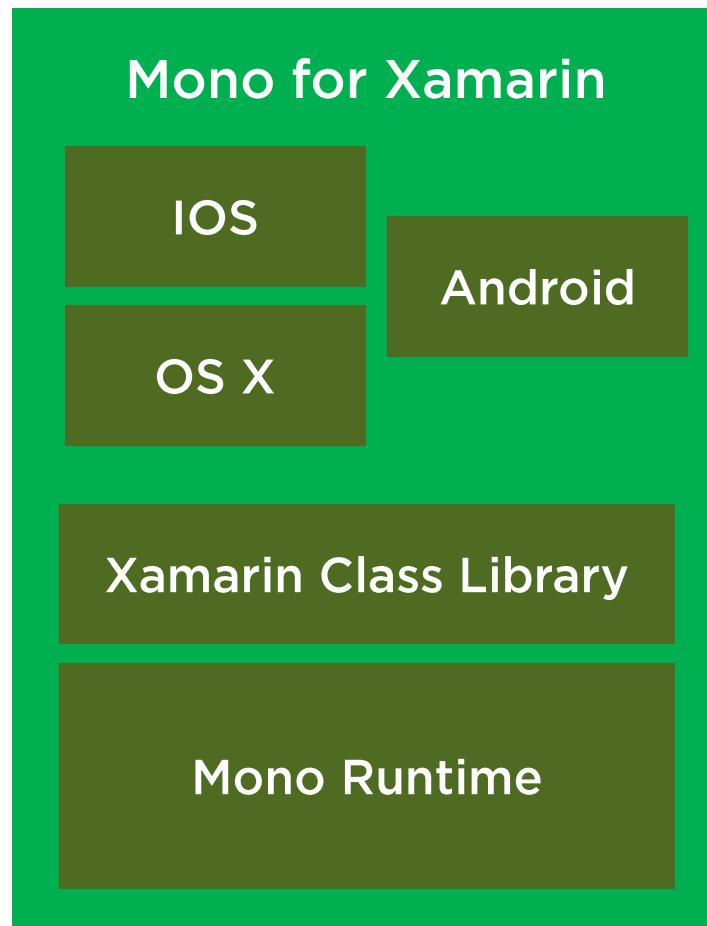
## Cross-platform

# Mono for Xamarin

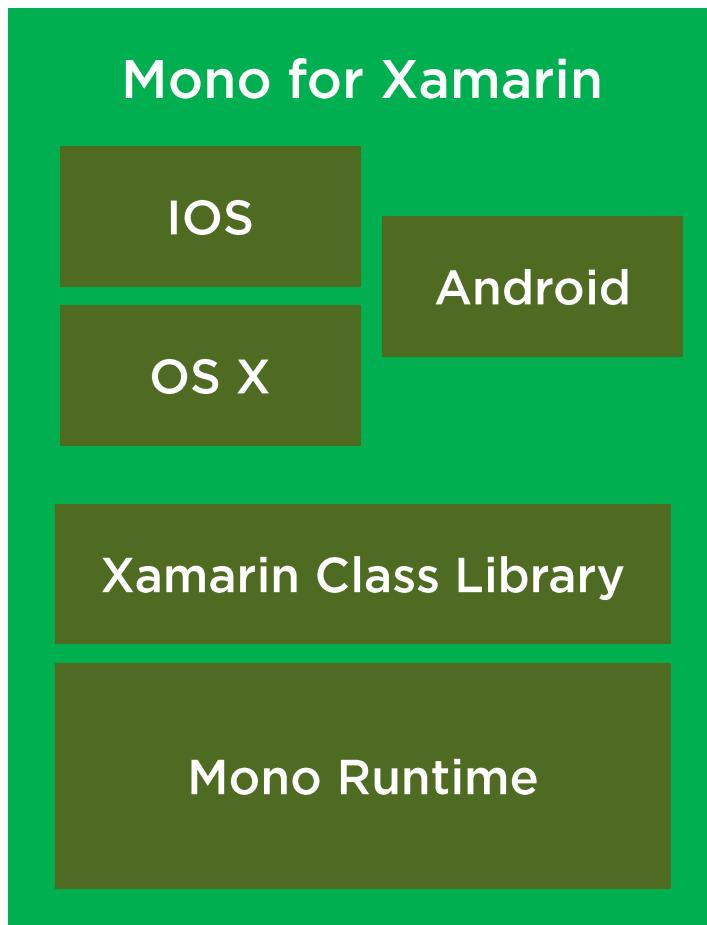
- Released in 2011
- Mono is open source
  - <https://github.com/mono/mono>
- [www.mono-project.com](http://www.mono-project.com)



# Mono for Xamarin

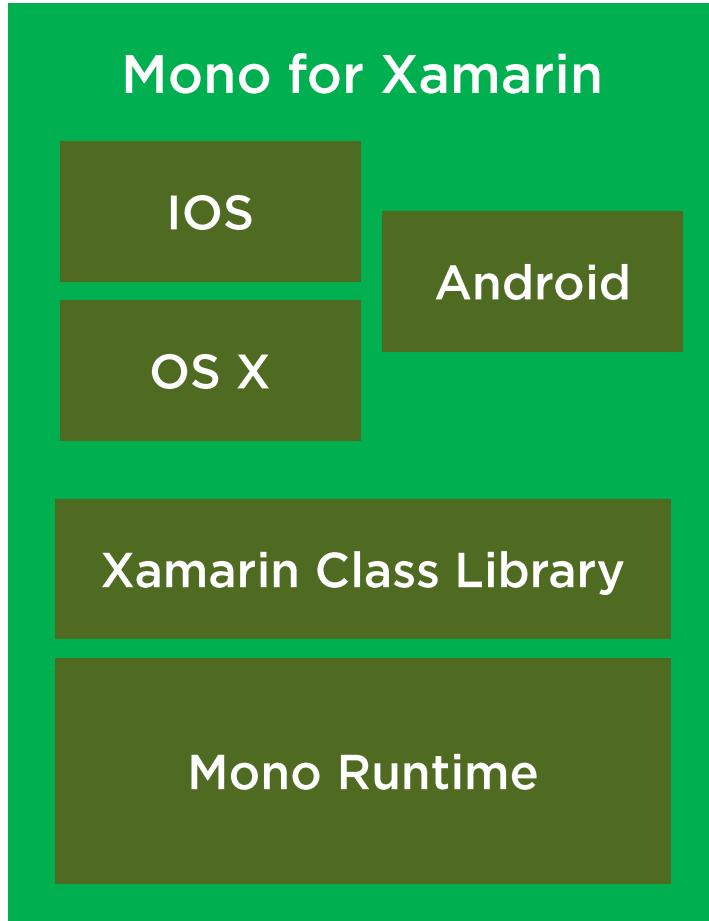


# Mono for Xamarin



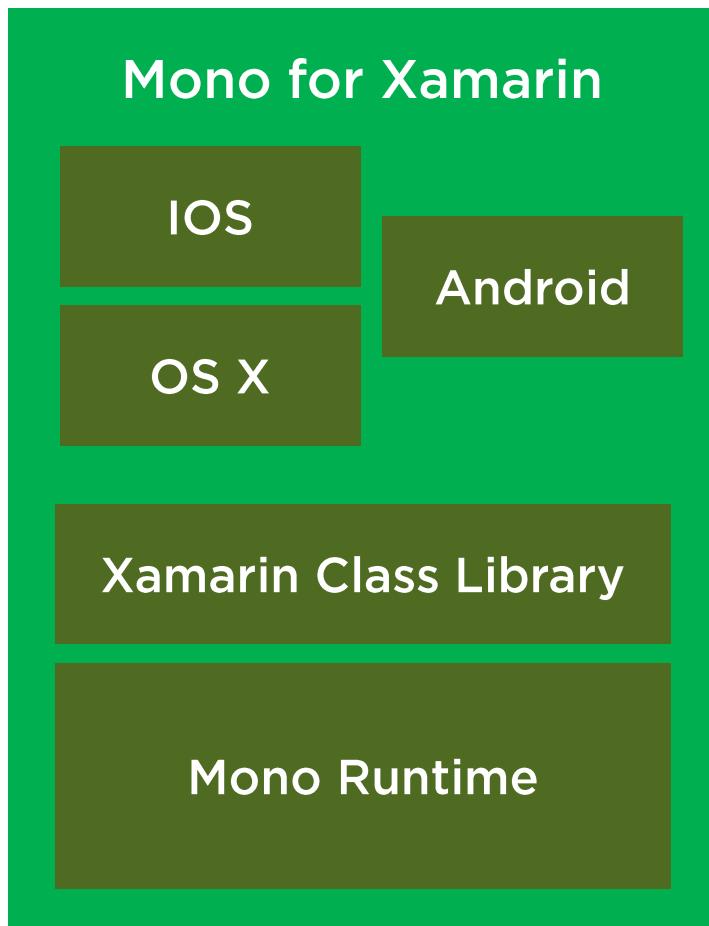
- Garbage Collection, JIT, AOT
- C#

# Mono for Xamarin



- Classes that provide capabilities
- Subset of the .NET Framework library

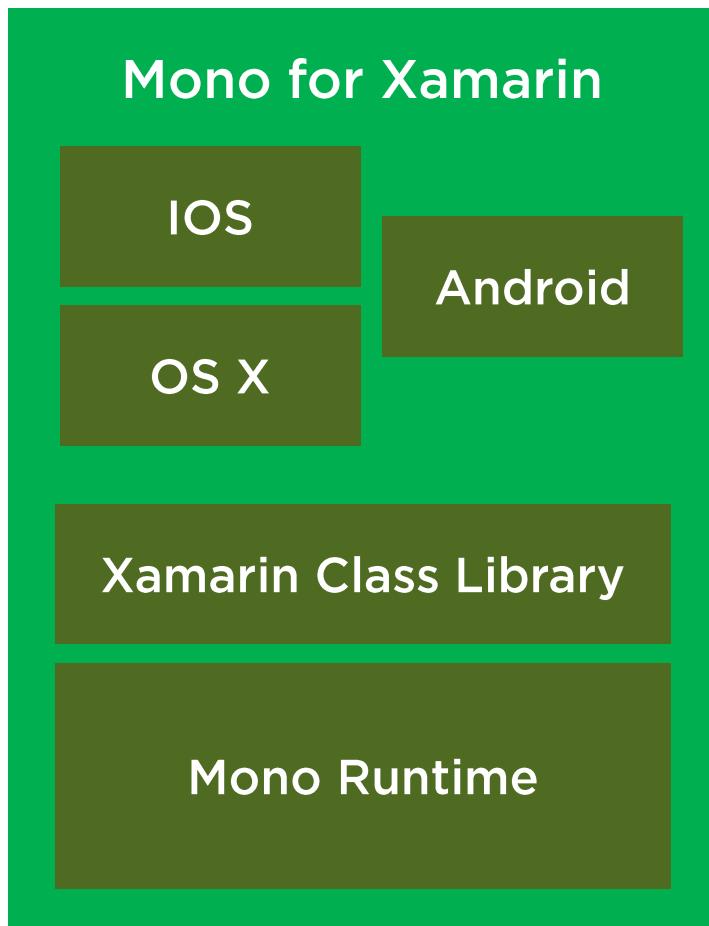
# Mono for Xamarin



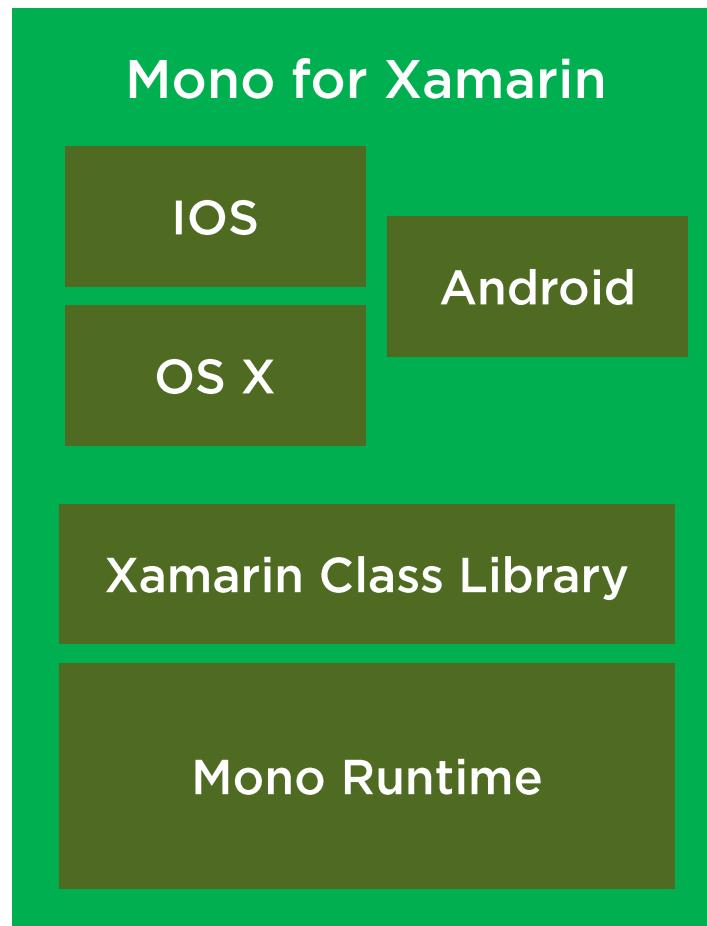
## Workloads (application types)

- Apple iOS applications
- Apple Mac OS X applications
- Android applications
- ...

# Mono for Xamarin



# Mono for Xamarin



# Mono for Xamarin

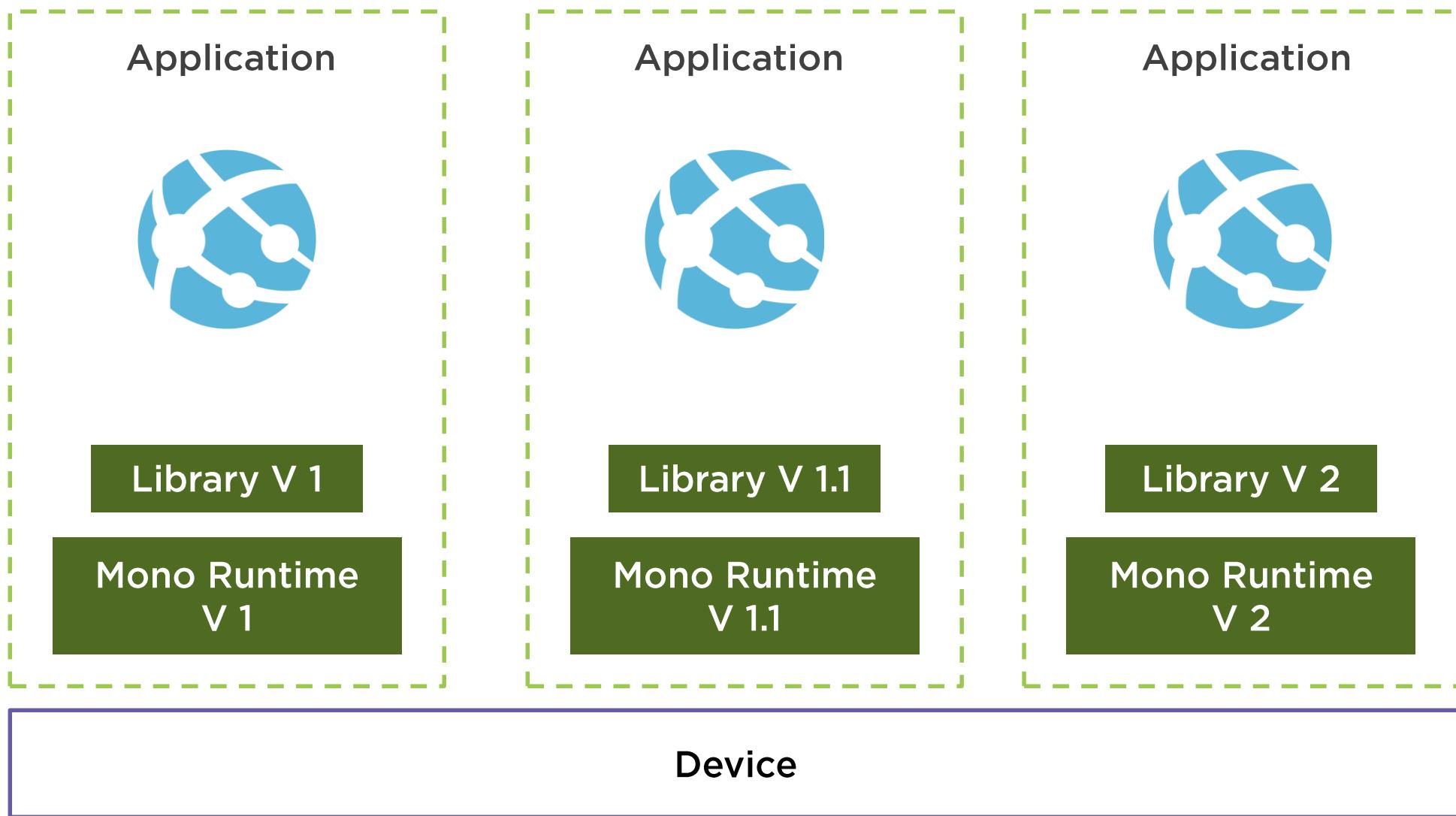
Mono for Xamarin

Apple IOS

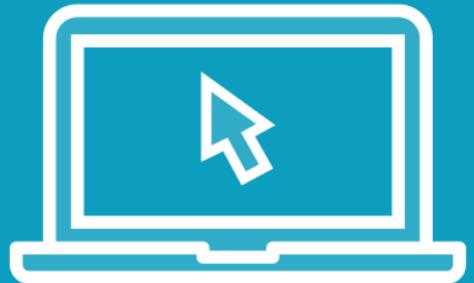
Apple OS X

Android

# Mono for Xamarin



Demo



Simple Xamarin.Mono app

# Let's compare runtimes!



# Comparison of Runtimes

|  | .NET Framework | .NET Core | Mono for Xamarin |
|--|----------------|-----------|------------------|
|  |                |           |                  |
|  |                |           |                  |
|  |                |           |                  |
|  |                |           |                  |
|  |                |           |                  |

# Comparison of Runtimes

|                  | <b>.NET Framework</b>                 | <b>.NET Core</b>     | <b>Mono for Xamarin</b>   |
|------------------|---------------------------------------|----------------------|---------------------------|
| <b>Workloads</b> | WPF, Windows Forms,<br>ASP.NET (Core) | ASP.NET Core,<br>UWP | iOS, Mac OS X,<br>Android |
|                  |                                       |                      |                           |
|                  |                                       |                      |                           |
|                  |                                       |                      |                           |
|                  |                                       |                      |                           |

# Comparison of Runtimes

|                | .NET Framework                        | .NET Core            | Mono for Xamarin          |
|----------------|---------------------------------------|----------------------|---------------------------|
| Workloads      | WPF, Windows Forms,<br>ASP.NET (Core) | ASP.NET Core,<br>UWP | iOS, Mac OS X,<br>Android |
| Cross-platform |                                       | X                    | X                         |
|                |                                       |                      |                           |
|                |                                       |                      |                           |

# Comparison of Runtimes

|                | .NET Framework                        | .NET Core            | Mono for Xamarin          |
|----------------|---------------------------------------|----------------------|---------------------------|
| Workloads      | WPF, Windows Forms,<br>ASP.NET (Core) | ASP.NET Core,<br>UWP | iOS, Mac OS X,<br>Android |
| Cross-platform |                                       | X                    | X                         |
| Side-by-side   | Only major versions                   | X                    | X                         |
|                |                                       |                      |                           |
|                |                                       |                      |                           |

# Comparison of Runtimes

|                | .NET Framework                        | .NET Core            | Mono for Xamarin          |
|----------------|---------------------------------------|----------------------|---------------------------|
| Workloads      | WPF, Windows Forms,<br>ASP.NET (Core) | ASP.NET Core,<br>UWP | iOS, Mac OS X,<br>Android |
| Cross-platform |                                       | X                    | X                         |
| Side-by-side   | Only major versions                   | X                    | X                         |
| Self-contained | X (Ngen.exe)                          | X                    | X                         |
|                |                                       |                      |                           |

# Comparison of Runtimes

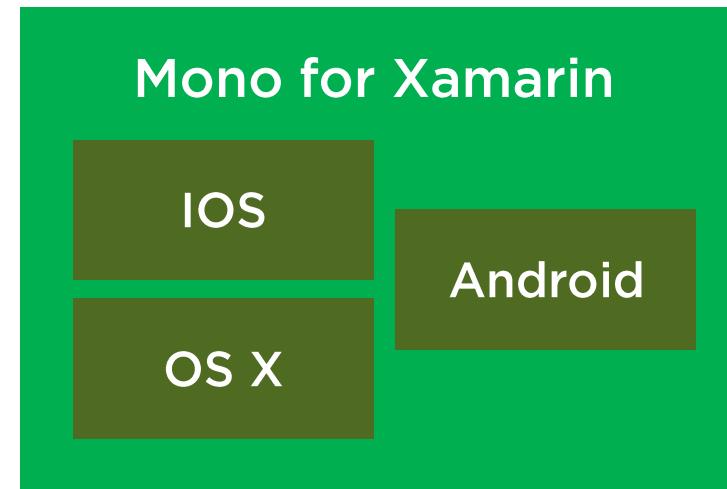
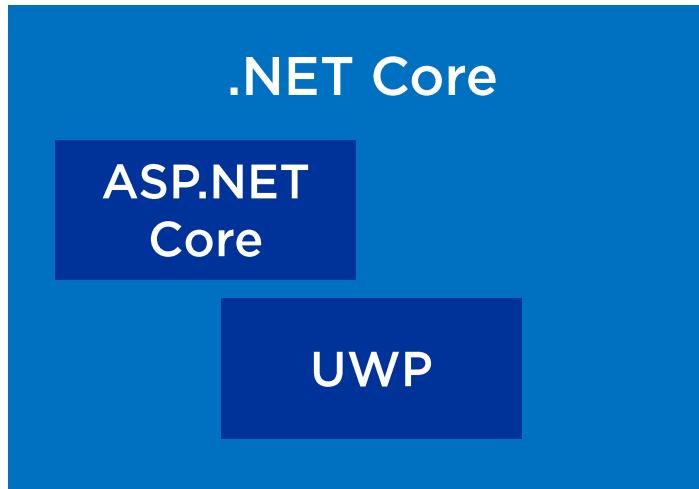
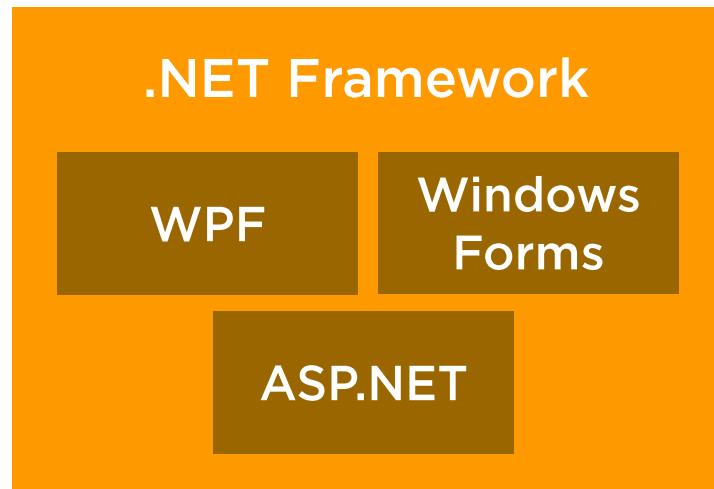
|                | .NET Framework                        | .NET Core                              | Mono for Xamarin              |
|----------------|---------------------------------------|--|-------------------------------|
| Workloads      | WPF, Windows Forms,<br>ASP.NET (Core) | ASP.NET Core,<br>UWP                   | iOS, Mac OS X,<br>Android     |
| Cross-platform |                                       | X                                      | X                             |
| Side-by-side   | Only major versions                   | X                                      | X                             |
| Self-contained | X (Ngen.exe)                          | X                                      | X                             |
| Main purpose   | Windows desktop<br>apps               | Cross-platform web<br>and desktop apps | Cross-platform<br>mobile apps |

# Sharing is Caring

(share code with .NET Standard)



# Class Libraries in the .NET Ecosystem



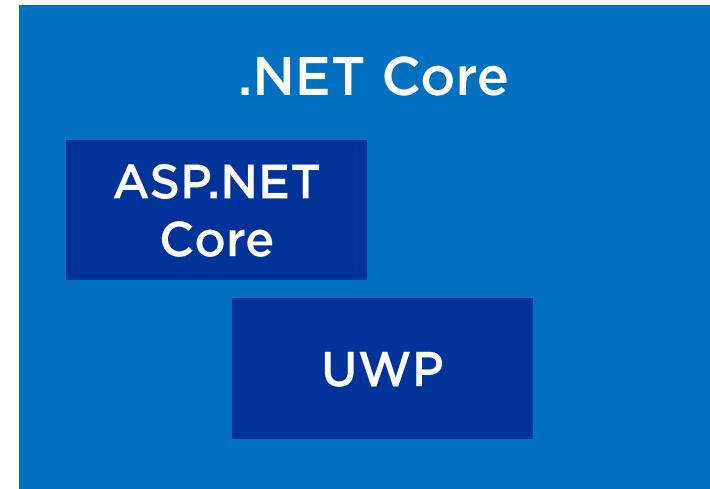
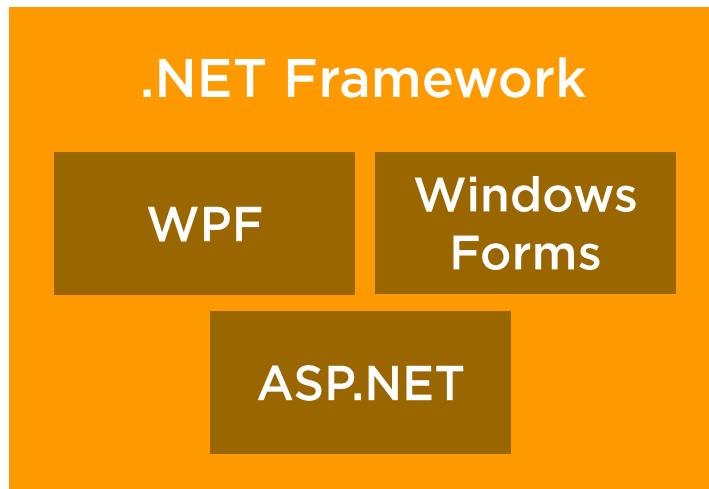
Common Infrastructure

Build Tools

Languages

Runtime Components

# .NET Standard



.NET Standard Library

Common Infrastructure

Build Tools

Languages

Runtime Components

# .NET Standard

**.NET Standard Library**

# .NET Standard

## .NET Standard Library

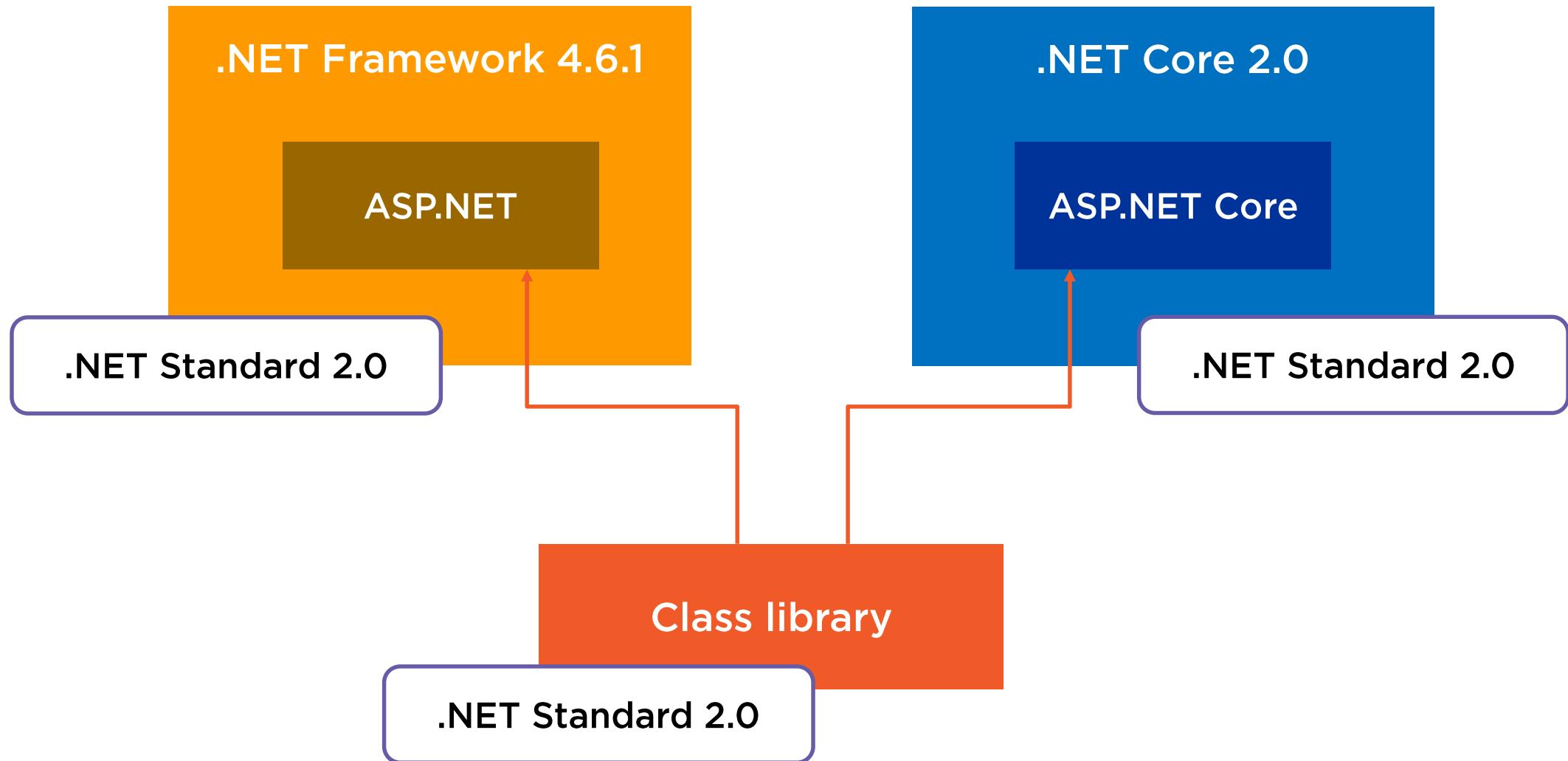
- Not something that you install!
- Formal specification of .NET APIs
- Evolution of Portable Class Libraries (PCL)
- Runtimes implement .NET Standard
- Runtime versions implement .NET standard versions
  - .NET Framework 4.5 implements .NET standard <= 1.1

# .NET Standard

## .NET Standard Library

- Not something that you install!
  - Formal specification of .NET APIs
- ### Share code between runtimes
- Runtimes implement .NET Standard
  - Runtime versions implement .NET standard versions
    - .NET Framework 4.5 implements .NET standard <= 1.1
  - Evolution of Portable Class Libraries (PCL)

# .NET Standard



# Comparison with Portable Class Libraries

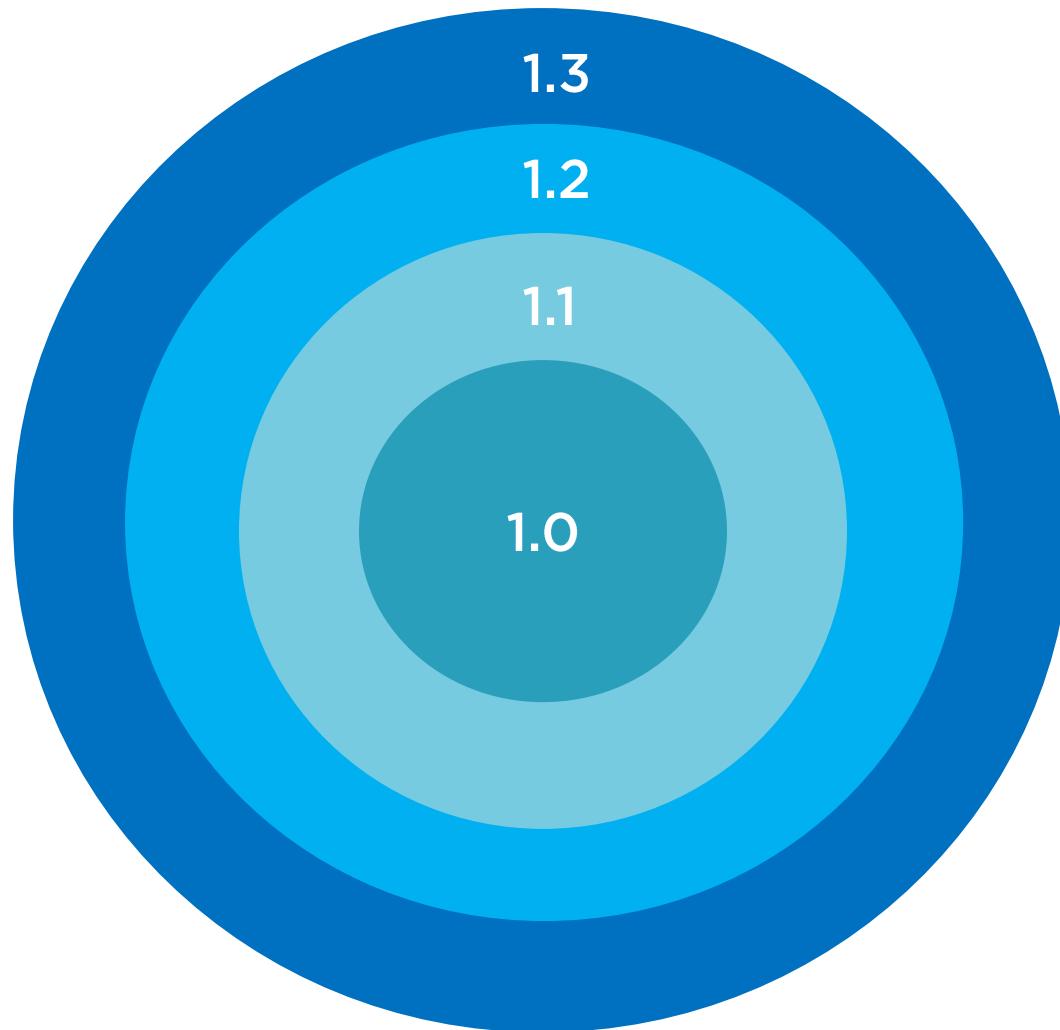
## .NET Standard

- Curated set of APIs
- Is platform agnostic

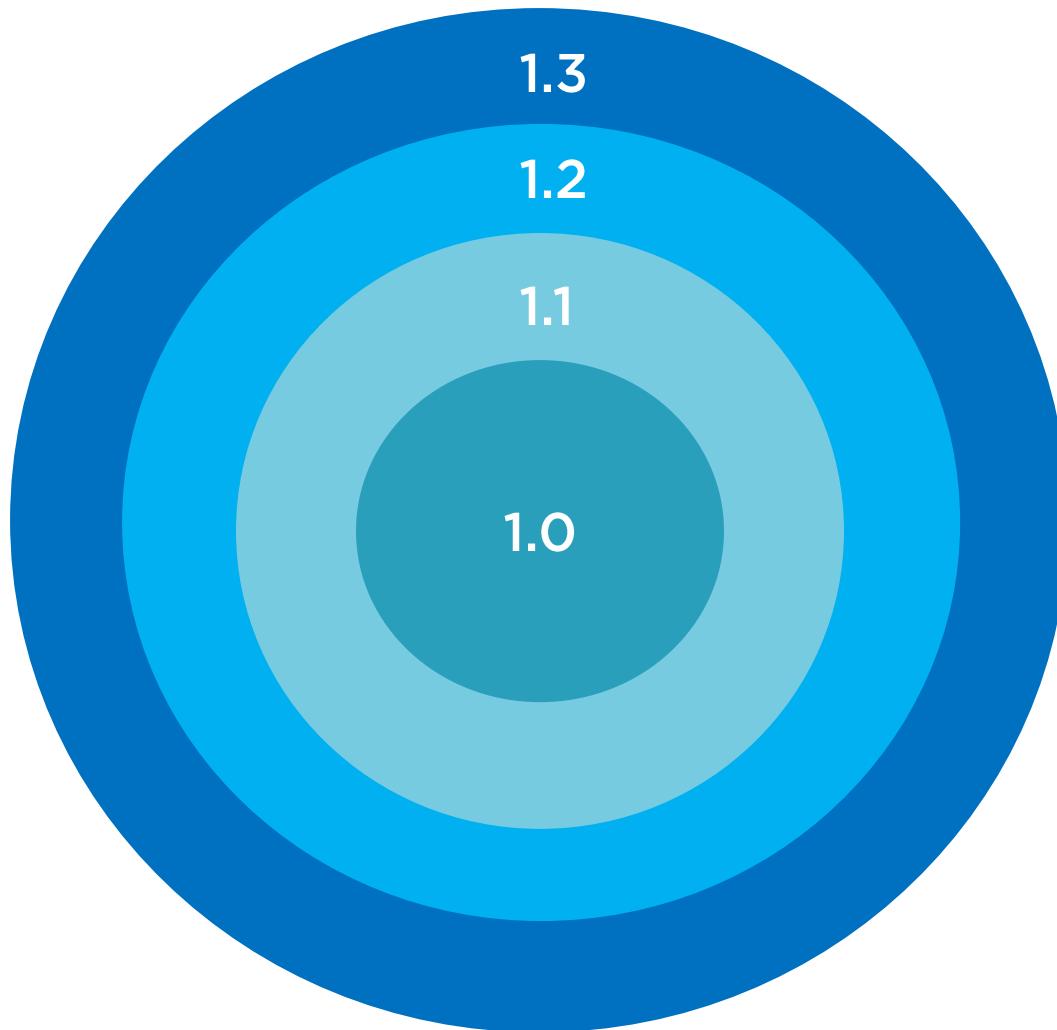
## Portable Class Libraries (PCL)

- APIs are defined by the platforms you target
- Targets limited amount of platforms

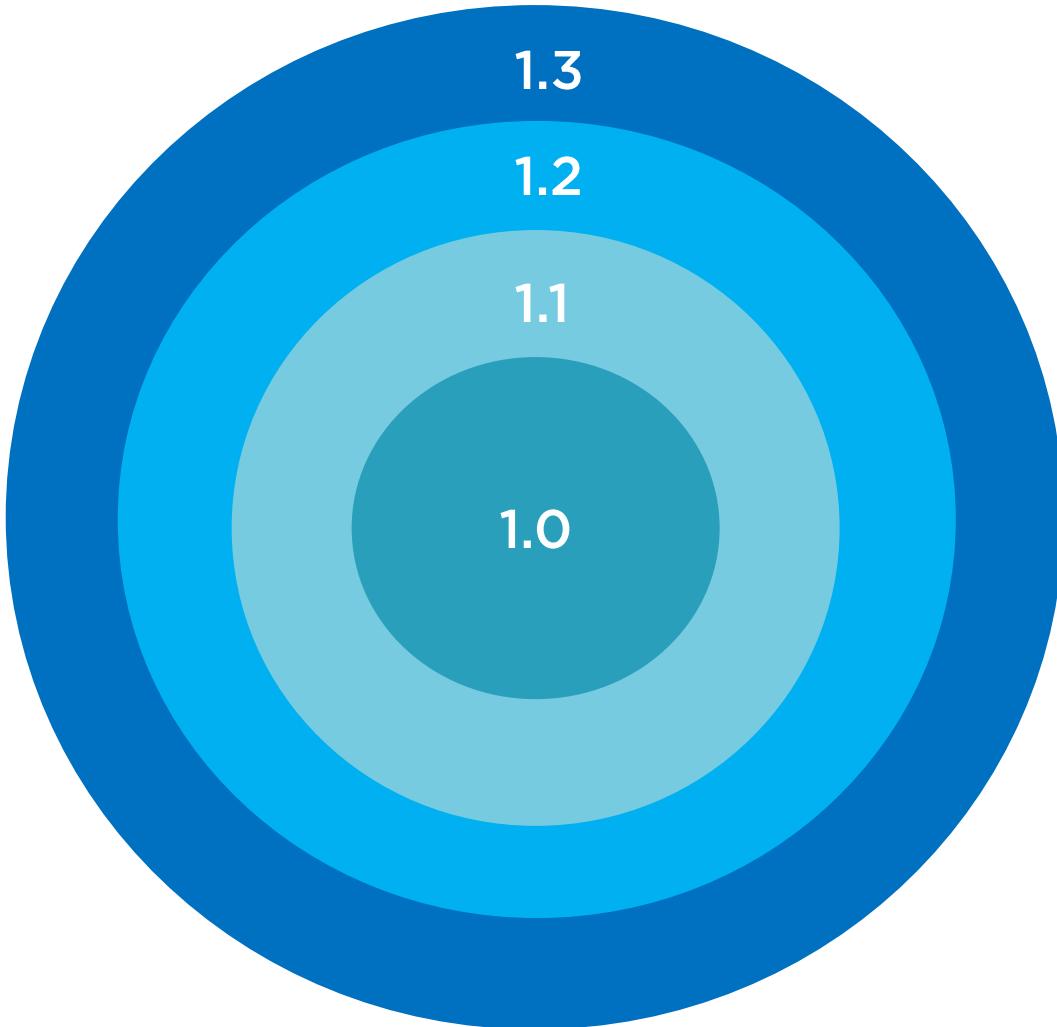
# .NET Standard Versioning



# .NET Standard Versioning

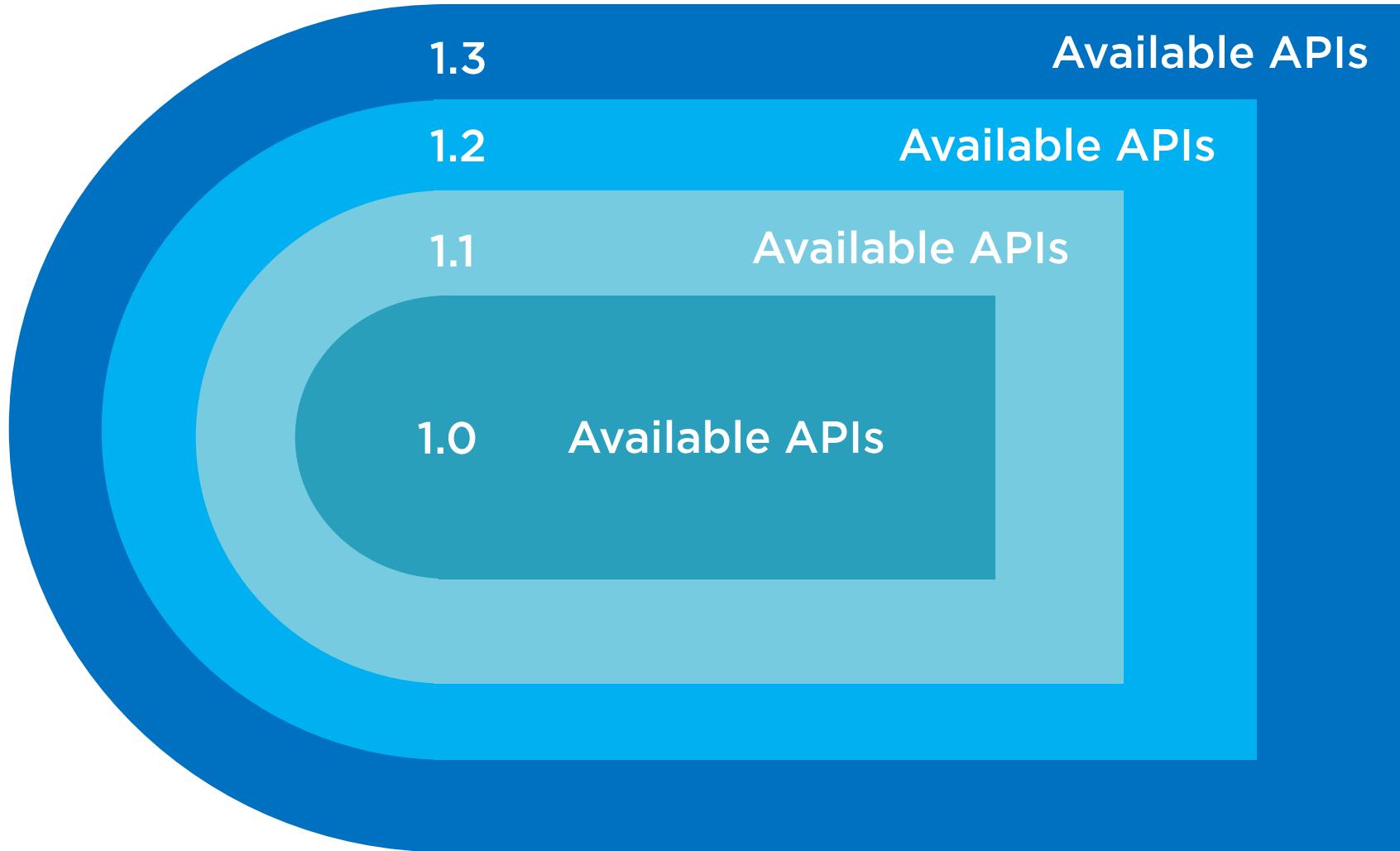


# .NET Standard Versioning



- Each version contains the APIs of the previous versions
- No breaking changes between versions
- Once shipped, versions are frozen
- Specific .NET runtime versions implement specific .NET Standard versions

# .NET Standard Versioning

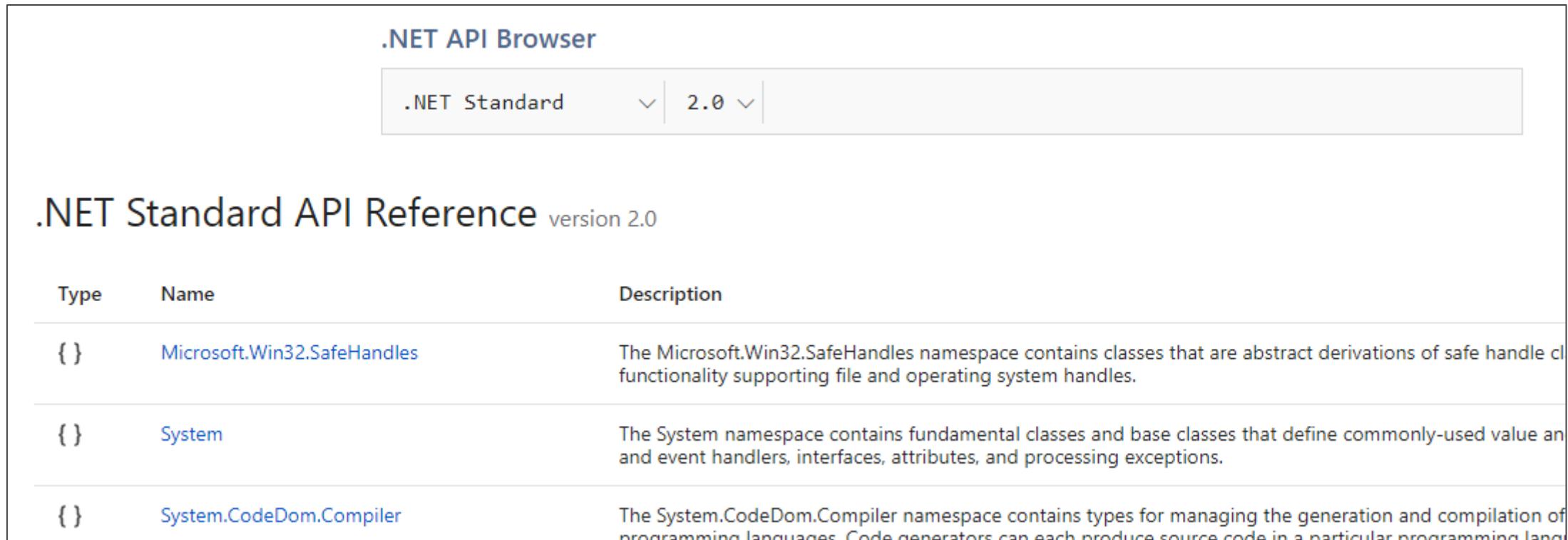


# .NET Standard Versioning



# .NET API Browser

<https://docs.microsoft.com/en-us/dotnet/api/>

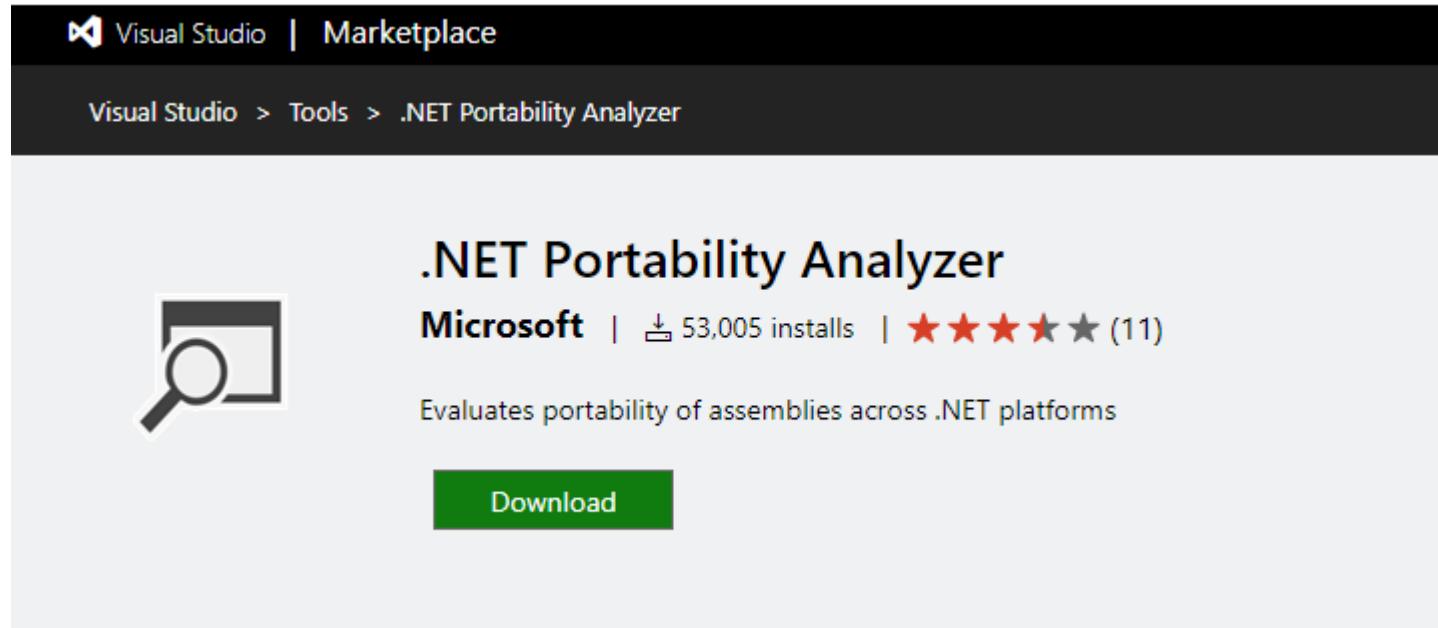


The screenshot shows the .NET API Browser interface. At the top, there is a header with the text ".NET API Browser". Below the header, there is a search bar containing ".NET Standard" and a dropdown menu set to "2.0". The main content area is titled ".NET Standard API Reference version 2.0". Below this title, there is a table with three rows. The first row contains the Microsoft.Win32.SafeHandles namespace, which is described as containing classes for safe handle functionality. The second row contains the System namespace, which is described as containing fundamental classes and base classes for value types and event handlers. The third row contains the System.CodeDom.Compiler namespace, which is described as containing types for managing code generation and compilation.

| Type | Name  | Description  |
|------|---|--|
| { }  | <a href="#">Microsoft.Win32.SafeHandles</a> | The Microsoft.Win32.SafeHandles namespace contains classes that are abstract derivations of safe handle classes supporting file and operating system handles.  |
| { }  | <a href="#">System</a>                      | The System namespace contains fundamental classes and base classes that define commonly-used value and reference types, interfaces, attributes, and processing exceptions.   |
| { }  | <a href="#">System.CodeDom.Compiler</a>     | The System.CodeDom.Compiler namespace contains types for managing the generation and compilation of source code in a particular programming language. Code generators can each produce source code in a particular programming language. |

# .NET Portability Analyzer

<https://marketplace.visualstudio.com/items?itemName=ConnieYau.NEPortabilityAnalyzer>



# What About Shared Projects?

New Project ? X

.NET Framework 4.5 ▾ Sort by: Default

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Templates

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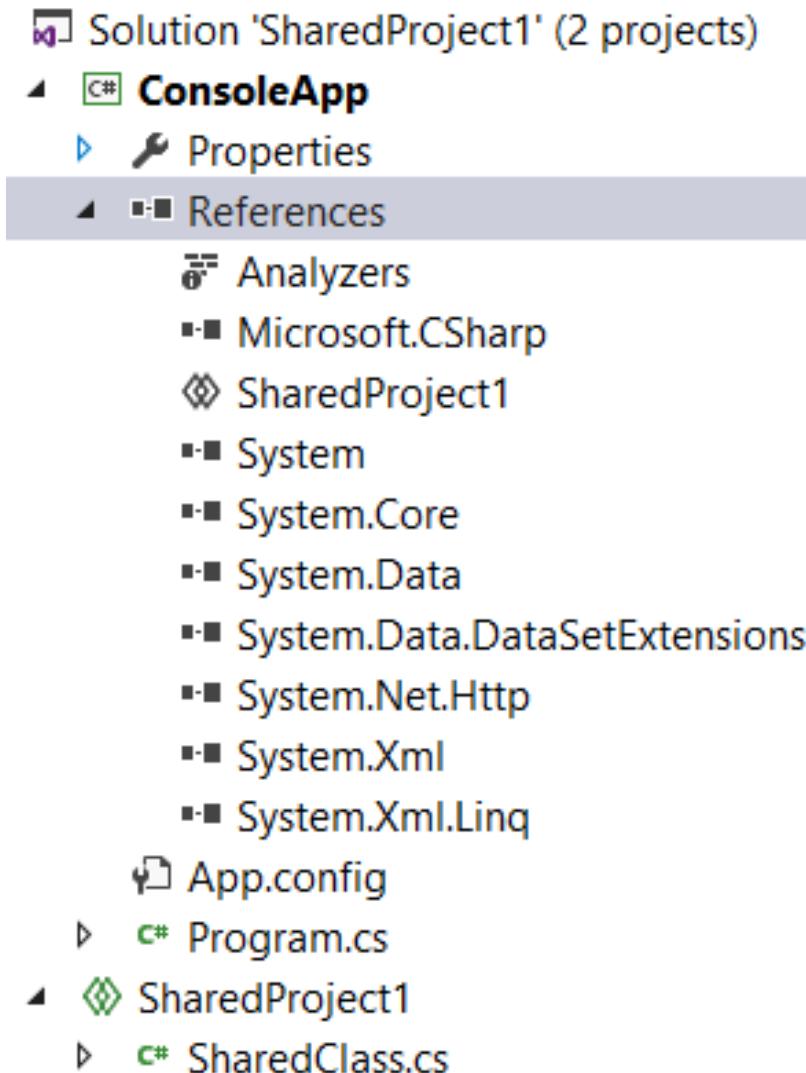
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Search Installed Templates (Ctrl ⌘ ⌂)

|   | Type      | Description  |
|---|-----------|--|
| Console App (.NET Core)                       | Visual C# | A project for creating a command-line application that can run on .NET Core on Windows, Linux and MacOS. |
| Console App (.NET Framework)                  | Visual C# |  |
| Class Library (.NET Standard)                 | Visual C# |  |
| Class Library (.NET Framework)                | Visual C# |  |
| ASP.NET Web Application (.NET Framework)      | Visual C# |  |
| ASP.NET Core Web Application (.NET Core)      | Visual C# |  |
| ASP.NET Core Web Application (.NET Framework) | Visual C# |  |
| Shared Project                                | Visual C# |  |
| Class Library (Portable)                      | Visual C# |  |

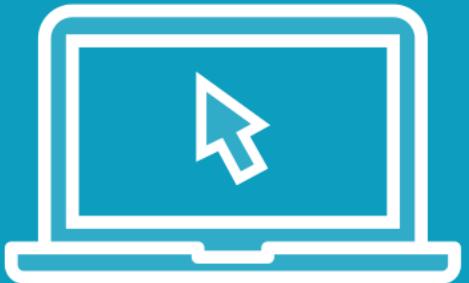
The "Shared Project" template is highlighted with a red box and an arrow points to it from the left.

# What About Shared Projects?



- Shared Projects are not compiled references
- They link files into your project
- Do not provide APIs
- Act as file-sharing mechanism between projects

## Demo



### **.NET Standard library**

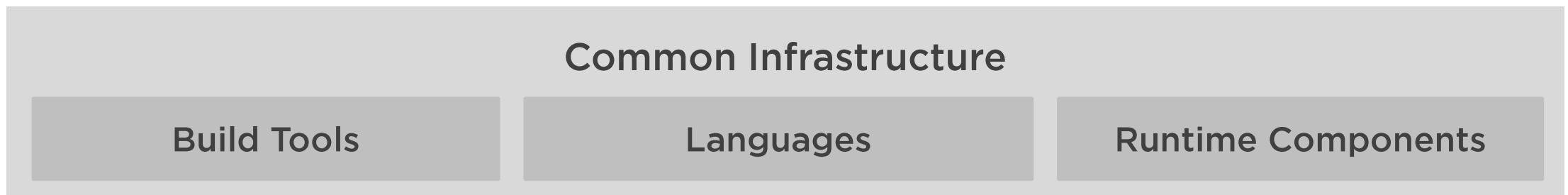
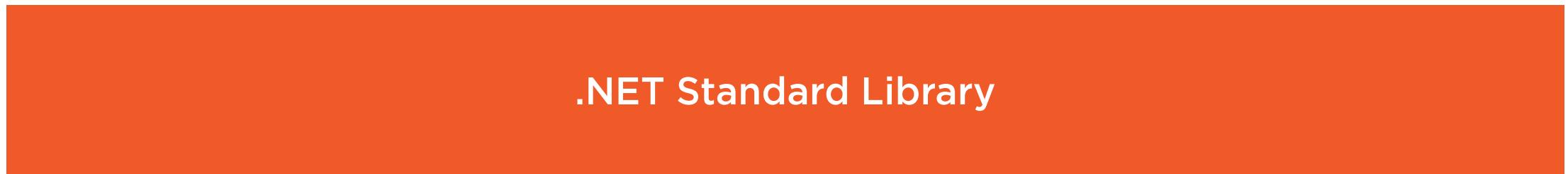
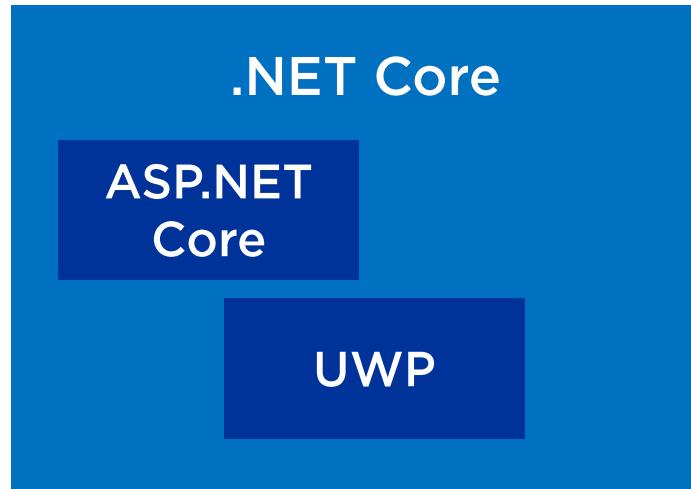
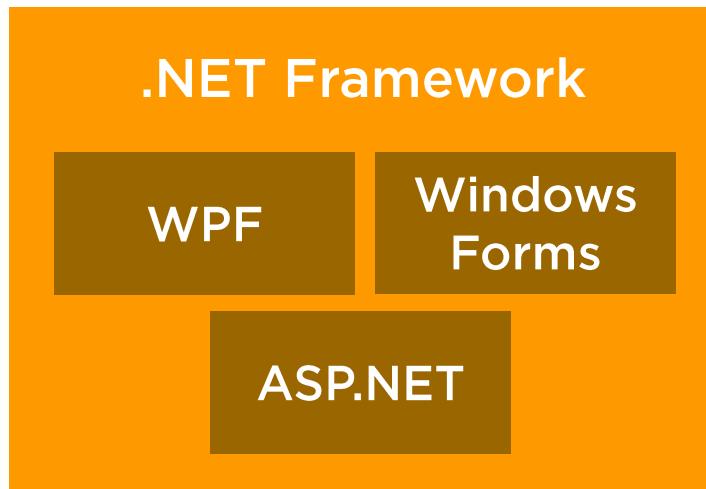
#### **Use it in the different projects**

- .NET Core Console application
- Windows Forms application
- Xamarin.Android application

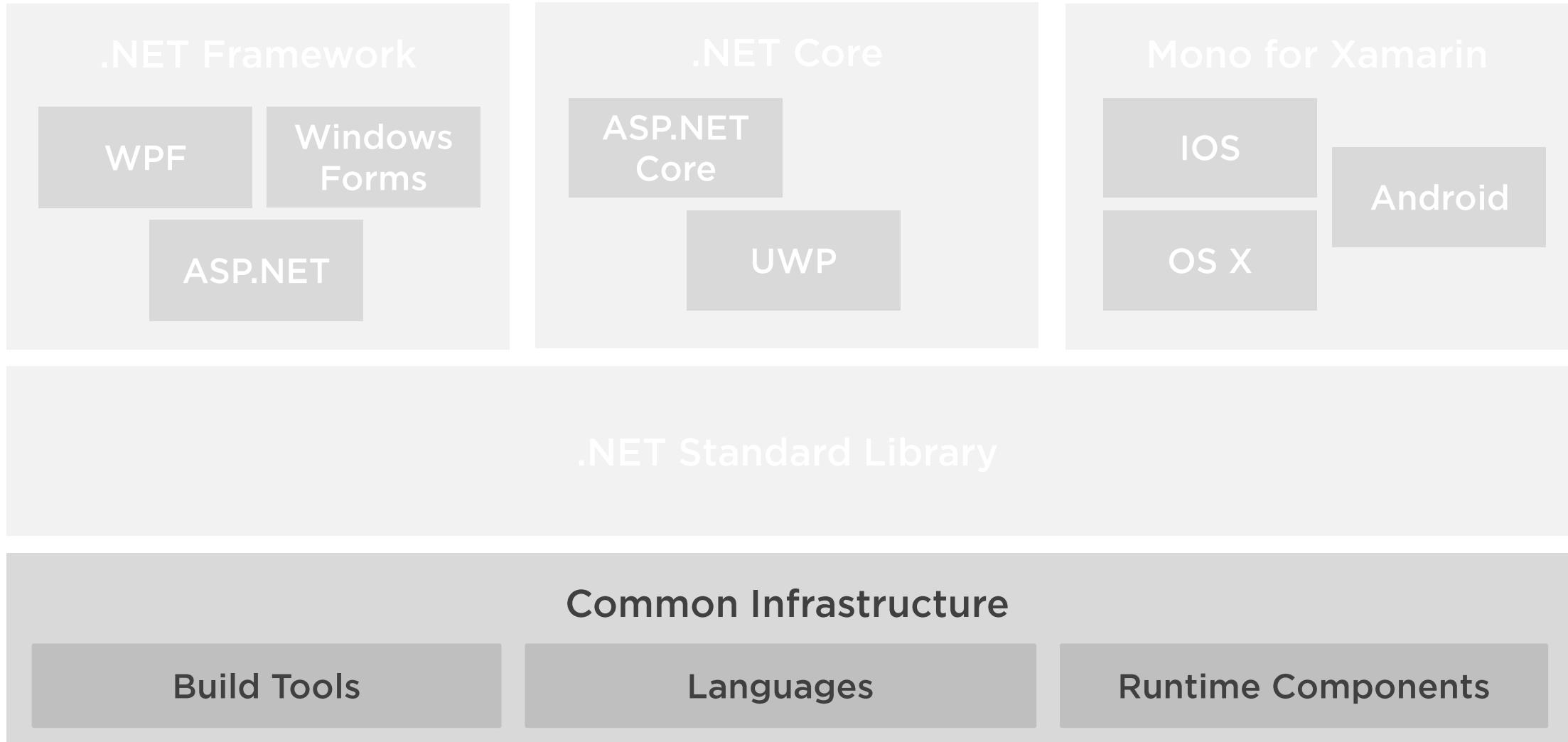
# Runtime Tools and Languages



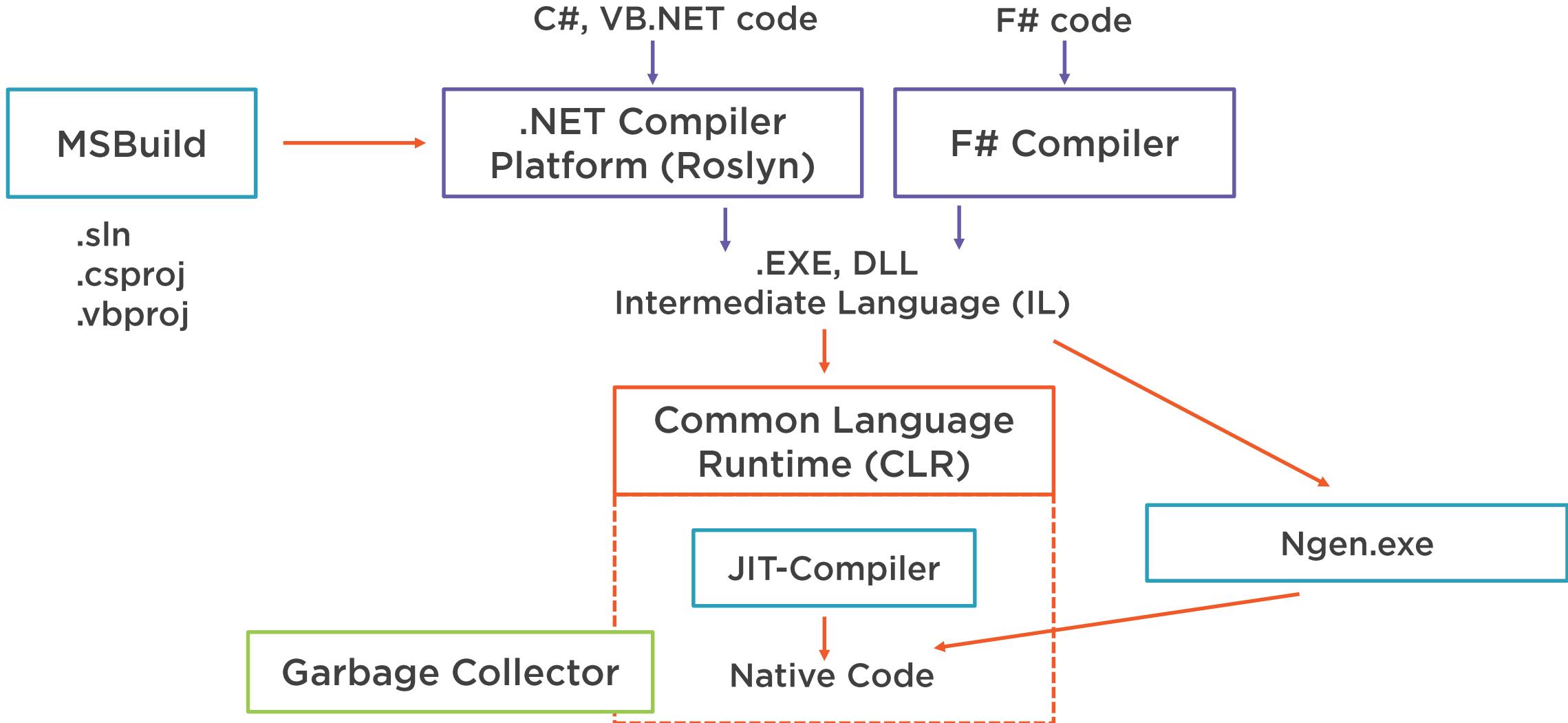
# The .NET Ecosystem



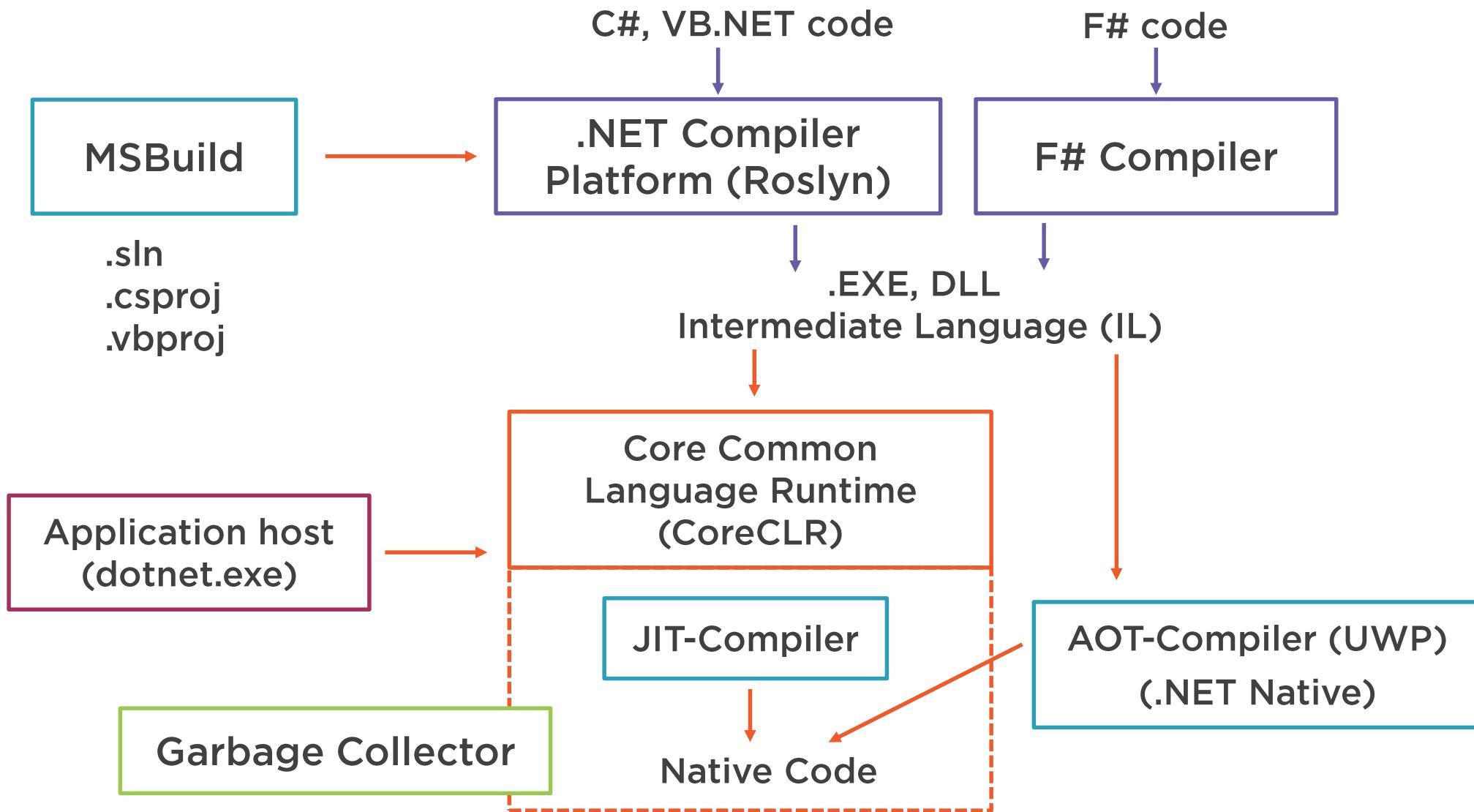
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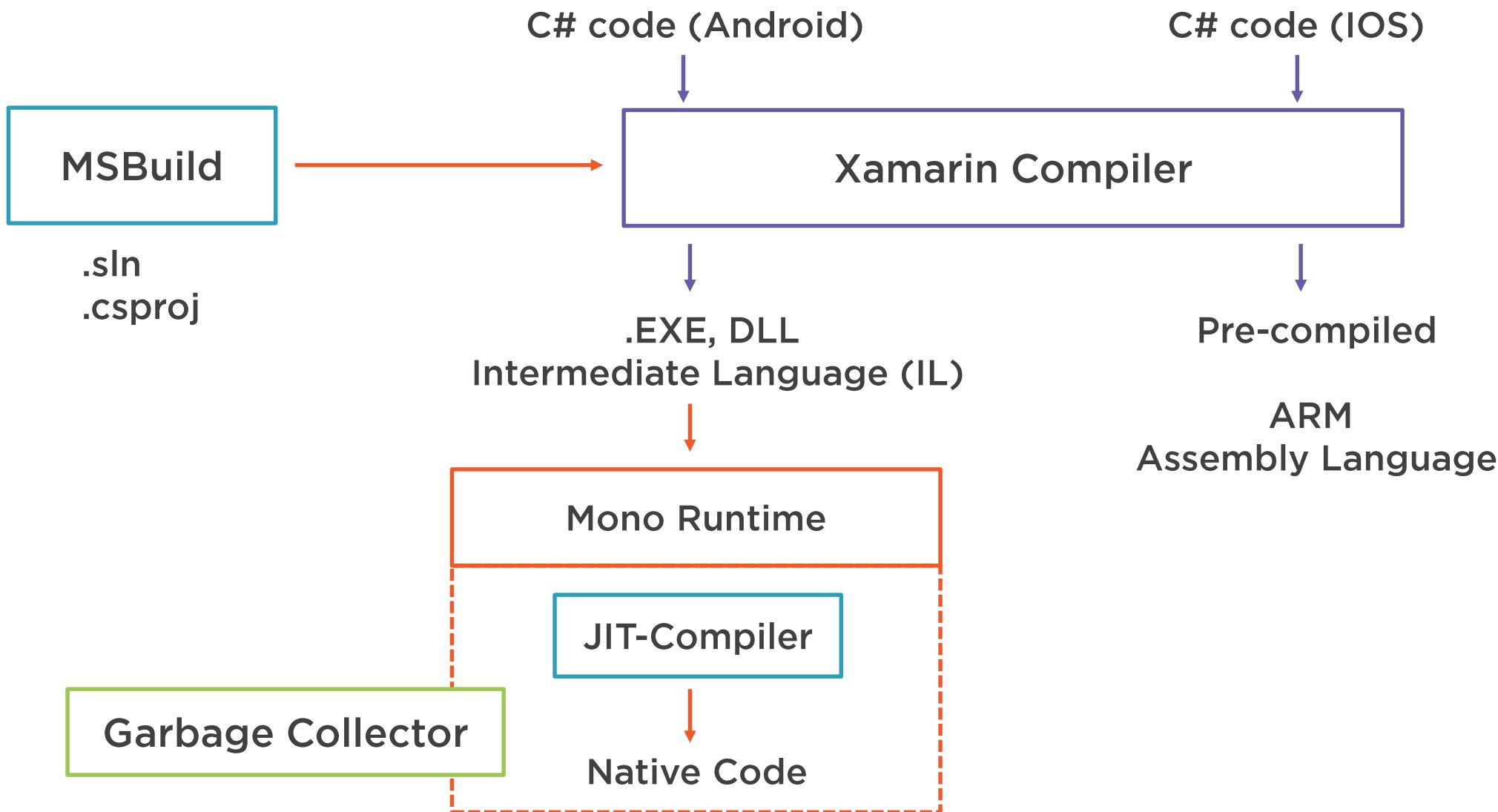
# The .NET Framework Toolchain



# The .NET Core Toolchain



# The Mono for Xamarin Toolchain



# Summary of Toolchains

|           | <b>.NET Framework</b> | <b>.NET Core</b> | <b>Mono for Xamarin</b> |
|-----------|-----------------------|------------------|-------------------------|
| Languages | C#, VB.NET, F#        | C#, VB.NET, F#   | C#                      |
|           |                       |                  |                         |
|           |                       |                  |                         |
|           |                       |                  |                         |
|           |                       |                  |                         |

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|                  |                       |                  |                         |
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|                  |                       |                  |                         |
|                  |                       |                  |                         |

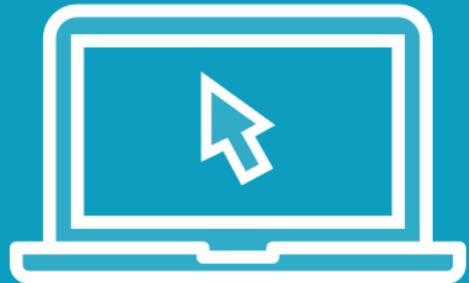
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| JIT (Just-In-Time) | CLR                   | CoreCLR          | Mono (Android)          |
|                    |                       |                  |                         |

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| JIT (Just-In-Time)  | CLR                   | CoreCLR           | Mono (Android)          |
| AOT (Ahead-Of-Time) | Ngen.exe              | .NET Native (UWP) | iOS                     |

Demo



Look at some Intermediate Language  
(using ILSpy)

# Choosing a direction

(what to use when?)



# The .NET Ecosystem

## .NET Framework

- Build ‘Forms’ applications
- That cannot run cross-platform
- Anything that you can’t do (yet) with .NET Core or Mono

## .NET Core

- Build high performance apps with a small footprint
- That run cross-platform
- And run truly side-by-side

## Mono for Xamarin

- Build mobile applications that utilize native features
- That run cross-platform

# The .NET Ecosystem

.NET Framework

- Build ‘Forms’ applications
- That cannot run cross-platform
- Anything that you can’t do (yet) with .NET Core or Mono

.NET Core

- **Framework-dependent applications**
- **Self-contained applications**

Mono for Xamarin

- Build mobile applications that utilize native features
- That run cross-platform

# Framework-dependent vs. Self-contained .NET Core Apps

## Framework-dependent

- + No target OS needed
- + Small deployment
- .NET Core needs to be installed

## Self-contained

- + .NET Core doesn't have to be installed
- Large deployment
- Need to select target OS

# Choosing ASP.NET or ASP.NET Core

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# ASP.NET or ASP.NET Core?

## ASP.NET (.NET Framework)

- Windows only
- Large set of capabilities
- ASP.NET Forms

## ASP.NET Core

- Cross-platform
- High-performance
- Self-contained
- Growing set of capabilities
- No ASP.NET Forms

That's it!

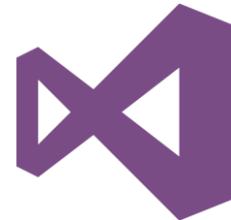
A man in a dark suit and tie stands in a room with stained glass windows, looking towards a bright, ethereal figure that appears to be floating in the air. The figure has a translucent, glowing blue and white appearance. The scene has a dramatic, religious atmosphere.

I have seen the light!

# Where to Find the Demo Files



<https://github.com/bmaluijb/Dot-Net-Ecosystem>



Visual Studio 2017

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