



# Module 2 – Getting Started with Windows Containers

Microsoft Services



# Objectives

- Introduce Windows Containers
- Understand The Microsoft And Docker Partnership
- Explore Windows Container Images
- Work With Dockerfiles
- Build And Run A Variety Of Windows Containers
- Learn About Visual Studio Support For Docker
- Understand How To Perform Container Updates

# Application Innovation with Windows Containers

## Windows Server 2016

Initial launch of containers  
Process and Hyper-V isolation  
Docker EE Basic Included at no additional cost

## Windows Server, version 1709

Optimized container images for Nano Server and Server Core  
Platform level support for Linux containers  
Windows Subsystem for Linux  
Networking enhancements for overlays and SDN

## Windows Server, version 1803

Optimized Server Core image  
App compat improvements  
Native command line tools—curl.exe, tar.exe and SSH  
Enhancements to the Windows Subsystem for Linux  
Networking enhancements for greater density and quicker endpoint creation  
Improved network security with Calico Open source storage plugins for Kubernetes  
Platform functionality required for Kubernetes conformance

## Windows Server 2019

Optimized Server Core image  
App compat improvements  
Enhanced Group Managed Service Account support  
Platform functionality for Kubernetes and Microsoft Service Fabric  
Performance and density improvements  
Platform and open source work on CNI networking plugins such as Calico and Flannel  
Enhancements to the Windows Subsystem for Linux  
...you will have to wait

# Docker and Microsoft delivers integrated tooling across the application lifecycle



Build



Ship



Run



Visual Studio

Visual Studio Tools  
for Docker



Docker  
Desktop

Library of Microsoft  
images on Docker Hub



Docker Datacenter for orchestration,  
management and security



Microsoft Operations Management Suite  
for hybrid cloud visibility and control



Windows Server

Docker containers available for Windows  
Server running on any infrastructure



Microsoft  
Hyper-V



Azure

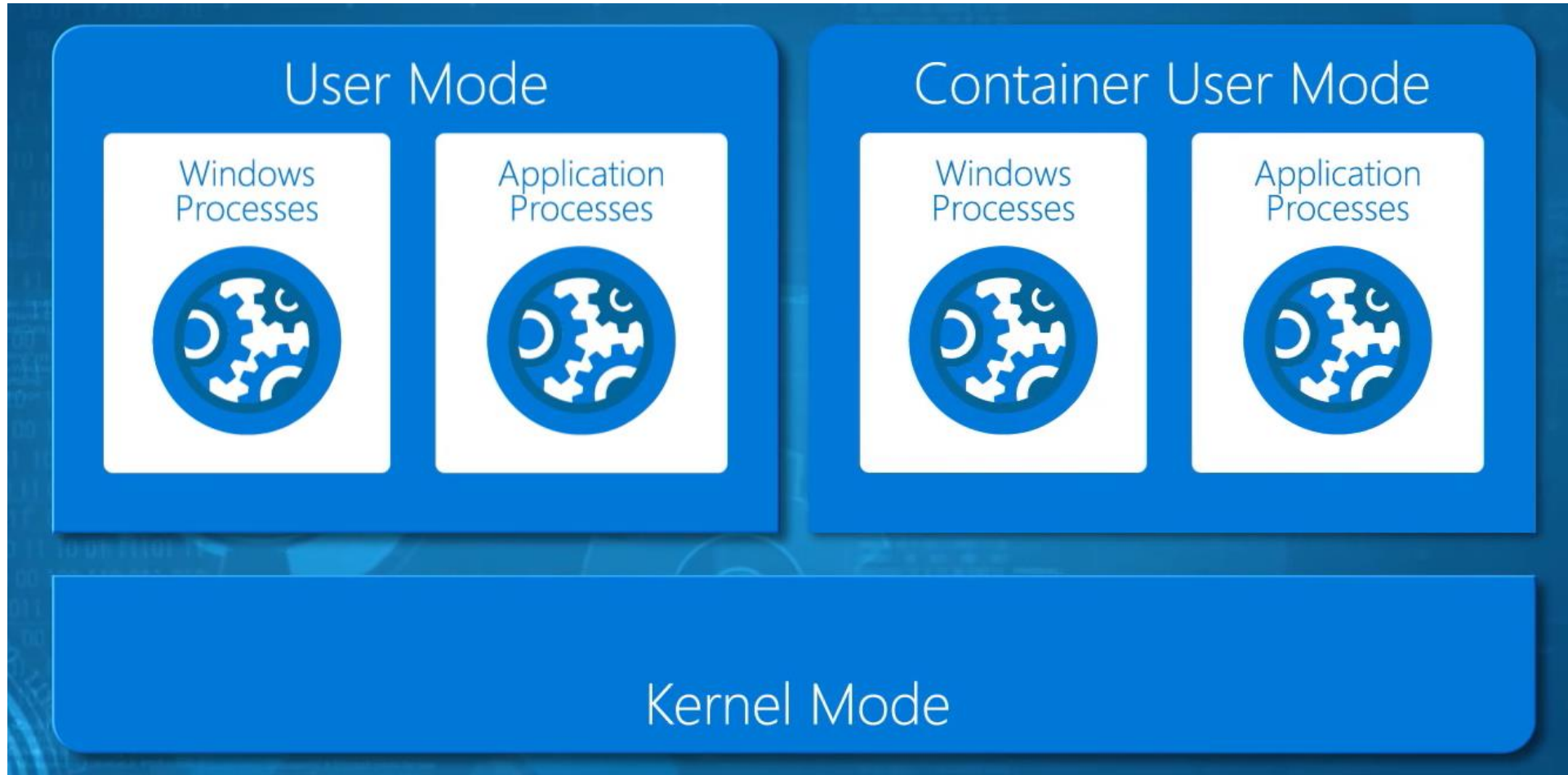


# Docker and Microsoft Partnership

- Docker Engine is tested, validated, and supported on Windows Server 2016 and 2019/Windows 10 customers at no additional cost
- Microsoft will provide Windows Server 2016 and 2019 customers enterprise support for CS Docker Engine, backed by Docker, Inc.
- Integration between Visual Studio Tools for Docker and Docker Desktop
- Windows Server container base images discoverable on Docker Hub



# Windows Containers Shared Kernel Model



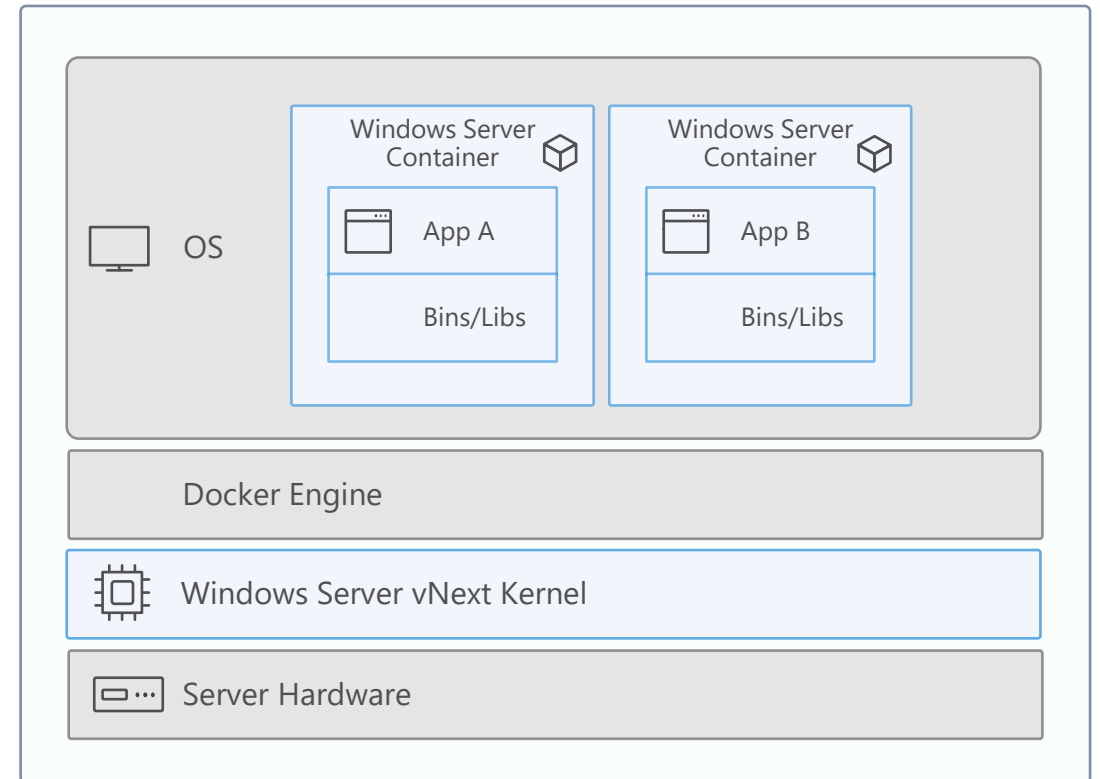
# Windows Containers

## Namespace and Resource Isolation

Container sees it's own file system and registry and can be told how much process, memory, and CPU it can use.

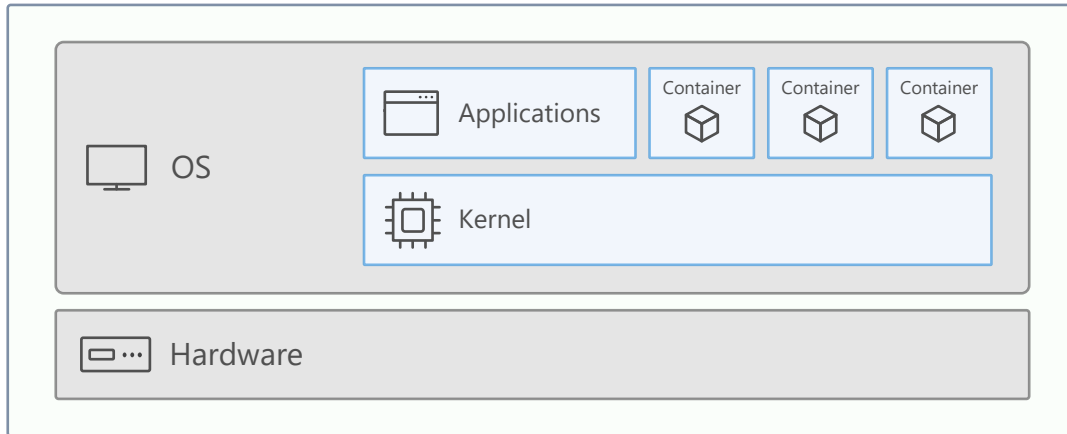
## Network virtualization

Each application/container could have it's own IP address to provide a layer of isolation so that the container doesn't have access outside of its sandboxed execution environment



# Types of Windows Containers

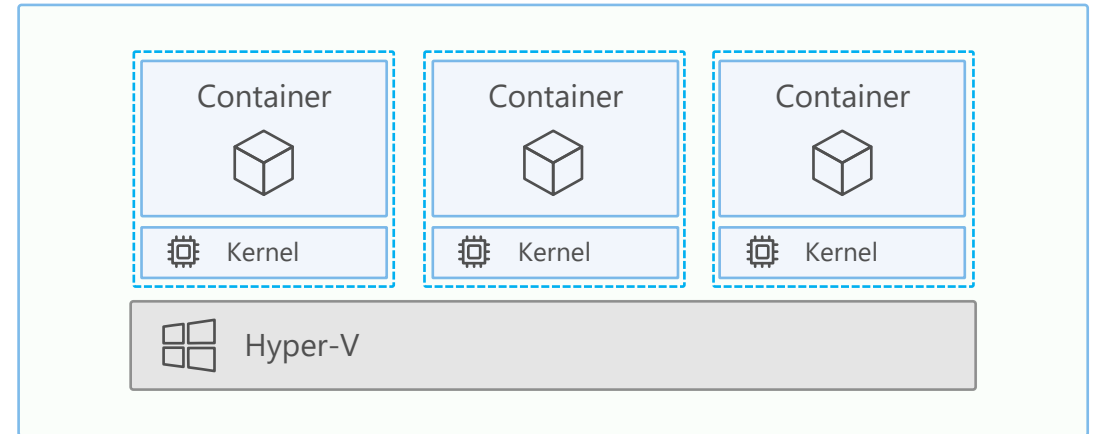
**Windows Server containers:** maximum speed and density



Namespace, resource control and process isolation

Shared host kernel

**Hyper-V containers:** isolation plus performance



Run inside a light-weight, utility VM

Kernel-level isolation

Isolation level can be specified at runtime `--isolation=process` or `hyperv`



# Windows Server 2019 Editions

Feature support key

● Feature available ○ Feature not available

Feature	Standard edition	Datacenter edition
Core Windows Server functionality	●	●
Hybrid integration	●	●
Hyper-Converged Infrastructure	○	●
OSEs*/Hyper-V containers	2 <sup>[*]</sup>	Unlimited
Windows Server containers	Unlimited	Unlimited
Host Guardian Service	●	●
Storage Replica	● <sup>[**]</sup>	●
Shielded virtual machines (VMs)	○	●
Software-defined networking	○	●
Software-defined storage	○	●

<sup>[\*]</sup> Windows Server Standard Edition license includes permission for two OSEs or VMs

<sup>[\*\*]</sup> Limited to single volume up to 2TB.

# Docker Desktop for Windows

- By installing “Docker Desktop for Windows”, Docker developers can use a single Docker CLI to build apps for both Windows or Linux
- Includes everything you need to build, test and ship containerized applications right from your machine
- Integrated tools including the Docker [command line](#), [Docker Compose](#) and [kubectl](#) command line
- Docker Desktop allows you to develop applications locally with either Docker Swarm or Kubernetes

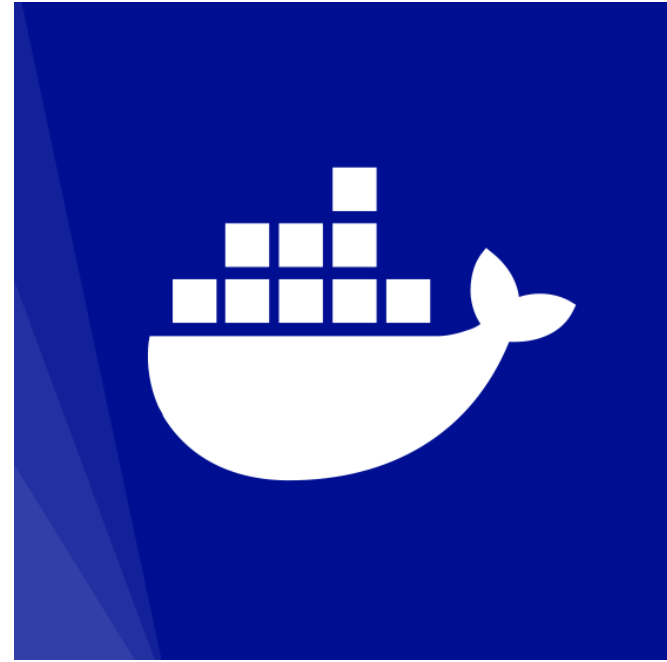


**kubernetes**

# Windows 10 vs. Windows Server



Docker Desktop for Windows

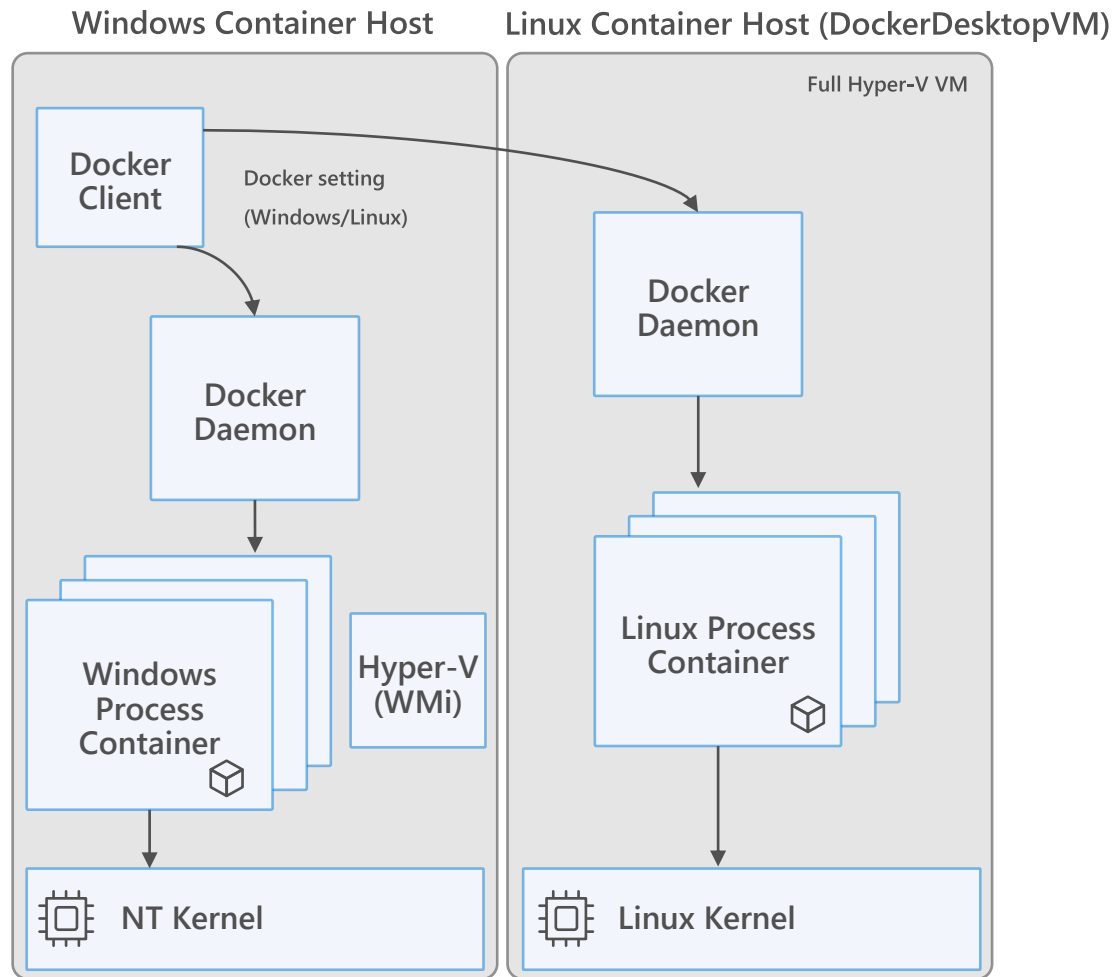


Docker on Windows Server

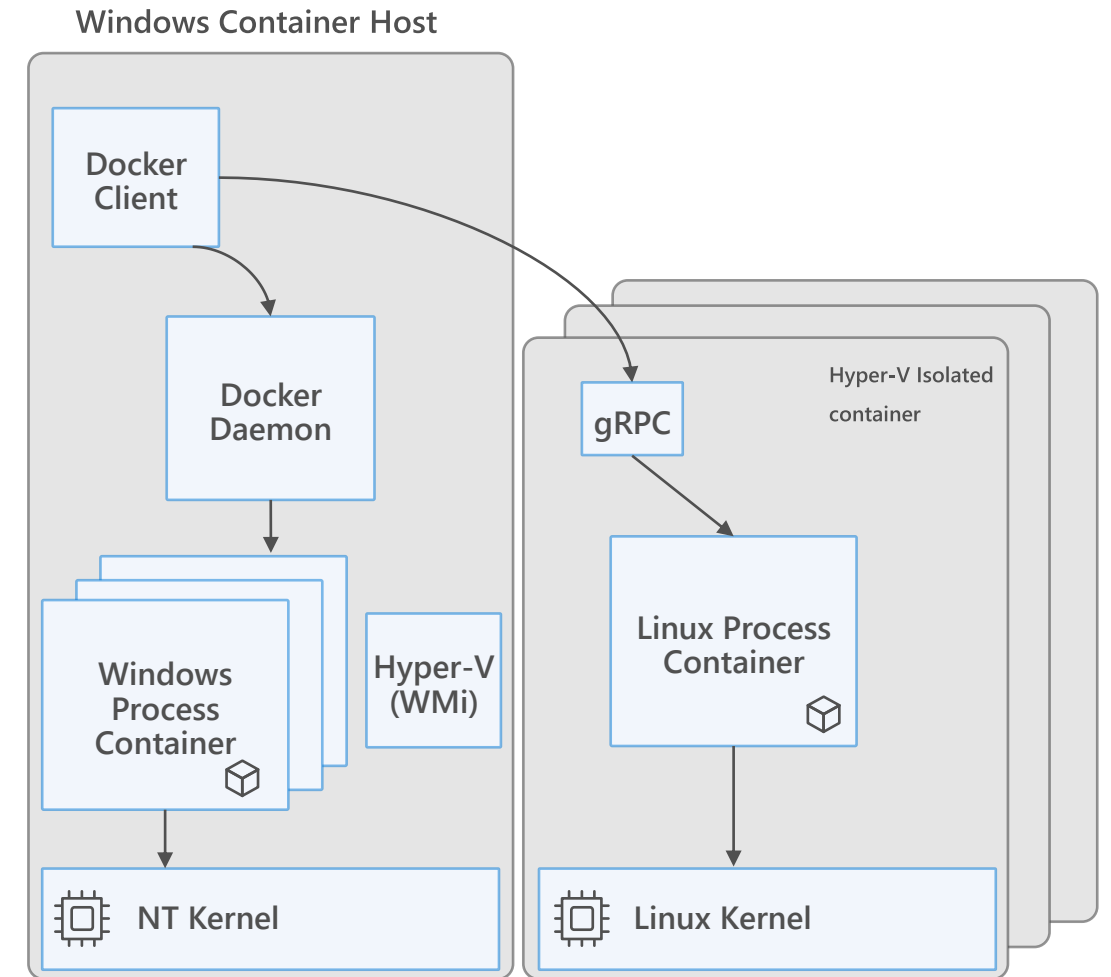
# Linux Containers on Windows

Right now there are two ways to run Linux containers with Docker Desktop and Hyper-V

Run Linux containers in a full Linux VM  
What Docker typically does today



Run Linux containers with [Hyper-V isolation](#) (LCOW)  
This is a new option in Docker Desktop



# Windows Container Base OS Images

- Base OS image is the first layer in potentially many image layers that make up a container
- Container OS Base Image is immutable (read-only)
- 4 options as of Windows Server 2019:
  - Nano server
  - Server core
  - Windows
  - IOT core
- Hosted in Microsoft Container Registry and discoverable via existing channels (i.e. Docker Hub)



# Windows Container Base OS Images

**Windows** ([https://hub.docker.com/\\_/microsoft-windows](https://hub.docker.com/_/microsoft-windows)) \*New in Windows Server 2019

- Automation workloads
- Carries most Windows OS components

3.5 GB

**Windows Server Core** ([https://hub.docker.com/\\_/microsoft-windows-servercore](https://hub.docker.com/_/microsoft-windows-servercore))

- Minimal installation of Windows Server 2016
- Contains only core OS features
- Command-line access only

1.4 GB

**Nano Server** ([https://hub.docker.com/\\_/microsoft-windows-nanoserver](https://hub.docker.com/_/microsoft-windows-nanoserver))

- Available only as container base OS image (no VM support)
- 20 times smaller than Server Core
- Headless – no logon or GUI
- Optimized for .NET Core applications

258 MB

\*Sizes based on Windows Server 2019



# Demonstration: Nano Server and Windows Server Core

Working with Windows Server Core Container

Working with Nano Server Container



# Container Image

An immutable, file-based template for a container that is created one of three ways:

- Manual via a Docker commit
- Automated with a Dockerfile
- Pulled from a registry

```
.
├── 47bcc53f74dc94b1920f0b34f6036096526296767650f223433fe65c35f149eb.json
├── 5f29f704785248ddb9d06b90a11b5ea36c534865e9035e4022bb2e71d4ecbb9a
│   ├── VERSION
│   ├── json
│   └── layer.tar
├── a65da33792c5187473faa80fa3e1b975acba06712852d1dea860692ccddf3198
│   ├── VERSION
│   ├── json
│   └── layer.tar
├── manifest.json
└── repositories
```

# Image Layering

## Base OS Image

## Base OS Image

- System Binaries
- C:\Windows

## Choices

- Windows
- Windows Server Core
- Nano Server

## Availability

- Obtainable through Container Image provider
- Published by Microsoft to the MCR

### Directory "\\Windows"

Host	\\layer0\\Windows
------	-------------------

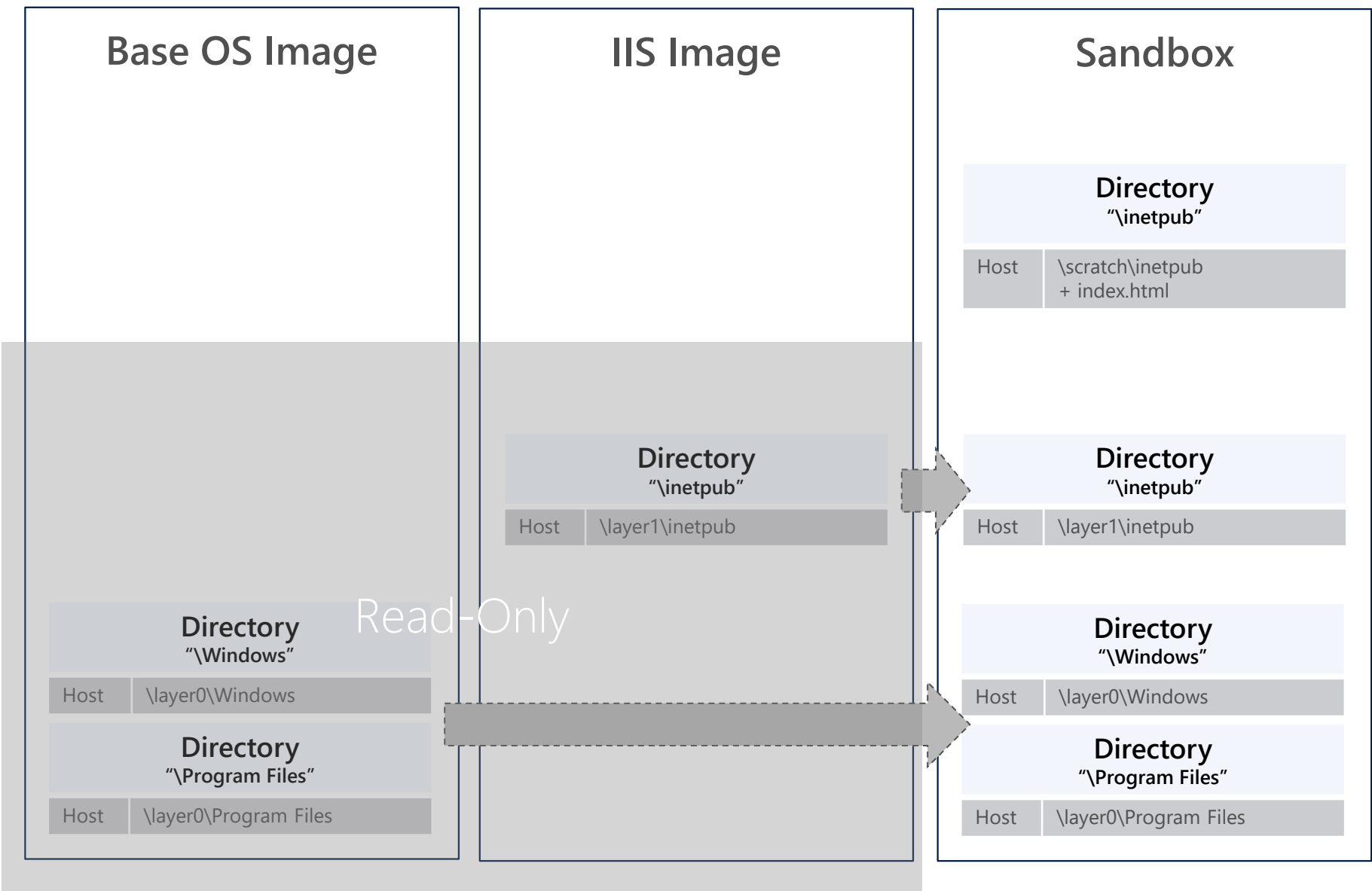
### Directory "\\Program Files"

Host	\\layer0\\Program Files
------	-------------------------

# Image Layering



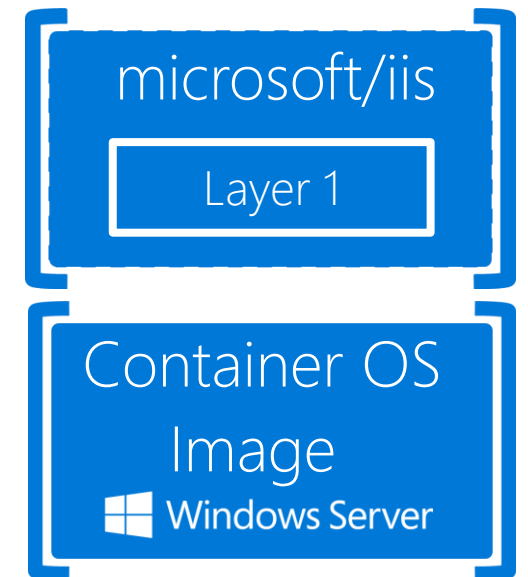
# Running Container



# Dockerfile – Build IIS Server Container Image

- Method for automated container image build
- Consumed when running “docker build”
- Enables automated builds via Docker Hub
- Caches unchanged commands

```
FROM windowsservercore  
RUN powershell -command Add-WindowsFeature Web-Server
```





# Demonstration: *Building and Running IIS Server Container*

Build IIS Container Image  
using Dockerfile

Run IIS Container



# Dockerfile – Build ASP.NET 4.5 Container Image

Leverage IIS Container Image

```
FROM mcr.microsoft.com/windows/servercore/iis:  
windowsservercore-ltsc2019
```

Install .NET and ASP.NET 4.5

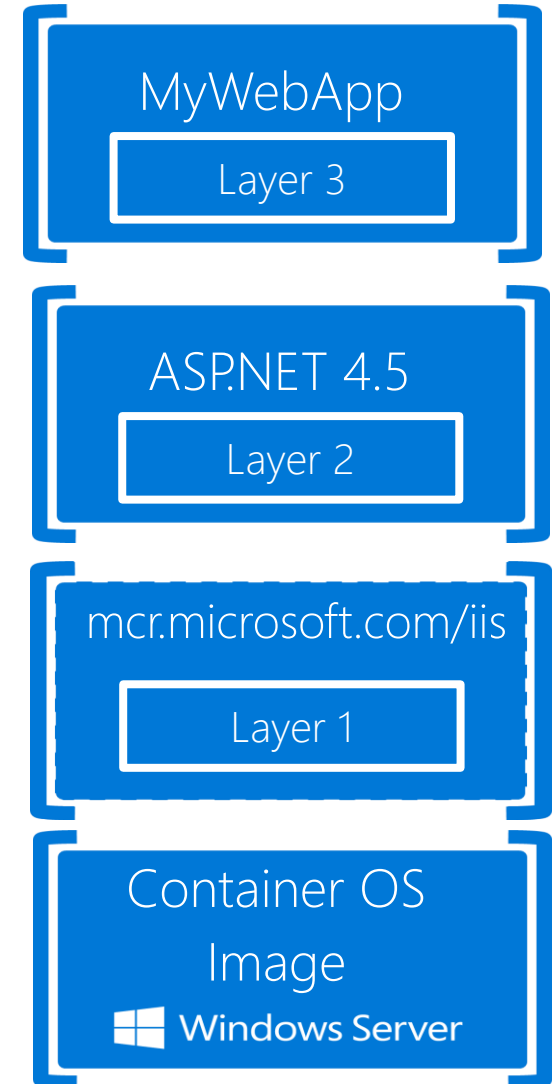
```
RUN Install-WindowsFeature Web-Asp-Net45
```

Copy MyWebApp to Container

```
COPY MyWebApp MyWebApp
```

MyWebApp IIS WebApplication

```
RUN New-Website -Name 'guidgenerator' -Port 80  
  \ -PhysicalPath 'c:\WebAppLegacy' -  
  ApplicationPool '.NET v4.5'
```



# Demonstration: *Package ASP.NET 4.5 Web Application as Container*

Containerized ASP.NET 4.5  
Web Application

Run ASP.NET 4.5 Web  
Application as Container



# Dockerfile – Build ASP.NET Core Container Image

Leverage IIS Container Image

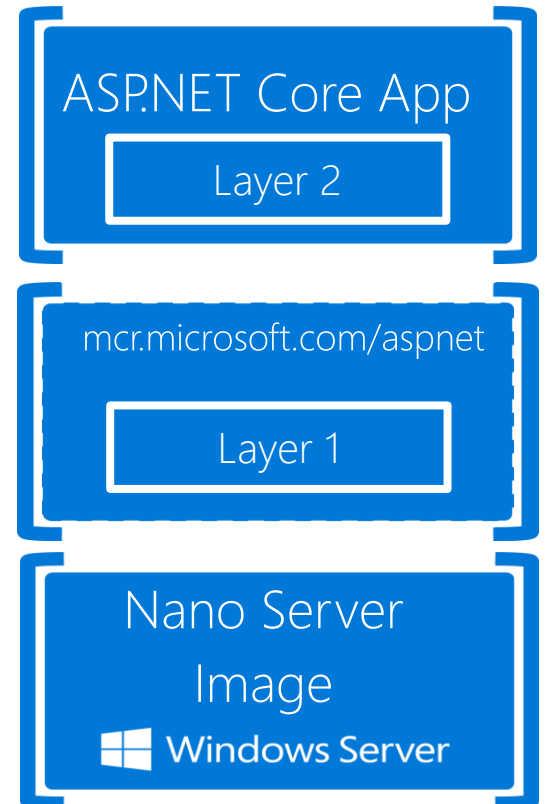
```
FROM mcr.microsoft.com/dotnet/core/aspnet:2.2.3-nanoserver-1809
```

Copy ASP.NET Core App to Container

```
COPY published ./
```

Entrypoint set to Application

```
ENTRYPOINT ["dotnet", "mywebapp.dll"]
```





# Demonstration: *Package ASP.NET Core Web Application as Container*

Containerized ASP.NET Core  
Web Application

Run ASP.NET Core Application  
as Container



# Initiating An Update Of The Base OS Image

- Rebuild containers using Dockerfile
- Pull updated base image

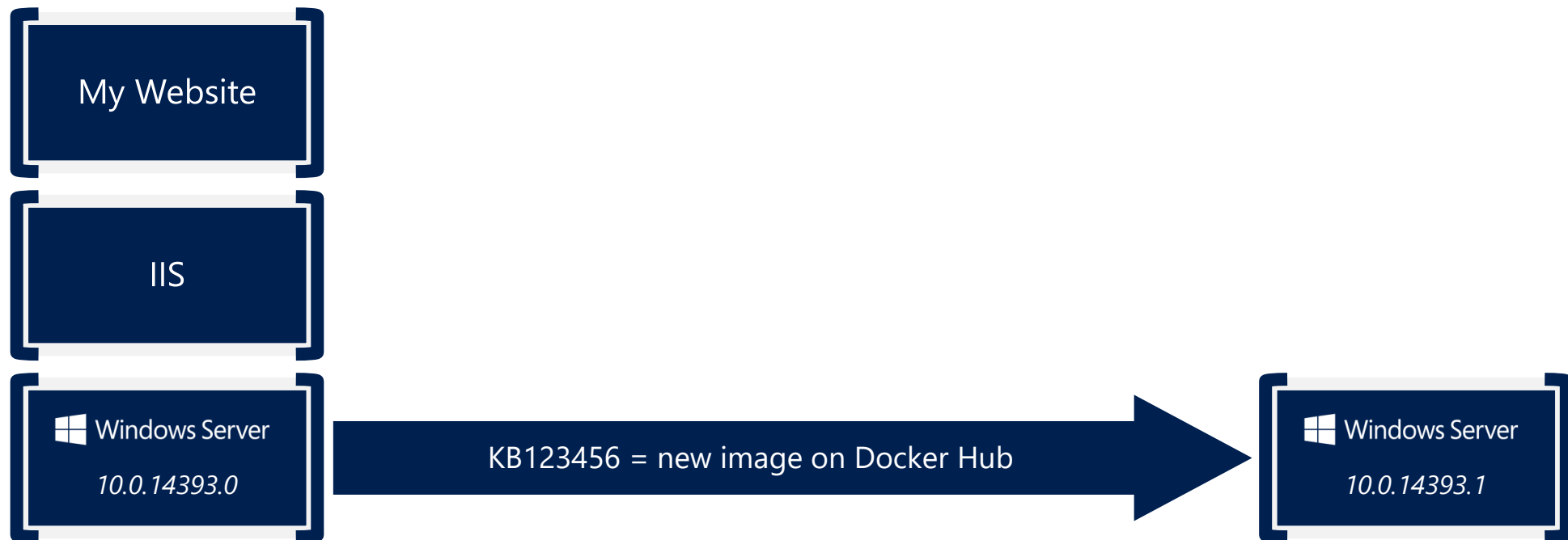




# Update Container OS Image

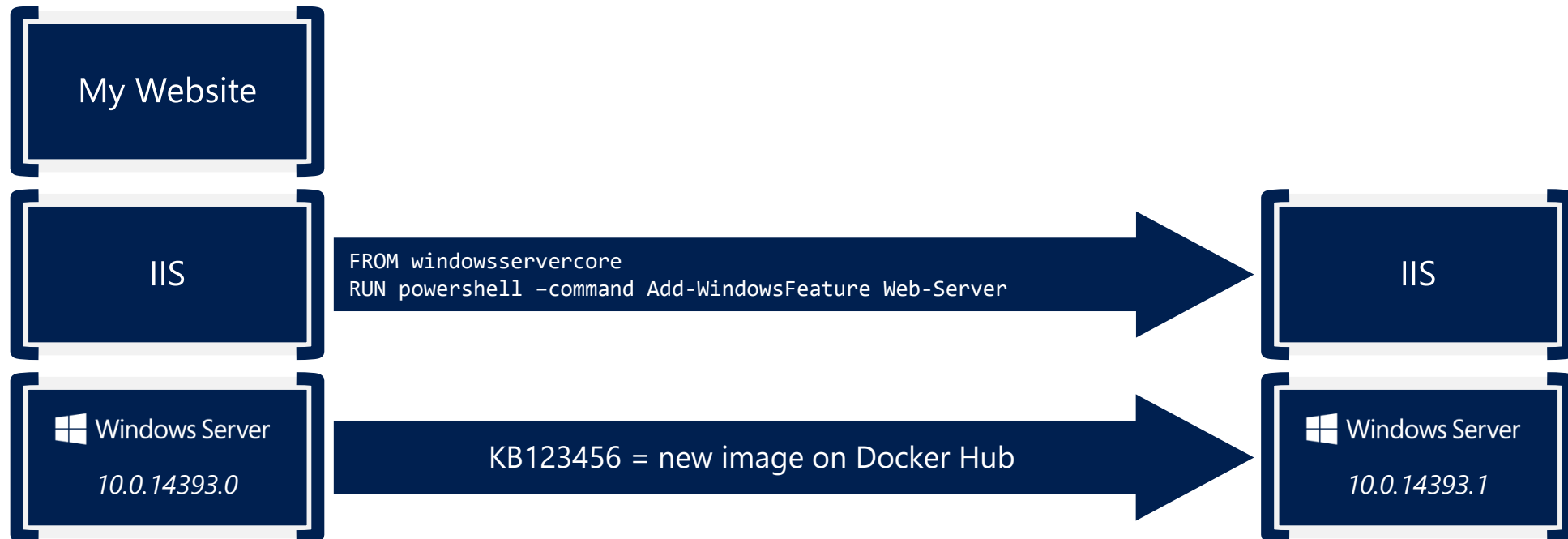
Pull updated base image

[https://hub.docker.com/\\_/microsoft-windows-nanoserver](https://hub.docker.com/_/microsoft-windows-nanoserver)



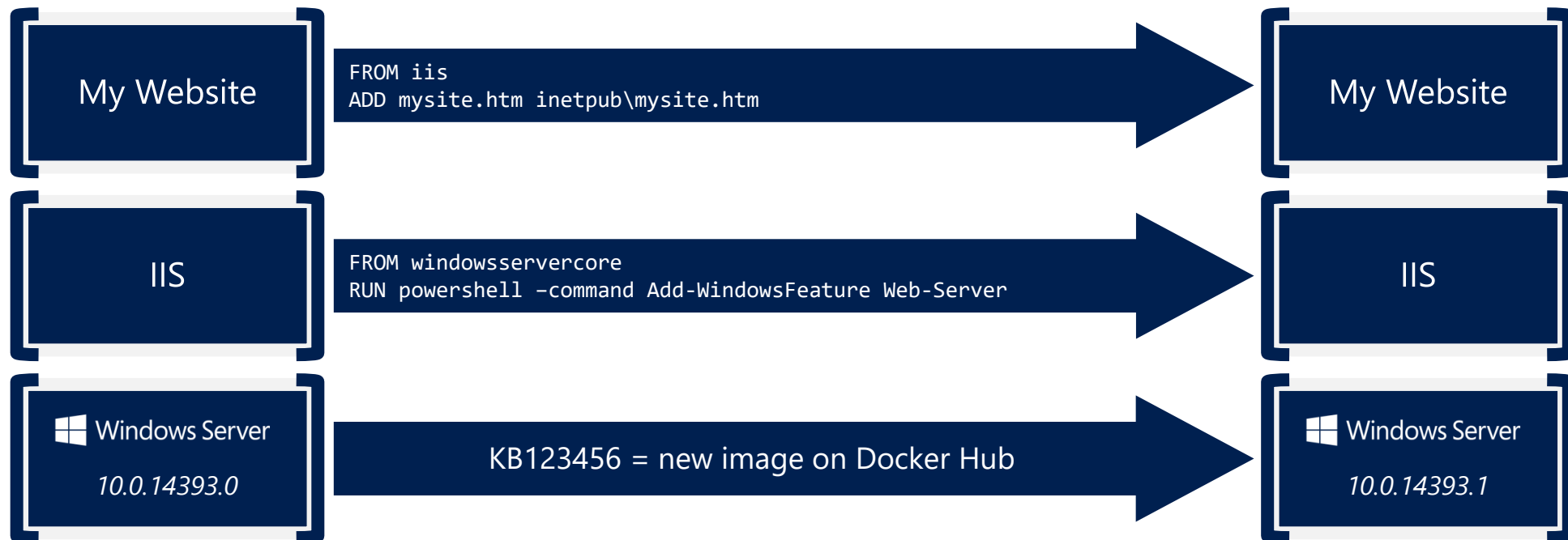
# Update Base OS Image

Create new image using Dockerfile



# Update Base OS Image

Create new image using Dockerfile



# Update as New Layer

Download update in container

When container is stopped update is applied as a new layer

**Not a recommended practice**



# Update as New Layer

Download update in container

When container is stopped update is applied as a new layer



# Update as New Layer

Download update in container

When container is stopped update is applied as a new layer

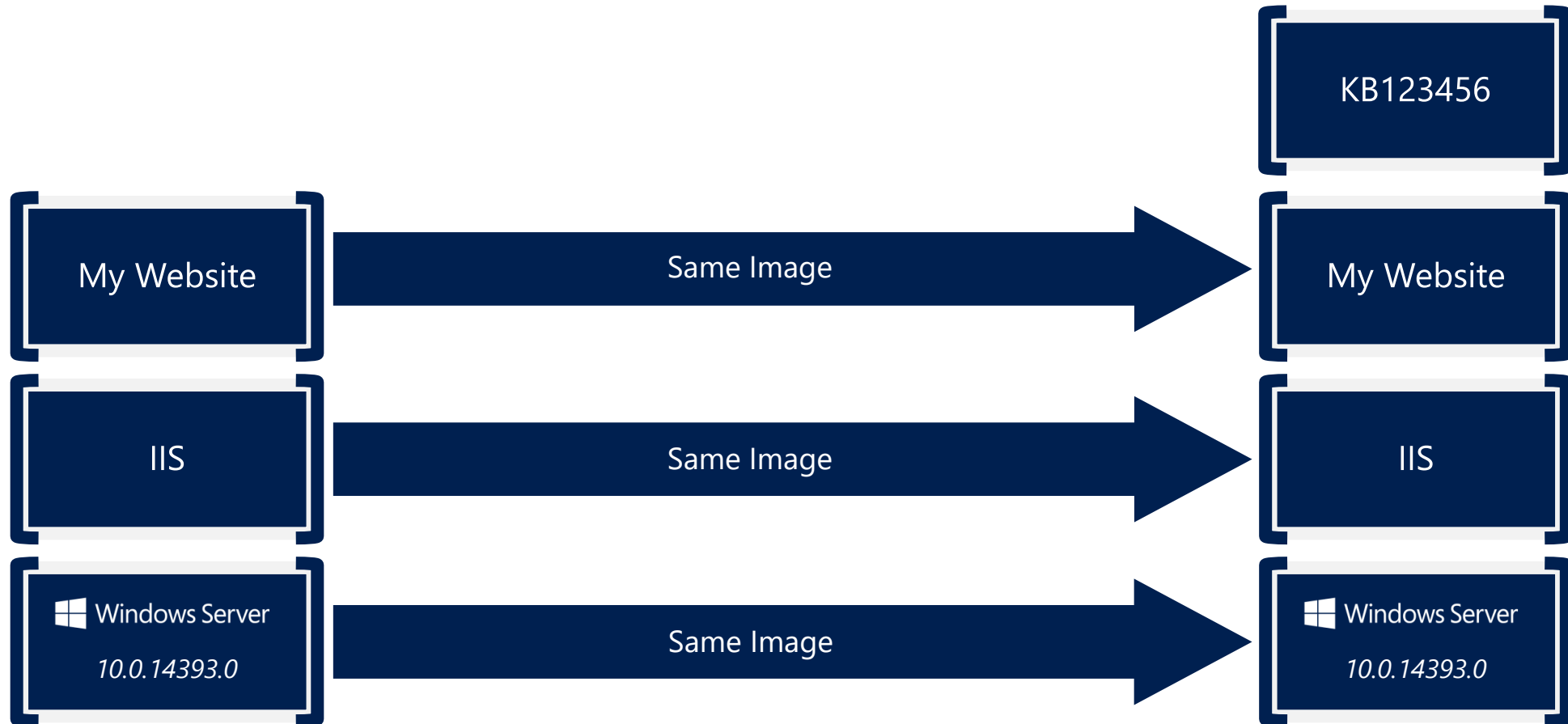




# Update as New Layer

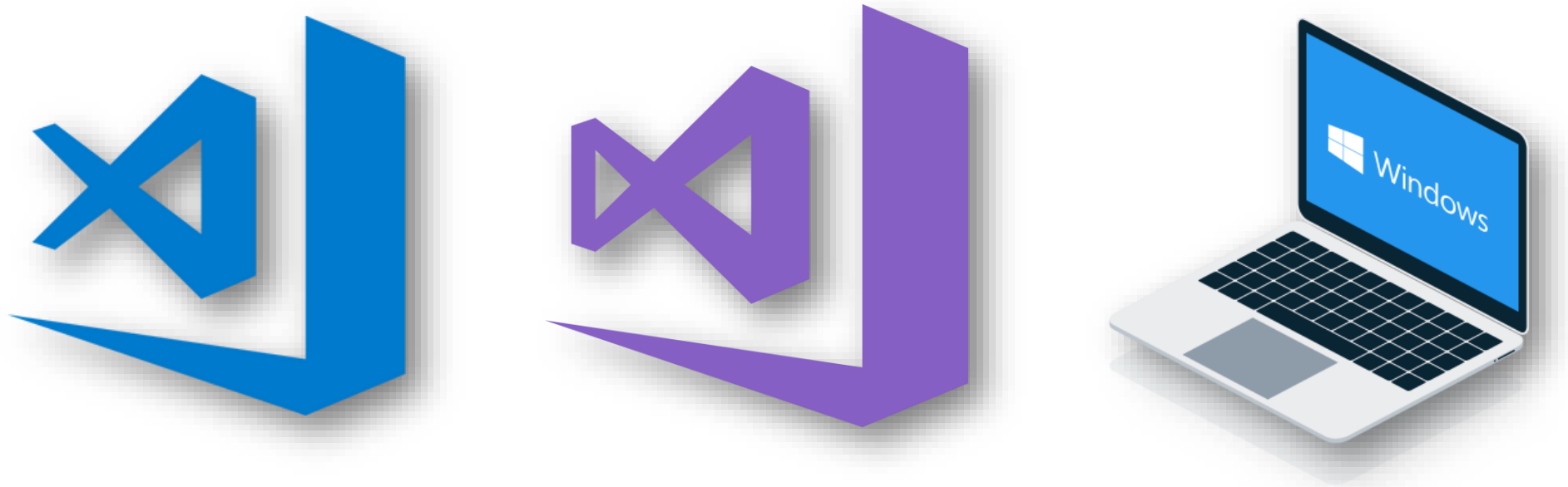
Download update in container

When container is stopped update is applied as a new layer



# Visual Studio Tools for Docker

- Microsoft Visual Studio 2017 and 2019 provide integrated developer experiences for Docker
- Leverage VS Code using the Docker extension



# Demonstration: *Visual Studio and Docker*

Building ASP.NET Core  
Application using Visual Studio  
2017/2019

Debugging ASP.NET Core  
Application using Visual Studio



