Building Enterprise Grade Web APIs in ASP.NET Core

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https://github.com/DavidCBerry13/FoodTruckNationApi

Why Getting APIs Right Matters

APIs power today's connected applications

APIs serve as an integration point


Danger:
Exampleware

Goals

- An API that is easy for users to consume
- A codebase that is easy the maintain
- A pragmatic implementation that meets our business goals

“Think of this talk as a discussion rather than a hard and fast set of rules”

Principles

API Design Guidelines

Design APIs from the consumer point of view

Think about how many individual API calls it takes to complete a business operation

Try to keep each API focused on one logical business domain

Be consistent. Within your API. With established practices

Be informative when something goes wrong

Resource URLs

`GET /api/FoodTrucks`

Gets a list of all of the food trucks

`GET /api/FoodTrucks/10`

Gets the food truck with the id number of 10

`GET /api/FoodTrucks?tag=tacos`

Gets a list of food trucks that have the tag “tacos”

`GET /api/FoodTrucks/10/Reviews`

Gets a list of the reviews for food truck with the id number of 10

HTTP Verbs

	GET	POST	PUT	DELETE
`/api/foodtrucks`	Gets all food trucks	Create a food truck	Error	Error
`/api/foodtrucks/10`	Get food truck 10	Error	Update food truck 10	Update food truck 10

Resource URL Guidelines

Favor plural nouns for resource names

Avoid URLs more than two layers deep

Use query parameters to your advantage

HTTP Status Codes

Response Code	Name	Notes
200	OK	Most frequently used status code
201	Created	Used when a resource is created with a PUT request. The URI of the new resource should be included in a Location header field
304	Not Modified	Used for GET requests when the resource has not changed and caching is enabled
400	Bad Request	The request contained invalid data. The client can fix the errors in the request and try again
401	Unauthorized	Used when the user has not authenticated
403	Forbidden	Used when the user has authenticated but does not have permission to perform the requested action
404	Not Found	The specified resource could not be found
409	Conflict	The resource you are trying to add or update is in conflict with another resource. Resolve the conflict and try again
500	Internal Server Error	Something went wrong on the server. Usually a coding error in the API itself

HTTP Status Code 404

`/api/foodtrucks/123`

- Makes sense to return HTTP 404 when food truck 123 does not exist
- Everyone understands and expects this behavior

`/api/foodtrucks or /api/foodtrucks?tags=Tacos`

- I personally prefer to return a status of HTTP 200 and an empty collection in these cases
- Think it is a little easier to develop against
- Avoids confusion of no results found vs incorrect URL

Some Good Coding Principles

Keep separate concerns separate

Aim for a balanced distribution of responsibilities

Code should easily reveal its intentions about how it works

Keep code simple and concise

Practices

Use Feature Folders to Organize Code

Everything related to a feature is in one place

Keeps features independent and testable

Traditional/Standard Folder Layout

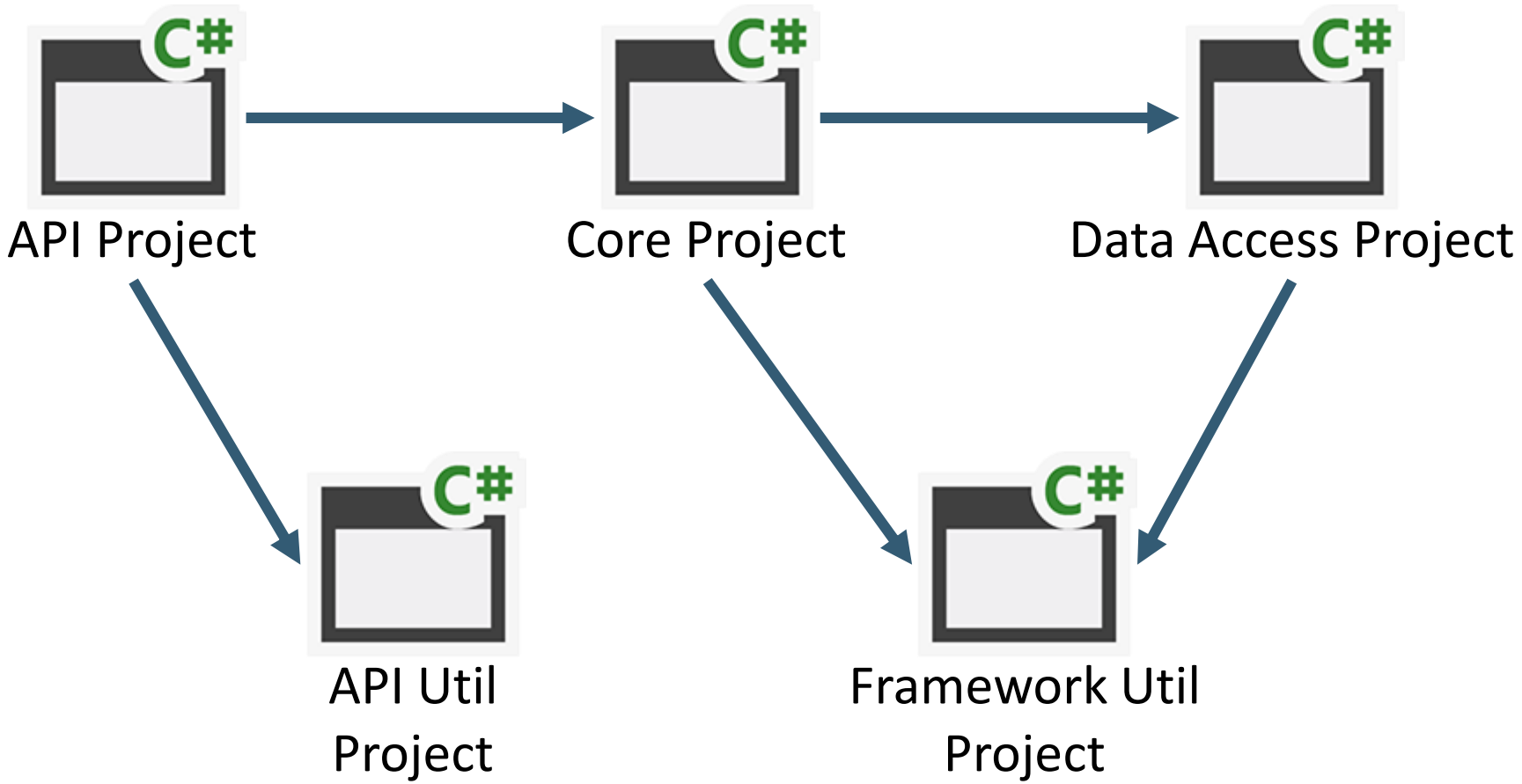
- Too many files in a single folder
- Code for any one “feature” is spread across multiple folders
- Hard to tell what goes with what

Use Multiple Projects to Organize Your Solution

Keep the API project focused on the API work

Extract common functionality into a shared project

Sample Solution Organization



Create a Base Controller for all Controllers to Inherit From

Provides a place to implement common functionality

Important if you want to implement HATEOS

Return IActionResult From Your Action Methods

Enables use of controller helper methods to return the correct HTTP status

Allows you to return custom error objects for non-HTTP 200 responses

Default Action Return Type

```
public FoodTruck Get(int id)
{
    FoodTruck foodTruck = this.foodTruckService.GetFoodTruck(id);

    if (foodTruck == null)
        return null;

    var model = this.mapper.Map<FoodTruck, FoodTruckModel>(foodTruck);
    return model;
}
```

Using IActionResult

```
public IActionResult Get(int id)
{
    FoodTruck foodTruck = this.foodTruckService.GetFoodTruck(id);

    if ( foodTruck == null)
    {
        return this.NotFound(new ApiMessageModel()
            { Message = $"No food truck found with id {id}"} );
    }
    else
    {
        var model = this.mapper.Map<FoodTruck, FoodTruckModel>(foodTruck);
        return this.Ok(model);
    }
}
```

Controller Action Result Helper Methods

Built into ASP.NET Core

Ok()	HTTP 200
Created()	HTTP 201
CreatedAtAction()	HTTP 201
CreatedAtRoute()	HTTP 201
Accepted()	HTTP 202
AcceptedAtAction()	HTTP 202
AcceptedAtRoute()	HTTP 203
NoContent()	HTTP 204
BadRequest()	HTTP 400
NotFound()	HTTP 404

Not Included in ASP.NET Core

Conflict()	HTTP 409
InternalServerError()	HTTP 500

Use View Models

Allows you to control the shape of the data sent to and from your API

Clearly communicates what is expected in POST and PUT operations

Food Truck View Model

```
{
    "foodTruckId": 1,
    "name": "American Burger",
    "description": "Classic American Burgers, Hot Dogs and Fries",
    "website": "http://foodtrucknation/BurgerTruck",
    "tags": [
        "Burgers",
        "Hot Dogs",
        "Fries“
    ],
    "socialMediaAccounts": [
        {
            "platformName": "Facebook",
            "accountName": "demo-AmericanBurger“
        },
        {
            "platformName": "Twitter",
            "accountName": "@DemoAmericanBurger“
        }
    ],
    "meta": {
        "self": "http://localhost:8000/api/FoodTrucks/1",
        "reviews": "http://localhost:8000/api/FoodTrucks/1/Reviews",
        "schedules": http://localhost:8000/api/FoodTrucks/1/Schedules
    }
}
```

Create Food Truck View Model

```
{
    "name": "That's a Wrap!",
    "description": "Your favorite sandwiches served as a wrap",
    "website": "http://thatsawrapmke.com",
    "tags": [
        "Sandwiches",
        "Gluten Free",
        "Vegetarian"
    ],
    “socialMediaAccounts": [
        {
            "socialMediaPlatformId": 2,
            "accountName": "thatsawrapmke“
        }
    ]
}
```

Name Your Routes

Allows you to use ASP.NET helper methods that build URLs based on route names

Makes it easier to implement HATEOS

Using a Route Name With CreateAtRoute

```
public const String GET_FOOD_TRUCK_BY_ID = "GetFoodTruckById";

[HttpGet("{id:int}", Name = GET_FOOD_TRUCK_BY_ID)]
public IActionResult Get(int id)
{
    // Method implemented here…
}


public IActionResult Post([FromBody]CreateFoodTruckModel createModel)
{
    var createCommand = this.mapper.Map<CreateFoodTruckModel,
        CreateFoodTruckCommand>(createModel);

    FoodTruck foodTruck = this.foodTruckService.CreateFoodTruck(createCommand);

    var model = this.mapper.Map<FoodTruck, FoodTruckModel>(foodTruck);
    return this.CreatedAtRoute(GET_FOOD_TRUCK_BY_ID,
        new { id = model.FoodTruckId }, model);
}
```

Returning an HTTP 201 Created

Response Headers

access-control-allow-origin →*
api-supported-versions →1.0, 1.1
content-type →application/json; charset=utf-8
date →Thu, 14 Sep 2017 02:57:16 GMT
location →http://localhost:8000/api/FoodTrucks/16
server →Kestrel
transfer-encoding →chunked
x-powered-by →ASP.NET

Response headers should include a location header giving the location of the newly created resource

Response Body

```
{
   "foodTruckId": 16,
   "name": "Sushi Truck",
   "description": "Fresh sushi on wheels",
   "website": "http://www.sushifoodtruck.com",
   "tags": [
      "Sushi",
      "Japanese",
      "Asian“
   ],
   "meta": {
      "self": "http://localhost:8000/api/FoodTrucks/16",
      "reviews":
         "http://localhost:8000/api/FoodTrucks/16/Reviews",
      "schedules":
         "http://localhost:8000/api/FoodTrucks/16/Schedules"
   }
}
```

Leverage Query Objects

Enables multiple parameters to be encapsulated into one object

Allows you to make use of validation frameworks for query parameters

Create Custom Error Model Objects

Allows you to return richer error information than a simple message

Helps create a consistent error experience across the application

Make Use of Action Filters

Handle cross cutting concerns in one place

→ Validation

→ Error Handling

Can be applied globally to make sure something always gets done

Create cleaner code by factoring out common functionality

Action Method Without Filters

```
public IActionResult Post([FromBody]CreateFoodTruckModel createModel)
{
    if ( !ModelState.IsValid)
    {
        var errors = ModelState
            .Where(e => e.Value.Errors.Count > 0)
            .Select(e => new RequestErrorModel() { Field = e.Key, Message = e.Value.Errors.First().ErrorMessage })
            .ToArray();
    }

    try
    {
        var createCommand = this.mapper.Map<CreateFoodTruckModel, CreateFoodTruckCommand>(createModel);

        FoodTruck foodTruck = this.foodTruckService.CreateFoodTruck(createCommand);

        var model = this.mapper.Map<FoodTruck, FoodTruckModel>(foodTruck);
        return this.CreatedAtRoute(GET_FOOD_TRUCK_BY_ID, new { id = model.FoodTruckId }, model);
    }
    catch (InvalidDataException ex)
    {
        var message = new ApiMessageModel() { Message = ex.Message };
        return this.BadRequest(message);
    }
    catch (Exception ex)
    {

        var message = new ApiMessageModel() { Message = ex.Message };
        return this.InternalServerError(message);
    }
}
```

Action Method With Filters

```
public IActionResult Post([FromBody]CreateFoodTruckModel createModel)
{
    var createCommand = this.mapper.Map<CreateFoodTruckModel,
        CreateFoodTruckCommand>(createModel);

    FoodTruck foodTruck = this.foodTruckService.CreateFoodTruck(createCommand);

    var model = this.mapper.Map<FoodTruck, FoodTruckModel>(foodTruck);
    return this.CreatedAtRoute(GET_FOOD_TRUCK_BY_ID,
        new { id = model.FoodTruckId }, model);
}
```

Handle Conflicts

Need to handle scenario where multiple clients are trying to update the same object at the same time

Include last modified time or other object version data in your response objects

Response code of 409 conflict should be used in these situations

Using a Last Modified Date

```
{
    "foodTruckId": 4,
    "name": "Rice Bowl",
    "description": "Asian favorites served in a bowl of rice",
    "website": "http://foodtrucknation.com/RiceBowl",
    "lastModifiedDate": "2017-10-23T01:57:37.185",
    "tags": [
        "Asian",
        "Chinese Food“
    ],
    "reviewCount": 4,
    "reviewAverage": 4,
    "socialMediaAccounts": [],
}
```

Include a last modified date or version number in the response

This value must be included when updating the object so the server can check for subsequent changes

CreateConcurrencyErrorResult Helper Method

- Defined in my BaseController class so it can be used by any controller when a concurrency error occurs
- Notice how it includes the current object in the HTTP 409 response

```
protected virtual IActionResult CreateConcurrencyConflictErrorResult
    <TModel, TObject>(ConcurrencyException<TObject> concurrencyException)
{
    var conflictingObject = concurrencyException.TypedObject;
    var model = this.mapper.Map<TObject, TModel>(conflictingObject);
    var message = new ConcurrencyErrorModel<TModel>()
    {
        Message = concurrencyException.Message,
        CurrentObject = model
    };
    return new ConflictObjectResult(message);
}
```

Document Your API With Swagger

Developers have to know what to call and how to call it

Provides a simple way to test out your interface

Important if you want to import your API into an API gateway

Swashbuckle

Swashbuckle.AspNetCore 1.0.0

Swagger tools for documenting APIs built on ASP.NET Core

Package Manager | .NET CLI | Paket CLI

```
PM> Install-Package Swashbuckle.AspNetCore -Version 1.0.0
```

Dependencies

Version History

Version	Downloads	Last updated
1.0.0 (current version)	479,804	6 months ago
1.0.0-rc3	111,484	7 months ago
1.0.0-rc2	653	7 months ago

Info

- last updated 6 months ago
- Project Site
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- Manual download

Statistics

- 697,845 total downloads
- 479,804 downloads of latest version
- 2,510 downloads per day (avg)

View full stats

Swashbuckle Configuration

```
public void Configure(IApplicationBuilder app, IHostingEnvironment env,
    ILoggerFactory loggerFactory)
{
    // Code removed for brevity ...

    app.UseSwagger(c =>
    {
        c.PreSerializeFilters.Add((swagger, httpReq) => swagger.Host = httpReq.Host.Value);
    });

    app.UseSwaggerUI(c =>
    {
        c.SwaggerEndpoint("/swagger/v1.0/swagger.json", "Food Truck API v1.0");
        c.SwaggerEndpoint("/swagger/v1.1/swagger.json", "Food Truck API v1.1");
    });

}
```

Swashbuckle Configuration Part 2

```
public void ConfigureServices(IServiceCollection services)
{
    var pathToXmlComments = Configuration["Swagger:FileName"];
    services.AddSwaggerGen(options =>
    {
        options.SwaggerDoc("v1.1", new Info { Title = "Food Truck API v1.1", Version = "v1.1" });
        options.SwaggerDoc("v1.0", new Info { Title = "Food Truck API v1.0", Version = "v1.0" });
        options.DocInclusionPredicate((docName, apiDesc) =>
        {
            var actionApiVersionModel = apiDesc.ActionDescriptor?.GetApiVersion();
            if (actionApiVersionModel == null)
                return true;

            if (actionApiVersionModel.DeclaredApiVersions.Any())
                return actionApiVersionModel.DeclaredApiVersions.Any(v => $"v{v.ToString()}" == docName);

            return actionApiVersionModel.ImplementedApiVersions.Any(v => $"v{v.ToString()}" == docName);
        });

        var filePath = Path.Combine(PlatformServices.Default.Application.ApplicationBasePath, pathToXmlComments);
        options.IncludeXmlComments(filePath);
        options.DescribeAllEnumsAsStrings();

}
```

Have a Versioning Strategy

Every API will change over time

ASP.NET Core provides some low friction ways to handle versioning

Versioning Package

Microsoft.AspNetCore.Mvc.Versioning 2.0.0

A service API versioning library for Microsoft ASP.NET Core.

Requires NuGet 2.5 or higher.

Package Manager | .NET CLI | Paket CLI

```
PM> Install-Package Microsoft.AspNetCore.Mvc.Versioning -Version 2.0.0
```

Release Notes

https://github.com/Microsoft/aspnet-api-versioning/releases/tag/v2.0.0

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Statistics

259,129 total downloads

Versioning Configuration

```
public void ConfigureServices(IServiceCollection services)
{
    // Code removed for brevity ...

    services.AddApiVersioning(cfg =>
    {
        cfg.DefaultApiVersion = new Microsoft.AspNetCore.Mvc.ApiVersion(1, 0);
        cfg.AssumeDefaultVersionWhenUnspecified = true;
        cfg.ReportApiVersions = true;
        cfg.ApiVersionReader = new HeaderApiVersionReader("api-version");
    });

    // Code removed for brevity ...
}
```

API Versioning Attributes

```
[Route("api/FoodTrucks")]
[ApiVersion("1.0")]
[ApiVersion("1.1")]
public class FoodTrucksController : BaseController
{
    [HttpGet(Name = GET_ALL_FOOD_TRUCKS)]
    [MapToApiVersion("1.0")]
    public IActionResult Get([FromQuery]String tag = null)
    { // Method Body would be here… }

    [HttpGet(Name = GET_ALL_FOOD_TRUCKS)]
    [MapToApiVersion("1.1")]
    public IActionResult GetV11([FromQuery]String tag = null)
    { // Method Body would be here… }

    [HttpDelete("{id}", Name ="DeleteFoodTruck")]
    public IActionResult Delete(int id)
    { // Method Body would be here… }

}
```

Validation is Really, Really Important

One of your first lines of defense for security issues

Fail fast – saves debugging time

Unit test your validations to make sure they work

A Better Validation Library

*

FluentValidation 7.2.0

A validation library for .NET that uses a fluent interface to construct strongly-typed validation rules.

Package Manager | .NET CLI | Paket CLI

```
PM> Install-Package FluentValidation -Version 7.2.0
```

Release Notes

Changes in 7.2:
* Updated AspNetCore integration to support IValidatableObject
* Updated AspNetCore integration to allow mixing multiple validation strategies in the same model
* Updated AspNetCore integration to support RulesetForClientsideMessagesAttribute
* Fix - Property names were not generated properly for nested types when using AddFailure inside a Custom validator
* Fix - NullReferenceException when using CustomAsync but the validator is invoked synchronously
* Fix - Clientside integration in AspNetCore being resolved from the root-level service provider
* Fix - Allow empty string to be passed to OverridePropertyName

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3,206,741 total downloads

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1,300 downloads per day (avg)

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Your API Ain't Done Till the Tests Are Run

Test your validations

Test mapping between objects

Test for behavior

Enable HTTP Compression

Payload size is one of the biggest factors in performance

Using IIS Dynamic Compression

Install IIS Dynamic Content Compression from Web Platform Installer

Go to the Compression feature at the IIS Server level and make sure dynamic compression is enabled

Edit your C:\Windows\System32\inetsrv\Config\applicationHost.config file to include JSON mime types for compression

IIS HTTP Compression Configuration

```
<httpCompression directory="%SystemDrive%\inetpub\temp\IIS Temporary Compressed Files">
    <scheme name="gzip" dll="%Windir%\system32\inetsrv\gzip.dll" />
    <staticTypes>
        <add mimeType="text/*" enabled="true" />
        <add mimeType="message/*" enabled="true" />
        <add mimeType="application/javascript" enabled="true" />
        <add mimeType="application/atom+xml" enabled="true" />
        <add mimeType="application/xaml+xml" enabled="true" />
        <add mimeType="image/svg+xml" enabled="true" />
        <add mimeType="*/*" enabled="false" />
    </staticTypes>
    <dynamicTypes>
        <add mimeType="text/*" enabled="true" />
        <add mimeType="message/*" enabled="true" />
        <add mimeType="application/x-javascript" enabled="true" />
        <add mimeType="application/javascript" enabled="true" />
        <add mimeType="application/json" enabled="true" />
        <add mimeType="application/json; charset=utf8" enabled="true" />
        <add mimeType="*/*" enabled="false" />
    </dynamicTypes>
</httpCompression>
```

Using Compression Middleware

Response Compression Middleware for ASP.NET Core

08/20/2017 • 9 minutes to read • Contributors

By Luke Latham

View or download sample code (how to download)

Network bandwidth is a limited resource. Reducing the size of the response usually increases the responsiveness of an app, often dramatically. One way to reduce payload sizes is to compress an app's responses.

When to use Response Compression Middleware

Use server-based response compression technologies in IIS, Apache, or Nginx. The performance of the middleware probably won't match that of the server modules. HTTP.sys server and Kestrel don't currently offer

https://docs.microsoft.com/en-us/aspnet/core/performance/response-compression?tabs=aspnetcore2x

Implement Health Checks

Your customer should not have to inform you that you are down

Can be utilized to remove a misbehaving instance from your server pool

Think about degraded conditions as well as down conditions

Health Check Options

.NET Team	• https://github.com/dotnet-architecture/HealthChecks • Hope was project would be incorporated into .NET 2.1, but appears stagnant at this time
App Metrics	• https://www.app-metrics.io/ • Open source, currently pre-release status • Also has functionality to measure what is happening in your app
Build Your Own	• Start simple, use the above libraries for inspiration

HATEOS

Part of the REST specification

Provides links to related resources and actions

Some controversy over if you really need to do it

HATEOS

```
{
    "foodTruckId": 1,
    "name": "American Burger",
    "description": "Classic American Burgers, Hot Dogs and Fries",
    "website": "http://foodtrucknation/BurgerTruck",
    "tags": [
        "Burgers",
        "Hot Dogs“
     ],
    "meta": {
        "self": "http://localhost:8000/api/FoodTrucks/1",
        "reviews": http://localhost:8000/api/FoodTrucks/1/Reviews",
        "schedules": "http://localhost:8000/api/FoodTrucks/1/Schedules"
    }
}
```

HATEOS Mapping

```
this.CreateMap<FoodTruck, FoodTruckLinks>()
    .ForMember(
        dest => dest.Self,
        opt => opt.ResolveUsing<UrlResolver, RouteUrlInfo>(src =>
            new RouteUrlInfo()
            {
                RouteName = FoodTrucksController.GET_FOOD_TRUCK_BY_ID,
                RouteParams = new { id = src.FoodTruckId }
            }
        )
    )
    .ForMember(
        dest => dest.Reviews,
        opt => opt.ResolveUsing<UrlResolver, RouteUrlInfo>(src =>
            new RouteUrlInfo()
            {
                RouteName = Reviews.FoodTruckReviewsController.GET_ALL_FOOD_TRUCK_REVIEWS,
                RouteParams = new { foodTruckId = src.FoodTruckId }
            }
        )
    );
```

Resources

REST Design Resources

https://pages.apigee.com/web-api-design-website-h-ebook-registration.html

https://apigee.com/about/blog/developer/web-api-design-missing-link

ASP.NET Core APIs

Implementing and Securing an API with ASP.NET Core

By Shawn Wildermuth

https://www.pluralsight.com/courses/aspdotnetcore-implementing-securing-api

Thank You

David Berry
@DavidCBerry13
https://github.com/DavidCBerry13/FoodTruckNationApi