



.NET Core 2.1

Getting Started Guide

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Abstract

.NET Core is a general purpose development platform featuring automatic memory management and modern programming languages. It allows users to build high-quality applications efficiently. .NET Core is available in Red Hat Enterprise Linux and OpenShift Container Platform via certified containers. .NET Core offers the following features: The ability to follow a microservices-based approach, where some components are built with .NET and others with Java, but all can run on a common, supported platform in Red Hat Enterprise Linux and OpenShift Container Platform. The capacity to more easily develop new .NET Core workloads on Microsoft Windows. Customers can deploy and run on either Red Hat Enterprise Linux or Windows Server. A heterogeneous data center, where the underlying infrastructure is capable of running .NET applications without having to rely solely on Windows Server. .NET Core 2.1 is supported on Red Hat Enterprise Linux 7 and OpenShift Container Platform versions 3.3 and later.

Table of Contents

CHAPTER 1. USING .NET CORE 2.1 ON RED HAT ENTERPRISE LINUX	3
1.1. INSTALL AND REGISTER RED HAT ENTERPRISE LINUX	3
1.2. INSTALL .NET CORE	4
1.3. CREATE AN APPLICATION	5
1.4. PUBLISH APPLICATIONS	5
1.4.1. Publish .NET Core Applications	5
1.4.2. Publish ASP.NET Core Applications	6
1.5. RUN APPLICATIONS ON DOCKER	7
CHAPTER 2. USING .NET CORE 2.1 ON RED HAT OPENSIFT CONTAINER PLATFORM	8
2.1. INSTALL IMAGE STREAMS	8
2.2. DEPLOY APPLICATIONS FROM SOURCE	9
2.3. DEPLOY APPLICATIONS FROM BINARY ARTIFACTS	10
2.4. ENVIRONMENT VARIABLES	10
2.5. SAMPLE APPLICATIONS	12
CHAPTER 3. MIGRATING TO .NET CORE 2.1	14
3.1. MIGRATING FROM PREVIOUS VERSIONS OF .NET CORE	14
3.2. MIGRATING FROM .NET FRAMEWORK TO .NET CORE 2.1	14
3.2.1. Migration considerations	14
3.2.2. .NET Framework migration articles	15
APPENDIX A. REVISION HISTORY	16

CHAPTER 1. USING .NET CORE 2.1 ON RED HAT ENTERPRISE LINUX

This Getting Started Guide describes how to install .NET Core 2.1 on Red Hat Enterprise Linux (RHEL). See [Red Hat Enterprise Linux documentation](#) for more information about RHEL 7.

1.1. INSTALL AND REGISTER RED HAT ENTERPRISE LINUX

1. Install RHEL 7 using one of the following images:

- [Red Hat Enterprise Linux 7 Server](#)
- [Red Hat Enterprise Linux 7 Workstation](#)
- [Red Hat Enterprise Linux for Scientific Computing](#)

See the [Red Hat Enterprise Linux Installation Guide](#) for details on how to install RHEL.

See [Red Hat Enterprise Linux Product Documentation page](#) for available RHEL versions.

2. Use the following command to register the system.

```
$ sudo subscription-manager register
```

You can also register the system by following the appropriate steps in [Registering and Unregistering a System](#) in the Red Hat Subscription Management document.

3. Display a list of all subscriptions that are available for your system and identify the pool ID for the subscription.

```
$ sudo subscription-manager list --available
```

This command displays the subscription name, unique identifier, expiration date, and other details related to it. The pool ID is listed on a line beginning with **Pool ID**.

4. Attach the subscription that provides access to the **dotNET on RHEL** repository. Use the pool ID you identified in the previous step.

```
$ sudo subscription-manager attach --pool=<appropriate pool ID from the subscription>
```

5. Enable the .NET Core channel for Red Hat Enterprise 7 Server, Red Hat Enterprise 7 Workstation, or HPC Compute Node with one of the following commands, respectively.

```
$ sudo subscription-manager repos --enable=rhel-7-server-dotnet-rpms
$ sudo subscription-manager repos --enable=rhel-7-workstation-dotnet-rpms
$ sudo subscription-manager repos --enable=rhel-7-hpc-node-dotnet-rpms
```

6. Verify the list of subscriptions attached to your system.

```
$ sudo subscription-manager list --consumed
```

7. Install the **scl** tool.

```
$ sudo yum install scl-utils
```

1.2. INSTALL .NET CORE

1. Install .NET Core 2.1 and all of its dependencies.

```
$ sudo yum install rh-dotnet21 -y
```

2. Enable the **rh-dotnet21** Software Collection environment so you can run **dotnet** commands in the bash shell

This procedure installs the .NET Core 2.1 runtime with the latest 2.1 SDK. When a newer SDK becomes available, it automatically installs as a package update.

```
$ scl enable rh-dotnet21 bash
```

This command does not persist; it creates a new shell, and the **dotnet** command is only available within that shell. If you log out, use another shell, or open up a new terminal, the **dotnet** command is no longer enabled.



WARNING

Red Hat does not recommend permanently enabling **rh-dotnet21** because it may affect other programs. For example, **rh-dotnet21** includes a version of **libcurl** that differs from the base RHEL version. This may lead to issues in programs that do not expect a different version of **libcurl**. If you want to enable **rh-dotnet** permanently, add the following line to your **~/.bashrc** file.

```
source scl_source enable rh-dotnet21
```

3. Run the following command to verify the installation succeeded.

```
$ dotnet --info
.NET Core SDK (reflecting any global.json):
  Version:   2.1.300
  Commit:    ded465c666

Runtime Environment:
  OS Name:     rhel
  OS Version:  7
  OS Platform: Linux
  RID:         rhel.7-x64
  Base Path:   /opt/rh/rh-dotnet21/root/usr/lib64/dotnet/sdk/2.1.300/

Host (useful for support):
  Version: 2.1.0
```



```
Commit: N/A
```

```
.NET Core SDKs installed:
2.1.300 [/opt/rh/rh-dotnet21/root/usr/lib64/dotnet/sdk]
```

```
.... omitted
```

1.3. CREATE AN APPLICATION

1. Create a new Console application in a directory called **hello-world**.

```
$ dotnet new console -o hello-world
The template "Console Application" was created successfully.

Processing post-creation actions...
Running 'dotnet restore' on hello-world/hello-world.csproj...
Restoring packages for /home/<USER>/hello-world/hello-
world.csproj...
Generating MSBuild file /home/<USER>/hello-world/obj/hello-
world.csproj.nuget.g.props.
Generating MSBuild file /home/<USER>/hello-world/obj/hello-
world.csproj.nuget.g.targets.
Restore completed in 224.85 ms for /home/<USER>/hello-world/hello-
world.csproj.

Restore succeeded.
```

2. Run the project.

```
$ cd hello-world
$ dotnet run
Hello World!
```

1.4. PUBLISH APPLICATIONS

The .NET Core 2.1 applications can be published to use a shared system-wide version of .NET Core or to include .NET Core. These two deployment types are called framework-dependent deployment (FDD) and self-contained deployment (SCD), respectively.

For RHEL, we recommend publishing by FDD. This method ensures the application is using an up-to-date version of .NET Core, built by Red Hat, that includes a specific set of native dependencies. These native libraries are part of the **rh-dotnet21** Software Collection. On the other hand, SCD uses a runtime built by Microsoft. Running applications outside the **rh-dotnet21** Software Collection may cause issues due to the unavailability of native libraries.

1.4.1. Publish .NET Core Applications

1. Use the following command to publish a framework-dependent application.

```
$ dotnet publish -f netcoreapp2.1 -c Release
```

2. Optional: If the application is only for RHEL, trim out the dependencies needed for other platforms with these commands.

```
$ dotnet restore -r rhel.7-x64
$ dotnet publish -f netcoreapp2.1 -c Release -r rhel.7-x64 --self-contained false
```

3. Enable the Software Collection and pass the application assembly name to the **dotnet** command to run the application on a RHEL system.

```
$ scl enable rh-dotnet21 -- dotnet <app>.dll
```

4. This command can be added to a script that is published with the application. Add the following script to your project and update the **ASSEMBLY** variable.

```
#!/bin/bash

ASSEMBLY=<app>.dll
SCL=rh-dotnet21
DIR="$(dirname "$(readlink -f "$0")")"

scl enable $SCL -- dotnet "$DIR/$ASSEMBLY" "$@"
```

5. To include the script when publishing, add this **ItemGroup** to the **csproj** file.

```
<ItemGroup>
  <None Update="<scriptname>" Condition="'$(RuntimeIdentifier)' ==
'rhel.7-x64' and '$(SelfContained)' == 'false'"
CopyToPublishDirectory="PreserveNewest" />
</ItemGroup>
```

1.4.2. Publish ASP.NET Core Applications

When using the Microsoft SDK, ASP.NET Core 2.1 web applications are published with a dependency on the ASP.NET Core shared framework. This is a set of packages that are expected to be available on the runtime system.

When publishing on RHEL, these packages are included with the application. To include the packages using the Microsoft SDK, the **MicrosoftNETPlatformLibrary** property must be set to **Microsoft.NETCore.App** in the project file as shown below.

```
<Project Sdk="Microsoft.NET.Sdk.Web">
  <PropertyGroup>
    <TargetFramework>netcoreapp2.1</TargetFramework>

    <MicrosoftNETPlatformLibrary>Microsoft.NETCore.App</MicrosoftNETPlatformLibrary>
  </PropertyGroup>
  <ItemGroup>
    <PackageReference Include="Microsoft.AspNetCore.App" Version="2.1" />
  </ItemGroup>
</Project>
```

As an alternative, this property can be set when publishing the application.

```
$ dotnet publish -f netcoreapp2.1 -c Release -r rhel.7-x64 --self-contained false /p:MicrosoftNETPlatformLibrary=Microsoft.NETCore.App
```

1.5. RUN APPLICATIONS ON DOCKER

This section shows how to use the **dotnet/dotnet-21-runtime-rhel7** image to run a precompiled application inside a Docker container.

1. Create a new mvc project in a directory named **mvc_runtime_example**.

```
$ dotnet new mvc -o mvc_runtime_example --no-restore
$ cd mvc_runtime_example
```

2. Restore and publish the project.

```
$ dotnet restore -r rhel.7-x64
$ dotnet publish -f netcoreapp2.1 -c Release -r rhel.7-x64 --self-contained false /p:MicrosoftNETPlatformLibrary=Microsoft.NETCore.App
```

3. Create the **Dockerfile**.

```
$ cat > Dockerfile <<EOF
FROM registry.access.redhat.com/dotnet/dotnet-21-runtime-rhel7

ADD bin/Release/netcoreapp2.1/rhel.7-x64/publish/ .

CMD ["dotnet", "mvc_runtime_example.dll"]
EOF
```

4. Build your image.

```
$ docker build -t dotnet-21-runtime-example .
```

5. Run your image.

```
$ docker run -d -p8080:8080 dotnet-21-runtime-example
```

6. View the result in a browser: <http://127.0.0.1:8080>.

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CHAPTER 2. USING .NET CORE 2.1 ON RED HAT OPENSIFT CONTAINER PLATFORM

2.1. INSTALL IMAGE STREAMS

The .NET Core image streams definition can be defined globally in the **openshift** namespace or locally in your specific project.

1. If you are a system administrator or otherwise have sufficient permissions, change to the **openshift** project. Using the **openshift** project allows you to globally update the image stream definitions.

```
$ oc project openshift
```

If you do not have permissions to use the **openshift** project, you can still update your project definitions starting with Step 2.

2. Run the following commands to list all available .NET Core image versions.

```
$ oc describe is dotnet -n openshift
$ oc describe is dotnet
```

The output shows installed images or the message **Error from server (NotFound)** if no images are installed.

3. To pull the images, OpenShift needs credentials for authenticating with the **registry.redhat.io** server. These credentials are stored in a secret.



NOTE

For OpenShift 3.11 and later, a secret is preconfigured for the **openshift** namespace.

Enter the following command to list secrets. The first column shows the secret name.

```
$ oc get secret | grep kubernetes.io/dockerc
```

To check the contents of a secret, you can decode the **.dockercfg** or **.dockerconfigjson** data from Base64 format. This allows you to see if you already have credentials for the **registry.redhat.io** server. Enter the following command to show the **.dockercfg** section in a secret.

```
$ oc get secret <secret-name> -o yaml | grep .dockercfg
.dockercfg:
eyJyZWdpc3RyeS5yZWRoYXQuaW8iOnsidXNlcm5hbWUiOiIqKioqKioqKiIsInBhc3N3
b3JkIjoikioqKioqKioiLCJlbWVpYCI6InVudXNlZCI6ImF1dGgiOiJLaW9xS2lvcUtp
bzZLaW9xS2lvcUtpbz0ifX0=
```

Copy and paste the output in the following command to convert it from Base64 format. The example below shows the credentials for the **registry.redhat.io** server.

```
$ echo
```

```

eyJyZWdpc3RyeS5yZWRoYXQuaW8iOmsidXNlcm5hbWUiOiIqKioqKioqKiIsInBhc3N3
b3JkIjoikioqKioqKioiLCJlbWpCI6InVudXNlZCIsImF1dGgiOiJLaw9xS2lvcUtp
bzZLaw9xS2lvcUtpbz0ifX0= | base64 -d
{"registry.redhat.io":
{"username":"*****","password":"*****","email":"unused","auth"
:"KioqKioqKio6KioqKioqKio="}}

```

You need to add a secret if there is no secret listed with credentials for the **registry.redhat.io** server.

4. Red Hat account credentials are used for **registry.redhat.io** access. If you are a customer with entitlements to Red Hat products, you already have account credentials to use. These are typically the same credentials used to log in to the Red Hat Customer Portal. To verify your Red Hat credentials, enter the following command and attempt to log in.

```
$ docker login registry.redhat.io
```

If you cannot log in, you first need to get an account with Red Hat. See [Red Hat Container Registry Authentication](#) for additional information. If you can log in, enter the following commands to create the secret.

```

$ oc create secret docker-registry redhat-registry \
  --docker-server=registry.redhat.io \
  --docker-username=<user-name> \
  --docker-password=<password> \
  --docker-email=unused
$ oc secrets link default redhat-registry --for=pull
$ oc secrets link builder redhat-registry

```

5. After creating the secret, enter the following command to import new image streams.

```
$ oc create -f https://raw.githubusercontent.com/redhat-developer/s2i-dotnetcore/master/dotnet_imagestreams.json
```

If image streams were already installed, use the **replace** command to update the image stream definitions.

```
$ oc replace -f https://raw.githubusercontent.com/redhat-developer/s2i-dotnetcore/master/dotnet_imagestreams.json
```

2.2. DEPLOY APPLICATIONS FROM SOURCE

1. Run the following commands to deploy the ASP.NET Core application, which is in the **app** folder on the **dotnetcore-2.1** branch of the **redhat-developer/s2i-dotnetcore-ex** GitHub repository.

```

$ oc new-app --name=exampleapp
'dotnet:2.1~https://github.com/redhat-developer/s2i-dotnetcore-ex#dotnetcore-2.1' --build-env DOTNET_STARTUP_PROJECT=app

```

2. Use the **oc logs** command to track progress of the build.

```
$ oc logs -f bc/exampleapp
```

3. View the deployed application once the build is finished.

```
$ oc logs -f dc/exampleapp
```

4. At this point, the application is accessible within the project. To make it accessible externally, use the **oc expose** command. You can then use **oc get routes** to find the URL.

```
$ oc expose svc/exampleapp
$ oc get routes
```

2.3. DEPLOY APPLICATIONS FROM BINARY ARTIFACTS

The .NET Core S2I builder image can be used to build an application using binary artifacts that you provide.

1. Publish your application as described in [Publish Applications](#). For example, the following commands create a new web application and publish it.

```
$ dotnet new web -o webapp
$ cd webapp
$ dotnet publish -c Release
/p:Microsoft.NETPlatformLibrary=Microsoft.NETCore.App
```

2. Create a new binary build using the **oc new-build** command.

```
$ oc new-build --name=mywebapp dotnet:2.1 --binary=true
```

3. Start a build using the **oc start-build** command, specifying the path to the binary artifacts on your local machine.

```
$ oc start-build mywebapp --from-
dir=bin/Release/netcoreapp2.1/publish
```

4. Create a new application using the **oc new-app** command.

```
$ oc new-app mywebapp
```

2.4. ENVIRONMENT VARIABLES

The .NET Core images support a number of environment variables to control the build behavior of your .NET Core application. These variables can be set as part of the build configuration, or they can be added to an **.s2i/environment** file in the application source code repository.

Variable Name	Description	Default
DOTNET_STARTUP_PROJECT	Selects project to run. This must be a project file (for example, csproj or fsproj) or a folder containing a single project file.	.

Variable Name	Description	Default
DOTNET_SDK_VERSION	Selects the default sdk version when building. If there is a global.json file in the source repository, that takes precedence. When set to latest the latest sdk in the image is used.	Lowest sdk version available in the image.
DOTNET_ASSEMBLY_NAME	Selects the assembly to run. This must not include the .dll extension. Set this to the output assembly name specified in csproj (PropertyGroup/AssemblyName).	The name of the csproj file
DOTNET_RESTORE_SOURCES	Specifies the space-separated list of NuGet package sources used during the restore operation. This overrides all of the sources specified in the NuGet.config file.	
DOTNET_TOOLS	Specifies a list of .NET tools to install before building the app. It is possible to install a specific version by post pending the package name with @<version> .	
DOTNET_NPM_TOOLS	Specifies a list of NPM packages to install before building the application.	
DOTNET_TEST_PROJECTS	Specifies the list of test projects to test. This must be project files or folders containing a single project file. dotnet test is invoked for each item.	
DOTNET_CONFIGURATION	Runs the application in Debug or Release mode. This value should be either Release or Debug .	Release

Variable Name	Description	Default
DOTNET_VERBOSITY	Specifies the verbosity of the dotnet build commands. When set, the environment variables are printed at the start of the build. This variable can be set to one of the msbuild verbosity values (q[uiet] , m[inimal] , n[ormal] , d[etailed] , and diag[nostic]).	
HTTP_PROXY, HTTPS_PROXY	Configures the HTTP/HTTPS proxy used when building and running the application.	
DOTNET_RM_SRC	When set to true , the source code will not be included in the image.	
DOTNET_SSL_DIRS	Used to specify a list of folders/files with additional SSL certificates to trust. The certificates are trusted by each process that runs during the build and all processes that run in the image after the build (including the application that was built). The items can be absolute paths (starting with /) or paths in the source repository (for example, certificates).	
NPM_MIRROR	Uses a custom NPM registry mirror to download packages during the build process.	
ASPNETCORE_URLS	This variable is set to http://*:8080 to configure ASP.NET Core to use the port exposed by the image. Changing this is not recommended.	http://*:8080

2.5. SAMPLE APPLICATIONS

Three sample applications are available:

- **dotnet-example**: This is the default model–view–controller (MVC) application.
- **dotnet-runtime-example**: This shows how to build an MVC application using a chained build. The application is built in **dotnet/dotnet-21-rhel7**. The result is deployed in **dotnet/dotnet-21-runtime-rhel7**. Note that chained builds are not supported on OpenShift Online.

- [dotnet-pgsql-persistent](#): This is the Microsoft ASP.NET Core MusicStore sample application using a PostgreSQL backend.

To add the samples using the OpenShift Web Console, browse to your project and click **Add to project**. You can filter for **dotnet**. If the samples do not show up, you can add them to your installation by running the following commands.

```
$ oc create -f https://raw.githubusercontent.com/redhat-developer/s2i-dotnetcore/master/templates/dotnet-example.json
$ oc create -f https://raw.githubusercontent.com/redhat-developer/s2i-dotnetcore/master/templates/dotnet-runtime-example.json
$ oc create -f https://raw.githubusercontent.com/redhat-developer/s2i-dotnetcore/master/templates/dotnet-pgsql-persistent.json
```

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CHAPTER 3. MIGRATING TO .NET CORE 2.1

This chapter provides migration information for .NET Core 2.1.

3.1. MIGRATING FROM PREVIOUS VERSIONS OF .NET CORE

Microsoft provides instructions for migrating from most previous versions of .NET Core. When migrating, the following ASP.NET Core 2.0 property should no longer be specified. It should remain the default value for .NET Core 2.1. Make sure to remove this property from the project file and command line, if it is being specified there.

```
<PublishWithAspNetCoreTargetManifest>false</PublishWithAspNetCoreTargetManifest>
```

See the following Microsoft articles to migrate from previous versions of .NET Core.

- [Migrate from .NET Core 2.0 to 2.1](#)
- [Migrate from ASP.NET Core 2.0 to 2.1](#)
- [Migrate from ASP.NET Core 1.x to 2.0](#)
- [Migrate to ASP.NET Core](#)
- [Migrate from project.json to .csproj format](#)



NOTE

If migrating from .NET Core 1.x to 2.0, see the first few related sections in [Migrate from ASP.NET Core 1.x to 2.0](#). These sections provide guidance that is appropriate for a .NET Core 1.x to 2.0 migration path.

3.2. MIGRATING FROM .NET FRAMEWORK TO .NET CORE 2.1

Review the following information to migrate from the .NET Framework.

3.2.1. Migration considerations

Several technologies and APIs present in the .NET Framework are not available in .NET Core. If your application or library requires these APIs, consider finding alternatives or continue using the .NET Framework. .NET Core does not support the following technologies and APIs.

- Desktop applications, for example, Windows Forms and Windows Presentation Foundation (WPF)
- Windows Communication Foundation (WCF) servers (WCF clients are supported)
- .NET remoting

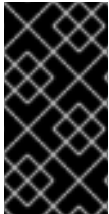
Additionally, a number of .NET APIs can only be used in Microsoft Windows environments. The following list shows a few examples of these Windows-specific APIs.

- Microsoft.Win32.Registry
- System.AppDomains

- System.Drawing
- System.Security.Principal.Windows

Consider using the [.NET Portability Analyzer](#) to identify API gaps and potential replacements. For example, enter the following command to find out how much of the API used by your .NET Framework 4.6 application is supported by .NET Core 2.1.

```
$ dotnet /path/to/ApiPort.dll analyze -f . -r html --target '.NET Framework,Version=4.6' --target '.NET Core,Version=2.1'
```



IMPORTANT

Several APIs that are not supported in the out-of-the-box version of .NET Core may be available from the [Microsoft.Windows.Compatibility](#) nuget package. Be careful when using this nuget package. Some of the APIs provided (such as Microsoft.Win32.Registry) only work on Windows, making your application incompatible with Red Hat Enterprise Linux.

3.2.2. .NET Framework migration articles

Refer to the following Microsoft articles when migrating from .NET Framework.

- For general guidelines, see [Porting to .NET Core from .NET Framework](#).
- For porting libraries, see [Porting to .NET Core - Libraries](#).
- For migrating to ASP.NET Core, see [Migrating to ASP.NET Core](#).

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APPENDIX A. REVISION HISTORY

Date	Version	Author	Changes
08/21/2017	2.0	Les Williams	Generally available
08/30/2017	2.0	Les Williams	Revised DOTNET_STARTUP_PROJECT and DOTNET_TEST_PROJECTS entries in Section 2.3
09/13/2017	2.0	Les Williams	Revised Section 1.2 to include a note about how to permanently enable rh-dotnet20
02/14/2018	2.0	Les Williams	Revised Section 2.2 to resolve BZ 1500230; added quoting for zsh and other shells
02/28/2018	2.0.3	Les Williams	Revised to include SDK 2.0 and 2.1
06/14/2018	2.1	Les Williams	Generally available
08/01/2018	2.1	Toby Drake	Added Chapter 3 to provide migration instructions
08/24/2018	2.1	Toby Drake	Added steps to enable a user to get new image streams
09/18/2018	2.1	Toby Drake	Revised Section 2.1 to include -n openshift in a command for listing .NET Core image versions. Modified the grep command to enable better search results.

Date	Version	Author	Changes
10/12/2018	2.1	Toby Drake	Added DOTNET_SSL_DIRS and DOTNET_RM_SRC to Environment Variables . Added Deploy Applications from Binary Artifacts .

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