ASP.NET Core 3 - Web API

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Module 2: Web API

Module Overview

Module 2: Web API

Section 1: RESTful Services

Lesson: REST Fundamentals

What is Representational State Transfer?

- REST defines a set of *design principles and architectural styles* for highly scalable distributed systems
- REST is coined by Roy Fielding in his PhD thesis in 2000
- Roy is also the principle author of the HTTP specification and the co-author of the Uniform Resource Identifier (URI) specification
- The World Wide Web is an existing proof of a massively scalable distributed system that follows REST principles

REST Constraints - I

- Client-Server
  - Clients not concerned with server function (processing of data, storage mechanism)
  - Server not concerned with UI representations of the resource (rendering)
- Stateless
  - Client context is not stored on the server
- Layered
  - Intermediary servers or devices (for example, load balancers) are transparent to the client.

REST Constraints - II

- Cacheable
- Code on Demand (optional)
    - JavaScript executed on the client.
- Uniform Interface
    - URI (addressing the resource)
    - Verbs (manipulation of the resource)
    - Self-Describing (content-type headers)
    - Hyperlinks / HATEOAS

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Section 1: RESTful Services

Lesson: REST Principles

REST Principles

- Identifiable resources
    - Give everything an ID
- Resource representations
    - Resources with multiple representations
- Hypermedia as the Engine of Application State (HATEOAS)
    - Link resources together
- Uniform Interface
    - Use standard methods
- Stateless communication
    - Communicate in a stateless fashion

Resource Representations

- Resource can have multiple representations, for example, HTML, XHTML, XML, JSON, plain text, multimedia, Atom, etc.
- Content negotiation allows client to specify the type of content it can accept and preference: “I want XML”
- MIME defines some standard content types:
    - “text/plain”
    - “text/html”
    - “image/jpeg”
    - “audio/mp3” and so on.

Uniform Interface

- Every resource supports the same interface
- In HTTP, this interface is
  - HTTP verbs: GET, PUT, POST, DELETE, HEAD, OPTIONS
  - HTTP status codes
- Safe operations: Idempotence
- Advantages
  - Simplicity
    - Stateless with respect to client and server communication
  - Extensibility
    - Mashups, MIME types, etc.
  - Visibility
    - URIs, Verbs, headers provide for services like caching

Why REST?

- Move towards a resource-based application model
- Interoperability between cloud, on-premises and cross-domains
- Take advantage of Web’s infrastructure
- Easy composition of resources via Uniform Interface
- A “must have” if your APIs will be consumed by third-party services

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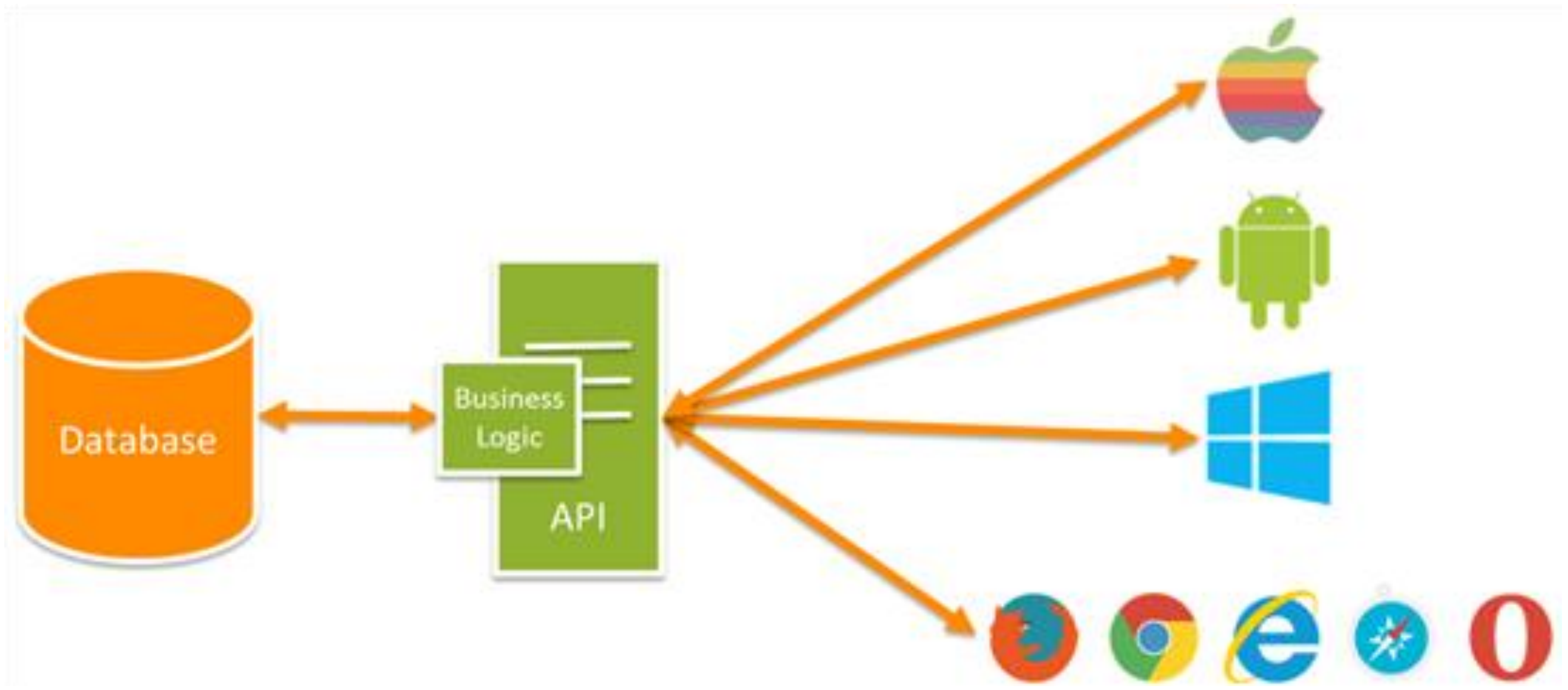
Section 2: ASP.NET Web API

Lesson: Web API Fundamentals

Web API



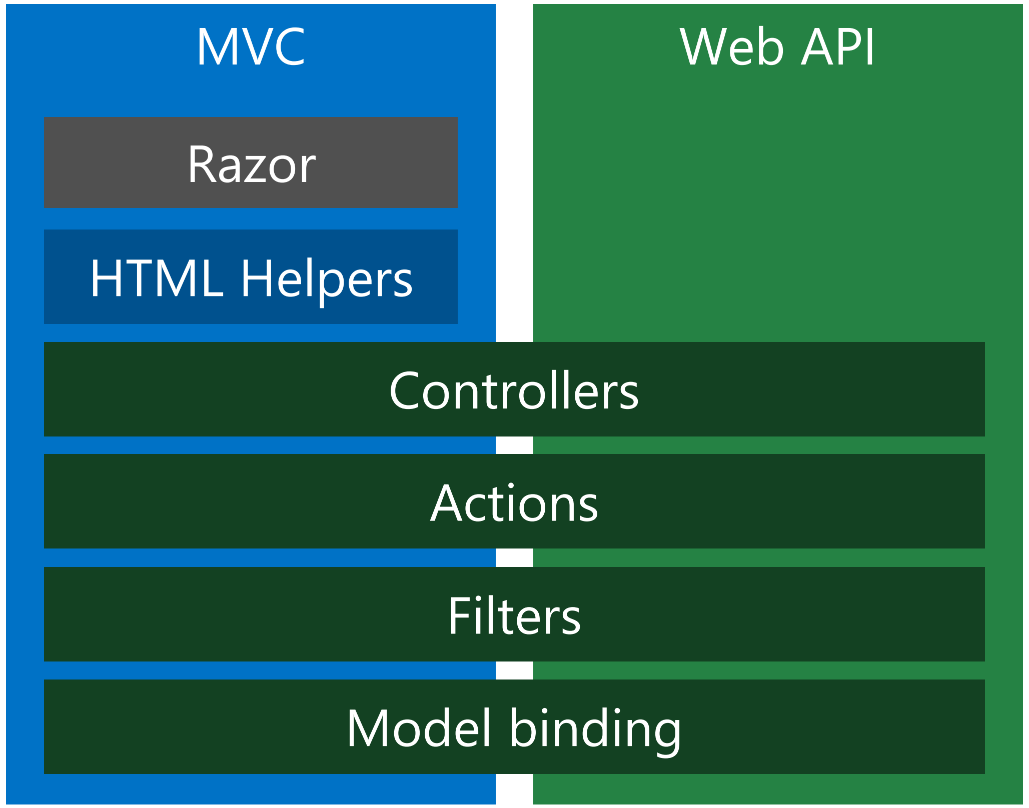
The History

- Windows Communication Foundation (WCF) Support for REST
    - WebHTTPBinding (WCF 3.5)
    - WCF REST Starter Kit (WCF 4)
    - WCF Web API (CodePlex)
- ASP.NET MVC 3
    - Returning JavaScript Object Notation (JSON) from controllers
- ASP.NET Web API takes the best features from WCF Web API and merges them with the best features from MVC

ASP.NET Web API

- ASP.NET Web API is a framework that makes it easy to build HTTP services.
  - Full support for ASP.NET Routing
  - Content negotiation and custom formatters
  - Model binding and validation
  - Filters
  - Query composition
  - Easy to unit test
  - Inversion of Control (IoC)
  - Code-based configuration
  - Self hosting

The World Today with ASP.NET Core



Demo: Adding Web API Controller

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Section 2: ASP.NET Web API

Lesson: Routing

Routing - Controllers

- Only one base class for ASP.NET MVC and ASP.NET Web API controllers
  - Both MVC and Web API controllers derive from the very same

    Microsoft.AspNetCore.Mvc.Controller base class

    ```
    [Route("api/[controller]")]
    public class ValuesController : Controller
    ```
  - You can use RESTful style routing with both MVC and Web API controllers
- Same routing framework for both MVC and the Web API
  - Convention-based routes or attribute routes
- Default route template for Web API is "**api/[controller]**"

IActionResult for UI and API

- Controllers return IActionResult
  - For MVC Controllers, it might be view or data
  - For Web API controllers, it might be data

UI	API
PartialViewResult	BadRequestResult
RedirectResult	ContentResult
ViewResult	CreatedAtRouteResult
JsonResult	HttpStatusCodeResult
	JsonResult
	ObjectResult
ChallengeResult	
HttpNotFoundResult	
FileContentResult	

IActionResult for UI and API

- Controllers return IActionResult
  - For MVC Controllers, it might be view or data
  - For Web API controllers, it might be data

```
[HttpGet("{id:int}")]
public IActionResult GetById(int id)
{
     var item = _items.FirstOrDefault(x => x.Id == id);
     if (item == null)
     {
            return NotFound();
     }

     return new ObjectResult(item);
}
```

Routing - Controllers

- To find the controller, Web API adds "Controller" to the value of the *[controller]* variable.
- Once a matching route is found, Web API selects the controller
- Web API uses the HTTP method, not the URI path, to select the action
- If no route matches, the client receives a 404 error

Routing - Actions

- Web API looks at the HTTP method, and then looks for an action whose HTTP attribute is the same as the method
- This convention applies to GET, POST, PUT, and DELETE methods
- Other placeholder variables in the route template, such as {id} and query strings, are mapped to action parameters.

```
[HttpGet("{id}")]
public string Select(int id)
```

- [**FromBody**] attribute tells the framework to deserialize the parameter from the request body

```
[HttpPut("{id:int}")]
public void Update(int id, [FromBody]string value)
```

HTTP Verbs

	Collection URI (http://api.example.com/v1/resources/)	**Element URI (http://api.example.com/v1/resources/item17)**
GET	List the URIs and perhaps other details of the collection's members.	Retrieve a representation of the addressed member of the collection.
PUT	Replace the entire collection with another collection.	Replace the addressed member of the collection, or if it does not exist, create it.
POST	Create a new entry in the collection.	Treat the addressed member as a collection in its own right and create a new entry in it.
DELETE	Delete the entire collection.	Delete the addressed member of the collection.

Routing - Actions

Verb	URL	Action
GET	api/values	[HttpGet] public IEnumerable<string> Get()
GET	api/values/5	[HttpGet("{id}")] public string Select(int id)
PUT	api/values/5	[HttpPut("{id}")] public void Update(int id, [FromBody]string value)
POST	api/values	[HttpPost] public void Create([FromBody]string value)
DELETE	api/values/5	[HttpDelete("{id}")] public void Delete(int id)

- To prevent a method from getting invoked as an action, use the **NonAction** attribute
- In case multiple Actions match, you get runtime exception:
  - 500 Internal Server Error - Microsoft.AspNetCore.Mvc.AmbiguousActionException

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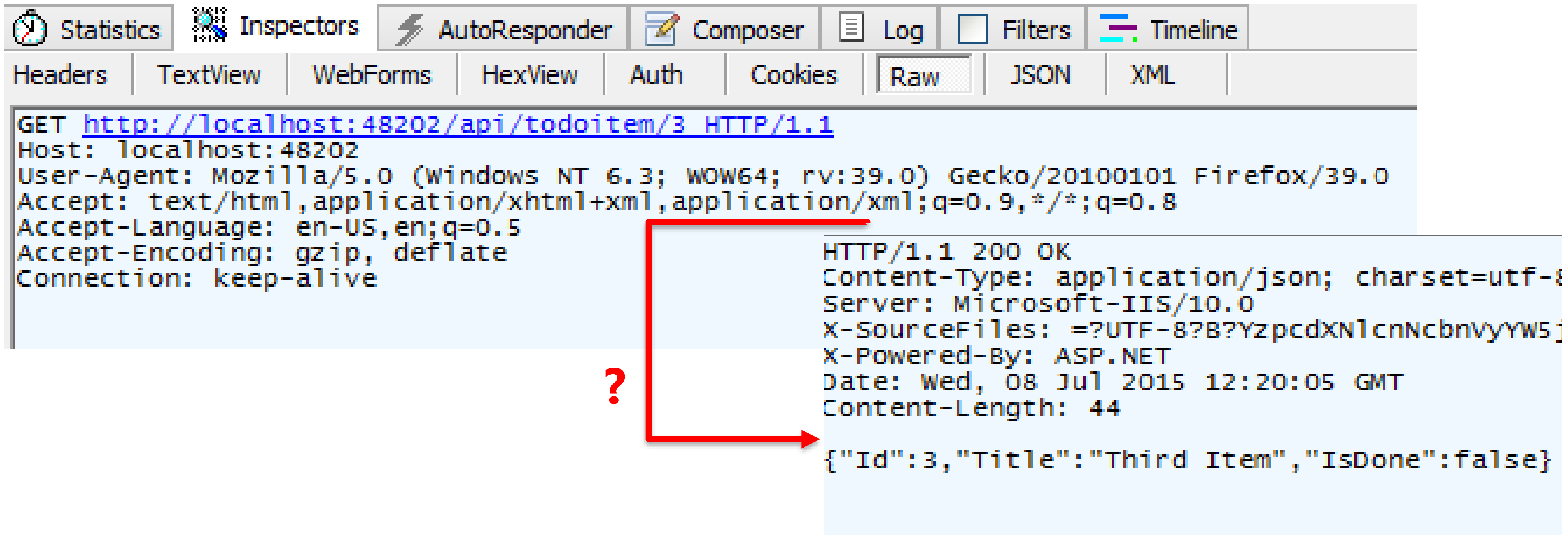
Section 2: ASP.NET Web API

Lesson: Content Negotiation

Content Negotiation

- Apps consume content in different ways
- JSON and Extensible Markup Language (XML) are the most popular formats
- A good client will request the favored type



```
GET http://localhost:48202/api/todoitem/3 HTTP/1.1
Host: localhost:48202
User-Agent: Mozilla/5.0 (Windows NT 6.3; WOW64; rv:39.0) Gecko/20100101 Firefox/39.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
```

```
HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-
Server: Microsoft-IIS/10.0
X-SourceFiles: =?UTF-8?B?YzpcdXNlcnNcbnVyYW5
X-Powered-By: ASP.NET
Date: Wed, 08 Jul 2015 12:20:05 GMT
Content-Length: 44

{"Id":3,"Title":"Third Item","IsDone":false}
```

JSON Only By Default

- XML formatters (input and output) are now removed by default

Input formatters	Output formatters
JsonInputFormatter	JsonOutputFormatter
JsonPatchInputFormatter	StringOutputFormatter
	StreamOutputFormatter
	HttpNoContentOutputFormatter

- Custom formatters can be developed

If You Need XML…

- XML formatters are found in "Microsoft.AspNetCore.Mvc.Formatters.Xml" package
- Manually add it to the formatters collection in Startup.cs

```
services.Configure<MvcOptions>(options =>
            {
             options.OutputFormatters.Add(new XmlSerializerOutputFormatter());
              //options.InputFormatters.Add(new XmlSerializerInputFormatter());
            });
```

- Use the [Produces] attribute in the action method

```
[Produces("application/xml")]
public IActionResult GetAll(int id)
```

Demo: Content Negotiation

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Section 2: ASP.NET Web API

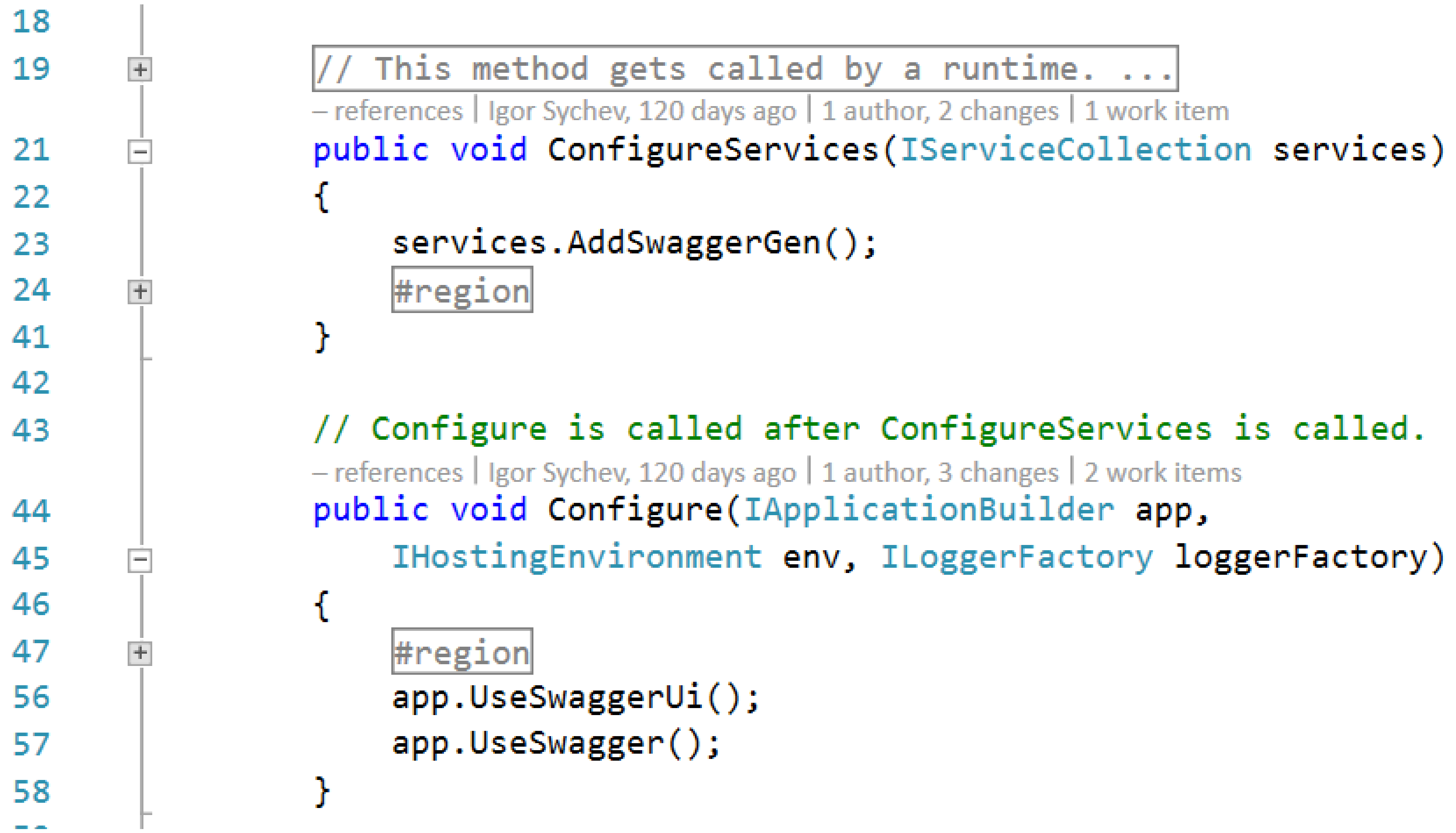
Lesson: Swagger Documentation

Swagger Documentation

- Swagger is a simple yet powerful representation of your RESTful API.
- Swagger is the **most popular** representation of RESTful API.

- Swagger generating good documentation and help pages as a part of your Web API
- Documentation is customizable:
  - XML comment from you code will be included
  - Data Annotation Attributes will be applied

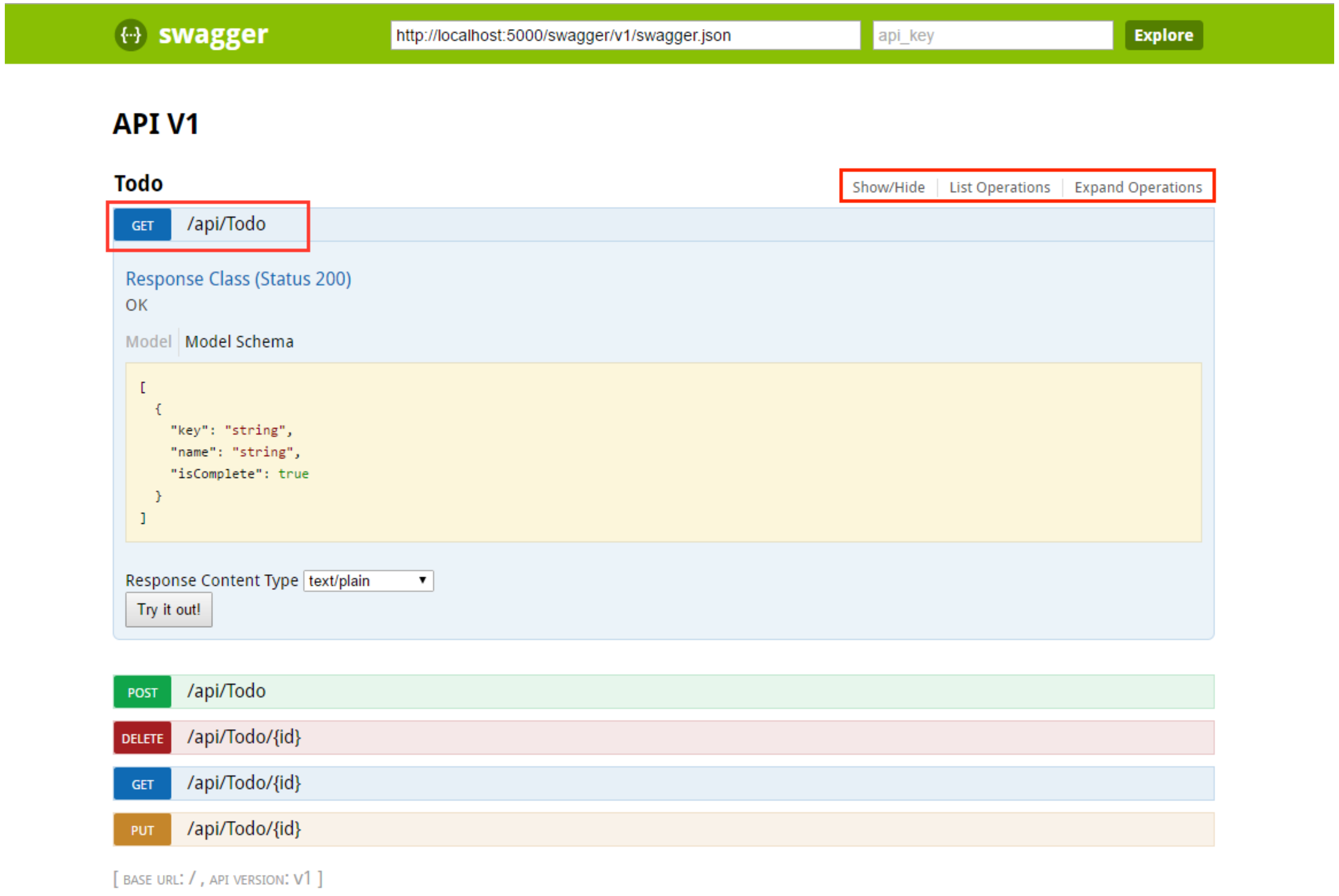
Swagger configuration



```
// This method gets called by a runtime. ...
– references | Igor Sychev, 120 days ago | 1 author, 2 changes | 1 work item
public void ConfigureServices(IServiceCollection services)
{
    services.AddSwaggerGen();
    #region
}

// Configure is called after ConfigureServices is called.
– references | Igor Sychev, 120 days ago | 1 author, 3 changes | 2 work items
public void Configure(IApplicationBuilder app,
    IHostingEnvironment env, ILoggerFactory loggerFactory)
{
    #region
    app.UseSwaggerUi();
    app.UseSwagger();
}
```

Swagger UI example:


swagger
http://localhost:5000/swagger/v1/swagger.json
api_key
Explore

API V1

Todo

Show/Hide | List Operations | Expand Operations

GET /api/Todo

Response Class (Status 200)

OK

```
[
  {
    "key": "string",
    "name": "string",
    "isComplete": true
  }
]
```

Response Content Type: text/plain

POST /api/Todo

DELETE /api/Todo/{id}

GET /api/Todo/{id}

PUT /api/Todo/{id}

[BASE URL: / , API VERSION: v1]

Demo: Swagger

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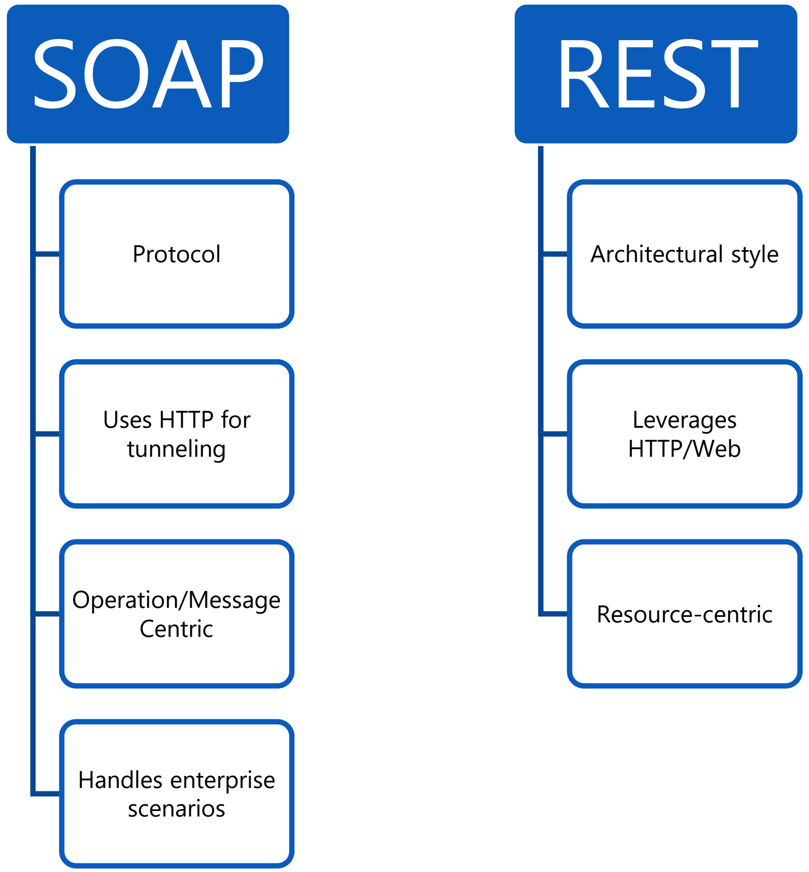
Section 3: Web API Usage Patterns

Lesson: Which Technology to Use?

SOAP and REST: Brief Comparison and Contrast



Which Technology To Use?

WCF	ASP.NET Web API
Multiple transport protocols (HTTP, TCP, UDP, and custom transports)	HTTP only. First-class programming model for HTTP
Web Services Description Language (WSDL) configuration file	Simple and lightweight
Multiple encodings (Text, MTOM, and Binary)	Wide variety of media types including XML, JSON etc.

Which Technology To Use? (continued)

WCF	ASP.NET Web API
Services with WS-* standards	Basic protocol and formats such as HTTP, WebSocket, and SSL
Supports Request-Reply, One Way, and Duplex message exchange patterns.	HTTP is request/response
WCF SOAP services can be described	Variety of ways to describe a Web API
Ships with the .NET framework	Ships with .NET framework but is open-source and is also available out-of-band as independent download

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Section 3: Web API Usage Patterns

Lesson: Web API Design

Good API Design

- There is no real standard or method for designing APIs
- Keep your base URL simple and intuitive
- Do not change your URLs over time

Nouns, No Verbs

- Use nouns for resource names
- Use plural rather than singular nouns, and concrete rather than abstract names
- Keep verbs out of your base URLs
- Use HTTP verbs to operate on the collections and elements

Tip: Nouns are good, verbs are bad

- Actions that do not fit into the world of CRUD operations can be endpoint
  - GitHub's API
    - star a gist with PUT /gists/:id/star
    - unstar with DELETE /gists/:id/star

Simplify Associations

- Nested resources(Association)
- User URI navigation (/resource/identifier/resource)
  - GET /api/Customers/123/Invoices
  - GET /api/Customers/123/Payments
  - GET /api/Customers/123/Shipments
- Keep the base resource URLs lean by implementing query parameters
  - GET /api/Customers?state=GA
  - GET /api/Customers?hasOpenOrders=true

Use Meaningful HTTP Status Codes

- Use HTTP status codes and map them cleanly to relevant standard-based codes

Group	Comment
1xx	Informational (100, 101)
2xx	Success (200, 201)
3xx	Redirect (301, 304)
4xx	Client Error (401, 404, 405)
5xx	Server Error (500, 503)

Versioning

- Never release an API without a versioning and make the versioning mandatory
- Maintain at least one version back
- Versioning with Content Negotiation and custom headers are popular now
    - Content-Type: application/json;v=2
    - X-MyApp-Version = 2
- Versioning with URI components are more common
    - Easier to implement
    - GET /api/v2/Customers/123/Invoices

Module Summary

- In this module, you learned about:
  - REST principles
  - Web API fundamentals
  - Web API routing
  - Content negotiation
  - Web API Design

Lab: ASP.NET Web API

Microsoft