Web server implementations in ASP.NET Core

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In this article

By Tom Dykstra, Steve Smith, Stephen Halter, and Chris Ross

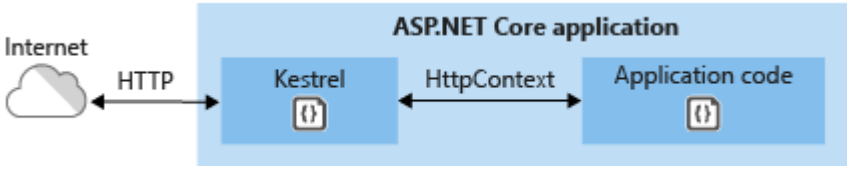
An ASP.NET Core app runs with an in-process HTTP server implementation. The server implementation listens for HTTP requests and surfaces them to the app as a set of request features composed into an HttpContext.

Kestrel

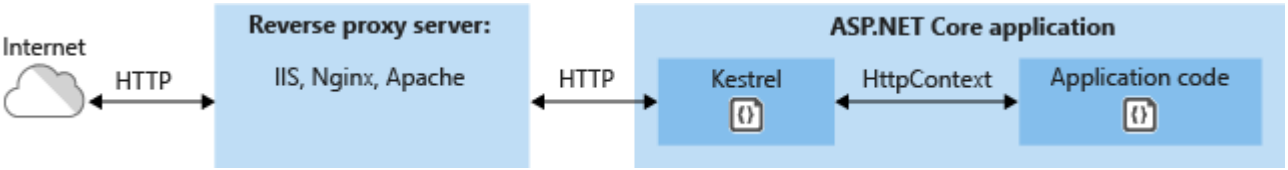
Kestrel is the default web server specified by the ASP.NET Core project templates.

Use Kestrel:

- By itself as an edge server processing requests directly from a network, including the Internet.



- With a *reverse proxy server*, such as Internet Information Services (IIS), Nginx, or Apache. A reverse proxy server receives HTTP requests from the Internet and forwards them to Kestrel.



Either hosting configuration—with or without a reverse proxy server—is supported.

For Kestrel configuration guidance and information on when to use Kestrel in a reverse proxy configuration, see Kestrel web server implementation in ASP.NET Core.

Windows | macOS | Linux

ASP.NET Core ships with the following:

- Kestrel server is the default, cross-platform HTTP server implementation.
- IIS HTTP Server is an in-process server for IIS.
- HTTP.sys server is a Windows-only HTTP server based on the HTTP.sys kernel driver and HTTP Server API.

When using IIS or IIS Express, the app either runs:

- In the same process as the IIS worker process (the in-process hosting model) with the IIS HTTP Server. *In-process* is the recommended configuration.
- In a process separate from the IIS worker process (the out-of-process hosting model) with the Kestrel server.

The ASP.NET Core Module is a native IIS module that handles native IIS requests between IIS and the in-process IIS HTTP Server or Kestrel. For more information, see ASP.NET Core Module.

Hosting models

Using in-process hosting, an ASP.NET Core app runs in the same process as its IIS worker process. In-process hosting provides improved performance over out-of-process hosting because requests aren't proxied over the loopback adapter, a network interface that returns outgoing network traffic back to the same machine. IIS handles process management with the Windows Process Activation Service (WAS).

Using out-of-process hosting, ASP.NET Core apps run in a process separate from the IIS worker process, and the module handles process management. The module starts the process for the ASP.NET Core app when the first request arrives and restarts the app if it shuts down or crashes. This is essentially the same behavior as seen with apps that run in-process that are managed by the Windows Process Activation Service (WAS).

For more information and configuration guidance, see the following topics:

- Host ASP.NET Core on Windows with IIS
- ASP.NET Core Module

Nginx with Kestrel

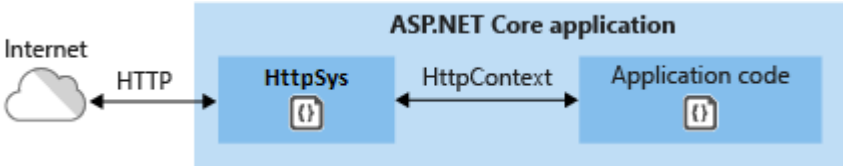
For information on how to use Nginx on Linux as a reverse proxy server for Kestrel, see Host ASP.NET Core on Linux with Nginx.

Apache with Kestrel

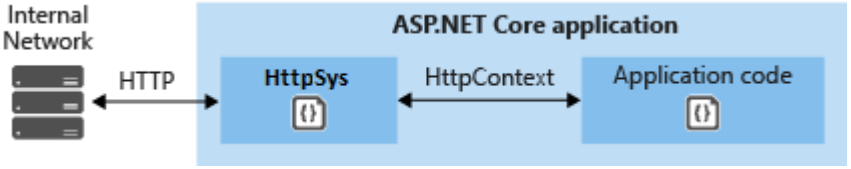
For information on how to use Apache on Linux as a reverse proxy server for Kestrel, see Host ASP.NET Core on Linux with Apache.

HTTP.sys

If ASP.NET Core apps are run on Windows, HTTP.sys is an alternative to Kestrel. Kestrel is generally recommended for best performance. HTTP.sys can be used in scenarios where the app is exposed to the Internet and required capabilities are supported by HTTP.sys but not Kestrel. For more information, see HTTP.sys web server implementation in ASP.NET Core.



HTTP.sys can also be used for apps that are only exposed to an internal network.



For HTTP.sys configuration guidance, see HTTP.sys web server implementation in ASP.NET Core.

ASP.NET Core server infrastructure

The IApplicationBuilder available in the `Startup.Configure` method exposes the ServerFeatures property of type IFeatureCollection. Kestrel and HTTP.sys only expose a single feature each, IServerAddressesFeature, but different server implementations may expose additional functionality.

`IServerAddressesFeature` can be used to find out which port the server implementation has bound at runtime.

Custom servers

If the built-in servers don't meet the app's requirements, a custom server implementation can be created. The Open Web Interface for .NET (OWIN) guide demonstrates how to write a Nowin-based IServer implementation. Only the feature interfaces that the app uses require implementation, though at a minimum IHttpRequestFeature and IHttpResponseFeature must be supported.

Server startup

The server is launched when the Integrated Development Environment (IDE) or editor starts the app:

- Visual Studio: Launch profiles can be used to start the app and server with either IIS Express/ASP.NET Core Module or the console.
- Visual Studio Code: The app and server are started by Omnisharp, which activates the CoreCLR debugger.
- Visual Studio for Mac: The app and server are started by the Mono Soft-Mode Debugger.

When launching the app from a command prompt in the project's folder, dotnet run launches the app and server (Kestrel and HTTP.sys only). The configuration is specified by the `-c|--configuration` option, which is set to either `Debug` (default) or `Release`.

A *launchSettings.json* file provides configuration when launching an app with `dotnet run` or with a debugger built into tooling, such as Visual Studio. If launch profiles are present in a *launchSettings.json* file, use the `--launch-profile {PROFILE NAME}` option with the `dotnet run` command or select the profile in Visual Studio. For more information, see dotnet run and .NET Core distribution packaging.

HTTP/2 support

HTTP/2 is supported with ASP.NET Core in the following deployment scenarios:

- Kestrel
  - Operating system
    - Windows Server 2016/Windows 10 or later†
    - Linux with OpenSSL 1.0.2 or later (for example, Ubuntu 16.04 or later)
    - HTTP/2 will be supported on macOS in a future release.
  - Target framework: .NET Core 2.2 or later
- HTTP.sys
  - Windows Server 2016/Windows 10 or later
  - Target framework: Not applicable to HTTP.sys deployments.
- IIS (in-process)
  - Windows Server 2016/Windows 10 or later; IIS 10 or later
  - Target framework: .NET Core 2.2 or later
- IIS (out-of-process)
  - Windows Server 2016/Windows 10 or later; IIS 10 or later
  - Public-facing edge server connections use HTTP/2, but the reverse proxy connection to Kestrel uses HTTP/1.1.
  - Target framework: Not applicable to IIS out-of-process deployments.

†Kestrel has limited support for HTTP/2 on Windows Server 2012 R2 and Windows 8.1. Support is limited because the list of supported TLS cipher suites available on these operating systems is limited. A certificate generated using an Elliptic Curve Digital Signature Algorithm (ECDSA) may be required to secure TLS connections.

An HTTP/2 connection must use Application-Layer Protocol Negotiation (ALPN) and TLS 1.2 or later. For more information, see the topics that pertain to your server deployment scenarios.

Additional resources

- Kestrel web server implementation in ASP.NET Core
- ASP.NET Core Module
- Host ASP.NET Core on Windows with IIS

- Deploy ASP.NET Core apps to Azure App Service
- Host ASP.NET Core on Linux with Nginx
- Host ASP.NET Core on Linux with Apache
- HTTP.sys web server implementation in ASP.NET Core

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Yes No
