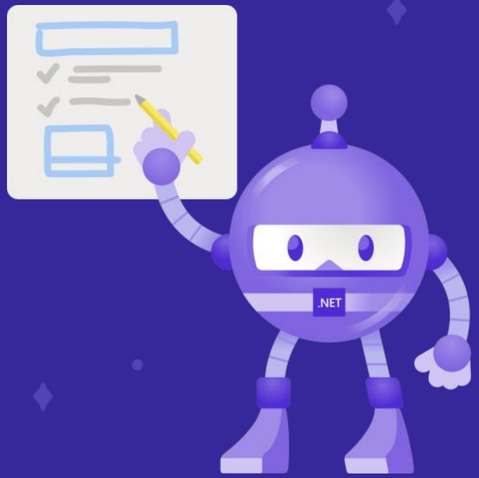
gRPC - 打造輕量、高效能的後端服務

黃升煌 Mike
多奇數位創意有限公司

wellwind

fullstackledder

gRPC 簡介



關於 gRPC

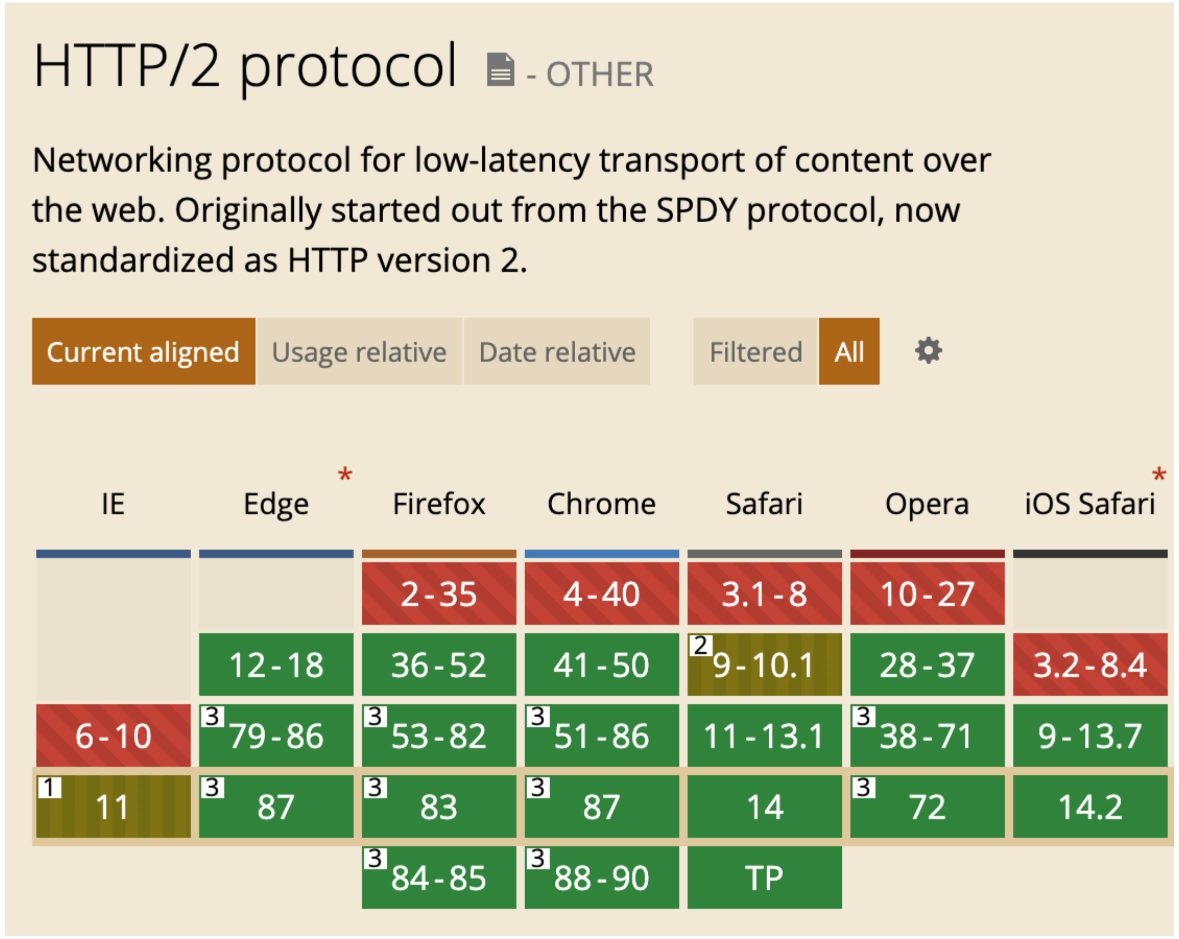
- 高效能的 RPC 框架
- 基於 HTTP/2 傳輸協定
- 支援多種程式語言
- 使用 Protocol Buffers 定義傳輸介面

關於 HTTP/2

- 更快、更安全的傳輸方式
  - Single TCP connection
  - Headers 壓縮
  - 以 binary 格式傳輸
  - 連線多工處理
  - 支援 Server Push
  - 允許雙向溝通
  - 更多...
- 相容 HTTP 1.1

HTTP/2 瀏覽器支援

- 主流瀏覽器都支援 HTTP/2
- IE 11 須在 Windows 10 下支援



HTTP/2 protocol - OTHER

Networking protocol for low-latency transport of content over the web. Originally started out from the SPDY protocol, now standardized as HTTP version 2.

Current aligned | Usage relative | Date relative | Filtered | All

IE	Edge *	Firefox	Chrome	Safari	Opera	iOS Safari *
		2-35	4-40	3.1-8	10-27	
	12-18	36-52	41-50	[2] 9-10.1	28-37	3.2-8.4
6-10	[3] 79-86	[3] 53-82	[3] 51-86	11-13.1	[3] 38-71	9-13.7
[1] 11	[3] 87	[3] 83	[3] 87	14	[3] 72	14.2
		[3] 84-85	[3] 88-90	TP		

關於 Protocol Buffers

- 簡稱 protobuff (副檔名通常為 `.proto`)
- 用來定義資料結構的一種語言
- 語言更簡單、更好理解
- 語言本身即可代表文件 (先寫文件在寫 code)
- 使用 Protocol Buffer Compiler 將其轉換成各種語言的實作
- 完整的 Protocol Buffer 語法說明

Protocol Buffer 基本語法

```
syntax = "proto3";

service Greeter {
  rpc SayHello (HelloRequest) returns (HelloReply);
}

message HelloRequest {
  string name = 1;
}

message HelloReply {
  string message = 1;
}
```

Protocol Buffer 基本語法

```
syntax = "proto3";
```

使用版本

```
service Greeter {
  rpc SayHello (HelloRequest) returns (HelloReply);
}

message HelloRequest {
  string name = 1;
}

message HelloReply {
  string message = 1;
}
```

Protocol Buffer 基本語法

```
syntax = "proto3";

service Greeter {
  rpc SayHello (HelloRequest) returns (HelloReply);
}

message HelloRequest {
  string name = 1;
}

message HelloReply {
  string message = 1;
}
```

定義服務

Protocol Buffer 基本語法

```
syntax = "proto3";

service Greeter {
  rpc SayHello (HelloRequest) returns (HelloReply);
}

message HelloRequest {
  string name = 1;
}

message HelloReply {
  string message = 1;
}
```

服務提供方法

Protocol Buffer 基本語法

```
syntax = "proto3";

service Greeter {
  rpc SayHello (HelloRequest) returns (HelloReply);
}

message HelloRequest {
  string name = 1;
}

message HelloReply {
  string message = 1;
}
```

Request 資料結構名稱

Request 資料結構定義

Protocol Buffer 基本語法

```
syntax = "proto3";

service Greeter {
  rpc SayHello (HelloRequest) returns (HelloReply);
}

message HelloRequest {
  string name = 1;
}

message HelloReply {
  string message = 1;
}
```

Response 資料結構名稱

Response 資料結構定義

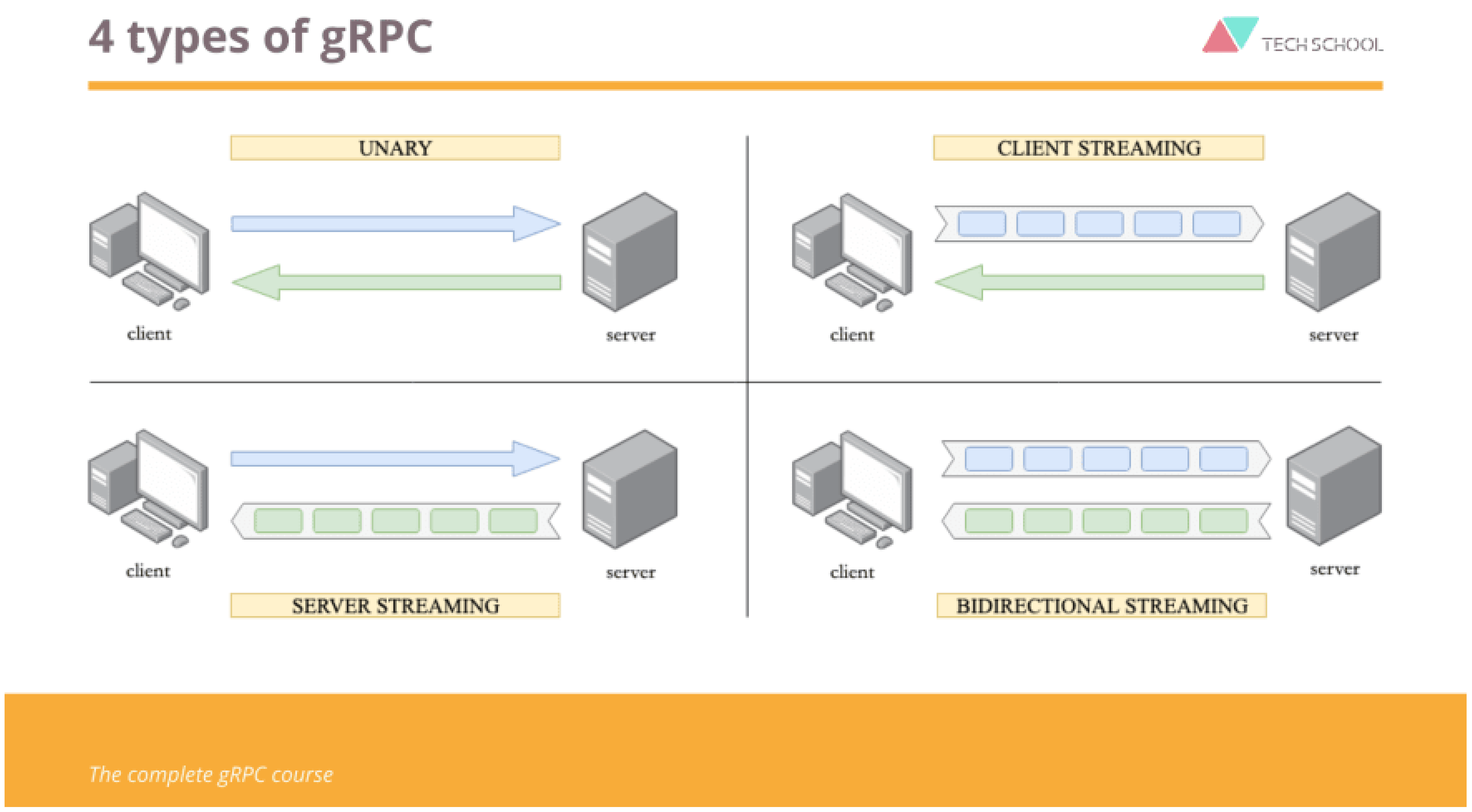
Protocol Buffer 基本語法

```
syntax = "proto3";

service Greeter {
  rpc SayHello (HelloRequest) returns (HelloReply);
}

message HelloRequest {
  string name = 1;
}

message HelloReply {
  string message = 1;
}
```

欄位編號

- 在每個 message 內不可重複
- 編號範圍 1~2^{29}-1
- 常用欄位建議使用 1~15 (1 byte)
- 編號 19000~19999 不可以使用

4 種 gRPC 交換資料類型



https://dev.to/techschoolguru/is-grpc-better-than-rest-where-to-use-it-3blg

Protocol Buffer 基本語法

- Unary
  - `rpc SayHello (HelloRequest) returns (HelloReply);`
- Server Stream
  - `rpc GetStockPrices (GetPriceRequest) returns (stream GetPriceReply);`
- Client Stream
  - `rpc UpdateStockPrices (stream UpdatePriceRequest) returns (UpdatePriceReply);`
- Bi-directional Stream
  - `rpc Echo (stream EchoRequest) returns (stream EchoReply);`

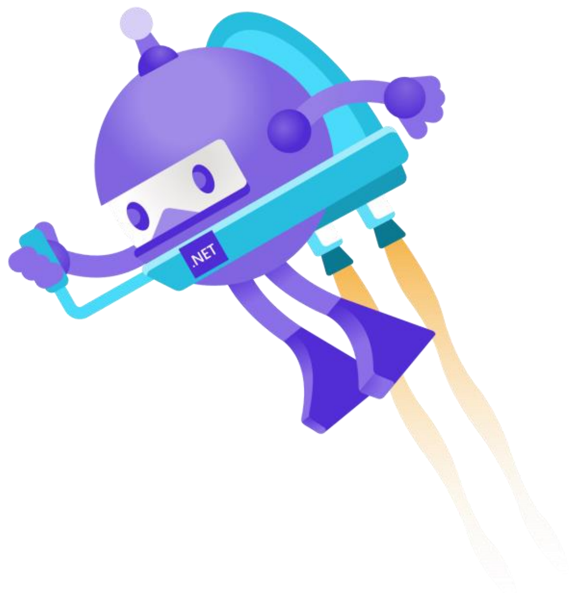
Microsoft STUDY4 Build School

gRPC 實戰

使用 ASP.NET Core

建立 gRPC Server

使用 ASP.NET Core



建立 gRPC Server

- `dotnet new grpc -n GrpcGreeter`
- `cd GrpcGreeter`
- `dotnet run`

macOS

- macOS 不支援具有 TLS 的 ASP.NET Core gRPC
  - 無法在 macOS 上啟動 ASP.NET Core gRPC 應用程式

```
public static IHostBuilder CreateHostBuilder(string[] args) =>
    Host.CreateDefaultBuilder(args)
        .ConfigureWebHostDefaults(webBuilder =>
        {
            webBuilder.ConfigureKestrel(options =>
            {
                // Setup a HTTP/2 endpoint without TLS.
                options.ListenLocalhost(5000, o => o.Protocols = HttpProtocols.Http2);
            });
            webBuilder.UseStartup<Startup>();
        });
```

gRPC Server 程式碼說明

- GrpcGreeter.csproj

```
<Project Sdk="Microsoft.NET.Sdk.Web">

  <PropertyGroup>
    <TargetFramework>net5.0</TargetFramework>
  </PropertyGroup>

  <ItemGroup>
    <Protobuf Include="Protos\greet.proto" GrpcServices="Server" />
  </ItemGroup>

  <ItemGroup>
    <PackageReference Include="Grpc.AspNetCore" Version="2.32.0" />
  </ItemGroup>

</Project>
```

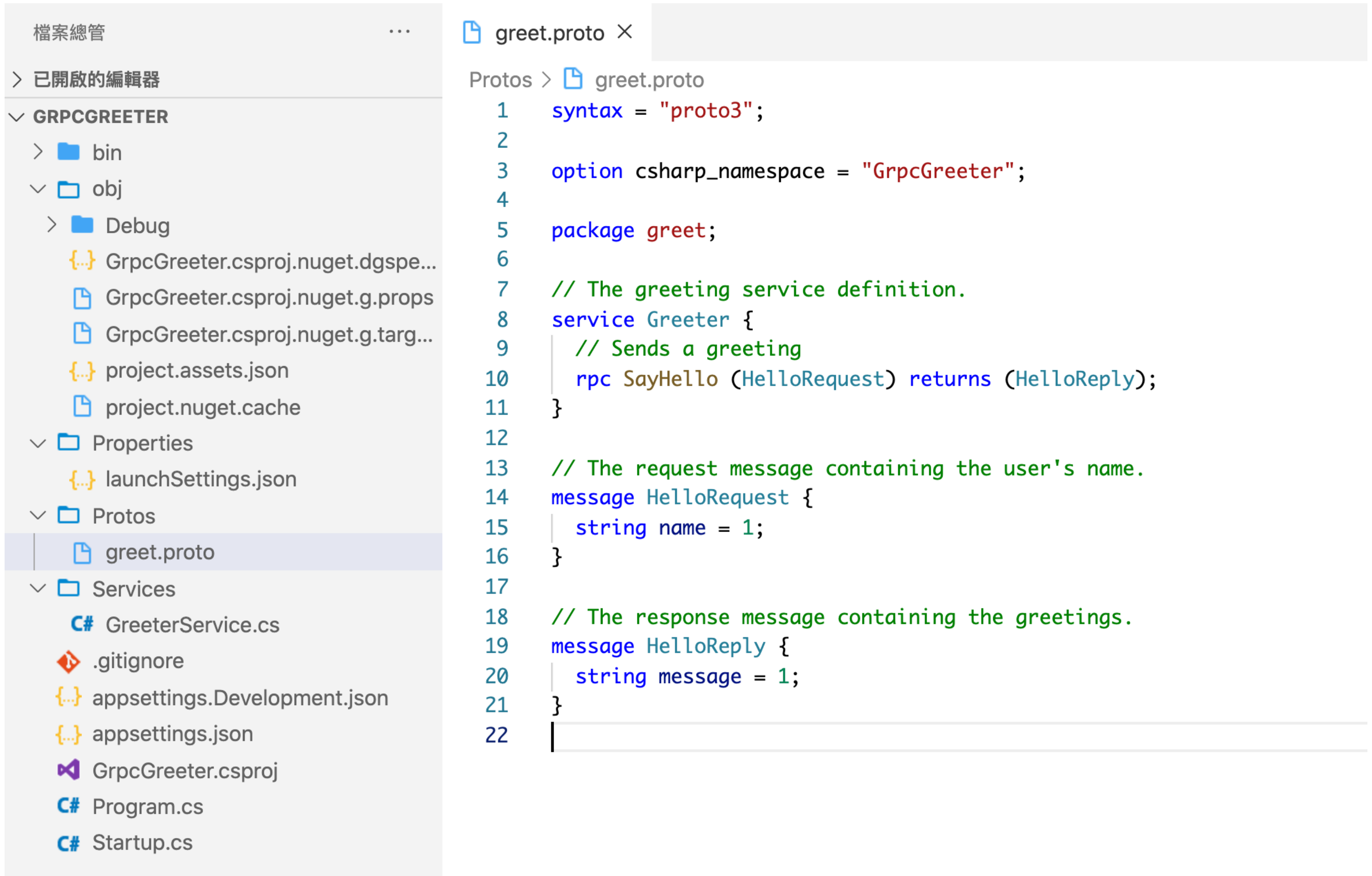
gRPC Server 程式碼說明

- Startup.cs

```
public void ConfigureServices(IServiceCollection services)
{
    services.AddGrpc();
}

public void Configure(IApplicationBuilder app, IWebHostEnvironment env)
{
    ...
    app.UseEndpoints(endpoints =>
    {
        endpoints.MapGrpcService<GreeterService>();
        ...
    });
}
```

gRPC Server 程式碼說明

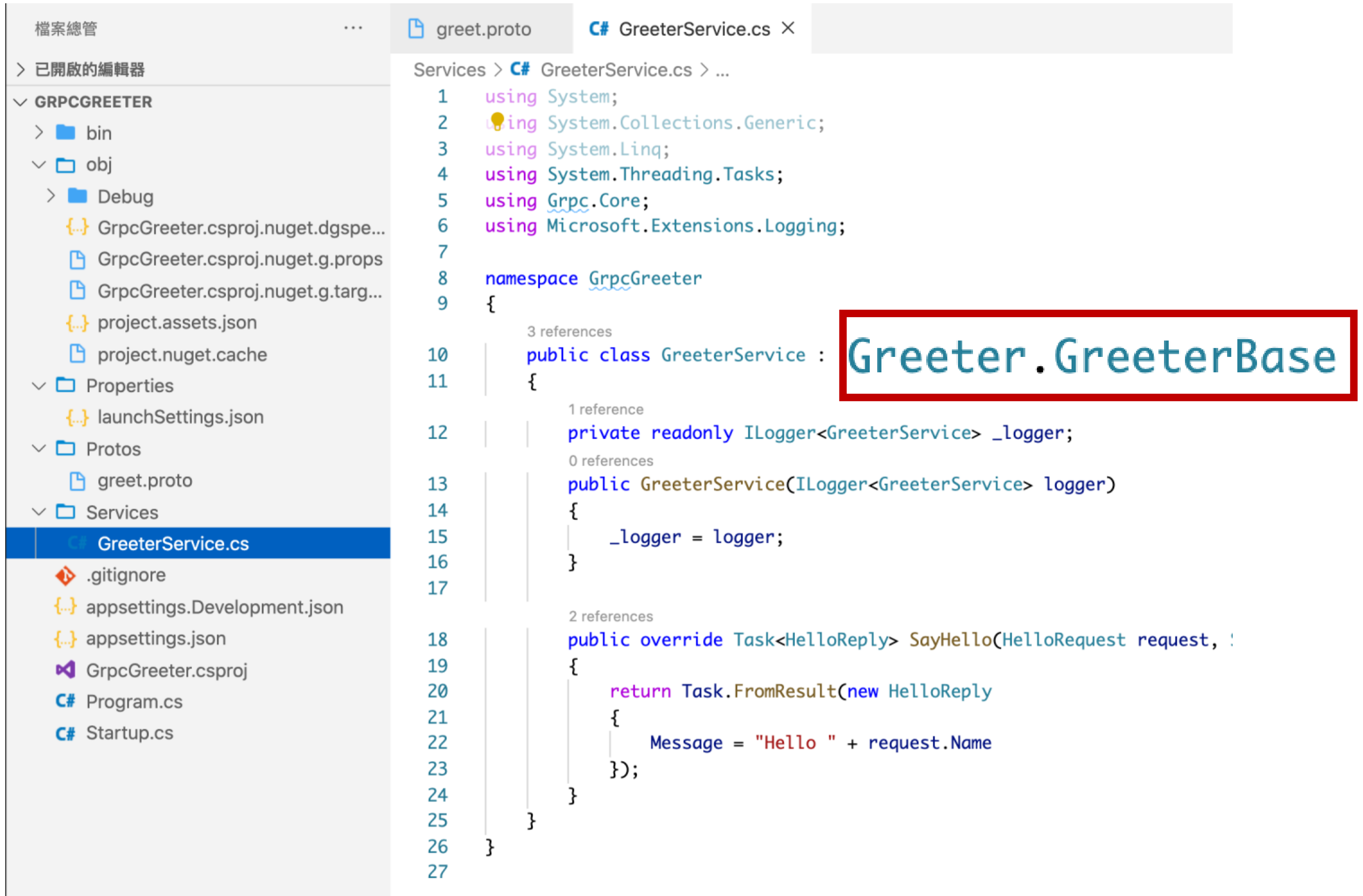
- Protos/greet.proto



```
syntax = "proto3";

option csharp_namespace = "GrpcGreeter";

package greet;

// The greeting service definition.
service Greeter {
  // Sends a greeting
  rpc SayHello (HelloRequest) returns (HelloReply);
}

// The request message containing the user's name.
message HelloRequest {
  string name = 1;
}

// The response message containing the greetings.
message HelloReply {
  string message = 1;
}

```

gRPC Server 程式碼說明

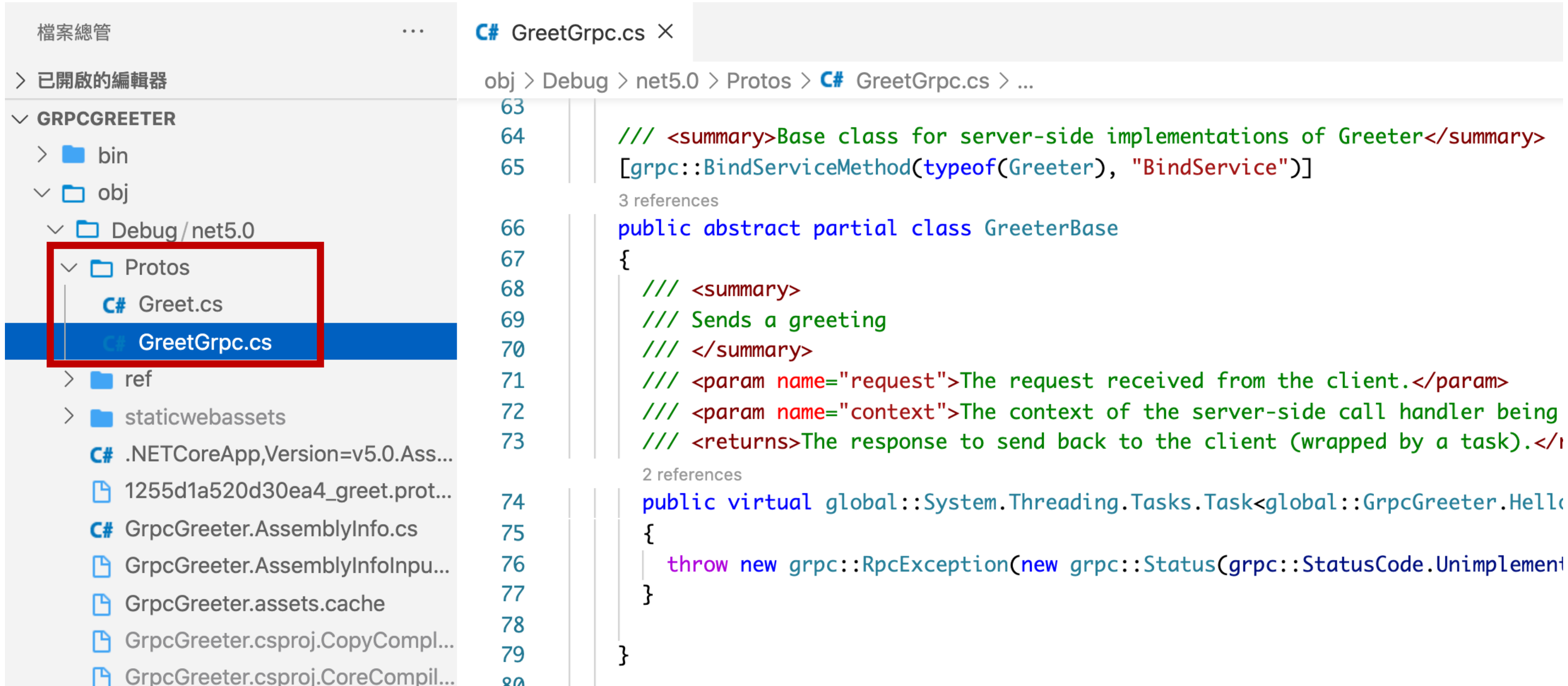
- Services/GreeterService.cs



```csharp
using System;
using System.Collections.Generic;
using System.Linq;
using System.Threading.Tasks;
using Grpc.Core;
using Microsoft.Extensions.Logging;

namespace GrpcGreeter
{
    3 references
    public class GreeterService : Greeter.GreeterBase
    {
        1 reference
        private readonly ILogger<GreeterService> _logger;
        0 references
        public GreeterService(ILogger<GreeterService> logger)
        {
            _logger = logger;
        }

        2 references
        public override Task<HelloReply> SayHello(HelloRequest request,
        {
            return Task.FromResult(new HelloReply
            {
                Message = "Hello " + request.Name
            });
        }
    }
}
```

gRPC Server 程式碼說明

- `Greeter.GreeterBase`
  - `obj/Debug/net5.0/Protos/GreetGrpc.cs`
- 加入 proto 檔後，在 build 時自動產生



檔案總管
已開啟的編輯器
GRPCGREETER
bin
obj
Debug / net5.0
Protos
Greet.cs
GreetGrpc.cs
ref
staticwebassets
.NETCoreApp,Version=v5.0.Ass...
1255d1a520d30ea4_greet.prot...
GrpcGreeter.AssemblyInfo.cs
GrpcGreeter.AssemblyInfoInpu...
GrpcGreeter.assets.cache
GrpcGreeter.csproj.CopyCompl...
GrpcGreeter.csproj.CoreCompil...
GreetGrpc.cs
obj > Debug > net5.0 > Protos > GreetGrpc.cs > ...

```csharp

/// <summary>Base class for server-side implementations of Greeter</summary>
[grpc::BindServiceMethod(typeof(Greeter), "BindService")]
3 references
public abstract partial class GreeterBase
{
  /// <summary>
  /// Sends a greeting
  /// </summary>
  /// <param name="request">The request received from the client.</param>
  /// <param name="context">The context of the server-side call handler being
  /// <returns>The response to send back to the client (wrapped by a task).</r
  2 references
  public virtual global::System.Threading.Tasks.Task<global::GrpcGreeter.Hell
  {
    throw new grpc::RpcException(new grpc::Status(grpc::StatusCode.Unimplement
  }

}
```

Unary 示範

```
public override Task<HelloReply> SayHello(HelloRequest request, ServerCallContext con
text)
{
    return Task.FromResult(new HelloReply
    {
        Message = "Hello " + request.Name
    });
}
```

Server Stream 示範

```
public override async Task GetStockPrices(
    GetPriceRequest request,
    IServerStreamWriter<GetPriceReply> responseStream,
    ServerCallContext context)
{
    for (var i = 0; i < 5; ++i)
    {
        await responseStream.WriteAsync(new GetPriceReply()
        {
            StockId = request.StockId,
            Price = 100 + i
        });
        await Task.Delay(TimeSpan.FromSeconds(1));
    }
}
```

Client Stream 示範

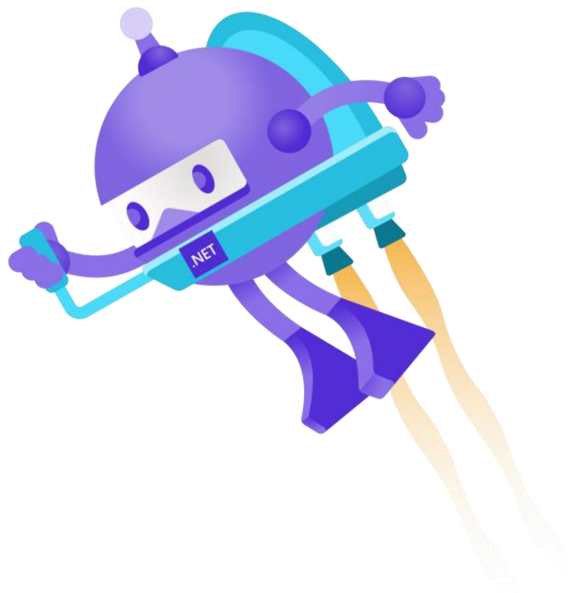
```
public override async Task<UpdatePriceReply> UpdateStockPrices(
    IAsyncStreamReader<UpdatePriceRequest> requestStream, ServerCallContext context)
{
    while (await requestStream.MoveNext())
    {
        var message = requestStream.Current;
    }

    return new UpdatePriceReply() { Success = true };
}
```

Bi-directional Stream 示範

```
public override async Task Echo(
    IAsyncStreamReader<EchoRequest> requestStream,
    IServerStreamWriter<EchoReply> responseStream,
    ServerCallContext context)
{
    var readTask = Task.Run(async () =>
    {
        await foreach (var message in requestStream.ReadAllAsync())
        {
            await responseStream.WriteAsync(new EchoReply() { ... });
        }
    });


    while (!readTask.IsCompleted)
    {
        await responseStream.WriteAsync(new EchoReply() { ... });
        await Task.Delay(TimeSpan.FromSeconds(5), context.CancellationToken);
    }
}
```

建立 gRPC Client

使用 .NET Core Console



建立 gRPC Client

- `dotnet new console -n GrpcGreeterClient`
- `cd GrpcGreeterClient`
- dotnet add package Grpc.Net.Client
- dotnet add package Google.Protobuf
- dotnet add package Grpc.Tools

加入 greet.proto

- 將 Server 的 `Protos/greet.proto`
  - 複製到 Client 的 `Protos/greet.proto`
- 修改 `Client greet.proto` 檔的 `namespace`

```
option csharp_namespace = "GrpcGreeterClient";
```

Microsoft STUDY4 Build School

呼叫 Server 服務

```
using var channel = GrpcChannel.ForAddress("https://localhost:5001");
var client = new Greeter.GreeterClient(channel);
```

建立連線

```
var reply = await client.SayHelloAsync(
                  new HelloRequest { Name = "GreeterClient" });
```

```
Console.WriteLine("Greeting: " + reply.Message);
```

呼叫 Server 服務

```
using var channel = GrpcChannel.ForAddress("http://localhost:5000");
var client = new Greeter.GreeterClient(channel);



var reply = await client.SayHelloAsync(
                  new HelloRequest { Name = "GreeterClient" });



Console.WriteLine("Greeting: " + reply.Message);
```

呼叫服務提供的方法

呼叫 Server 服務

```
using var channel = GrpcChannel.ForAddress("http://localhost:5000");
var client = new Greeter.GreeterClient(channel);
```

```
var reply = await client.SayHelloAsync(
                  new HelloRequest { Name = "GreeterClient" });
```

回傳結果

```
Console.WriteLine("Greeting: " + reply.Message);
```

Unary 示範

```
var reply = await client.SayHelloAsync(new HelloRequest { Name = "Mike" });

Console.WriteLine("Greeting: " + reply.Message);
```

Server Stream 示範

```
var call = client.GetStockPrices(new GetPriceRequest() { StockId = "2330" });

while (await call.ResponseStream.MoveNext(new System.Threading.CancellationToken()))
{
    Console.WriteLine("Greeting: " + call.ResponseStream.Current.Price);
}
```

Client Stream 示範

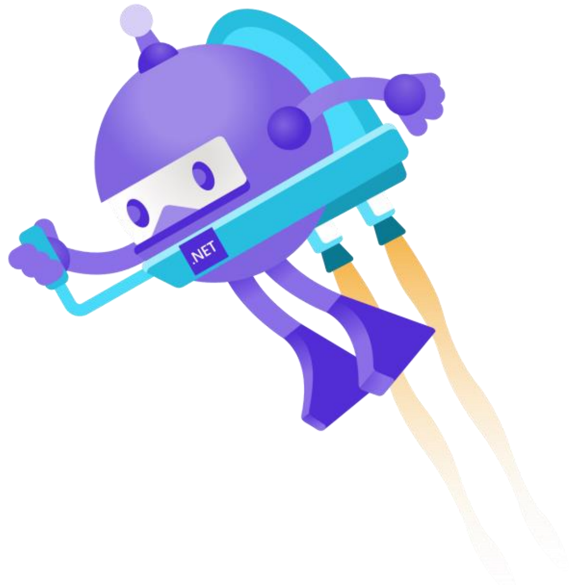
```csharp
var call = client.UpdateStockPrices();

for (var i = 0; i < 5; i++)
{
    await call.RequestStream.WriteAsync(new UpdatePriceRequest
    {
        StockId = "2330",
        Price = 100 + i
    });
    await Task.Delay(TimeSpan.FromSeconds(1));
}

await call.RequestStream.CompleteAsync();
```

Microsoft STUDY4 Build School

Bi-directional Stream 示範

```
var call = client.Echo();


var readTask = Task.Run(async () =>
{
    await foreach (var response in call.ResponseStream.ReadAllAsync())
    {
        Console.WriteLine(response.Message);
    }
});

while (true)
{
    var result = Console.ReadLine();
    if (string.IsNullOrEmpty(result)) { break; }

    await call.RequestStream.WriteAsync(new EchoRequest() { Message = result });
}


await call.RequestStream.CompleteAsync();
await readTask;
```

gRPC in Web



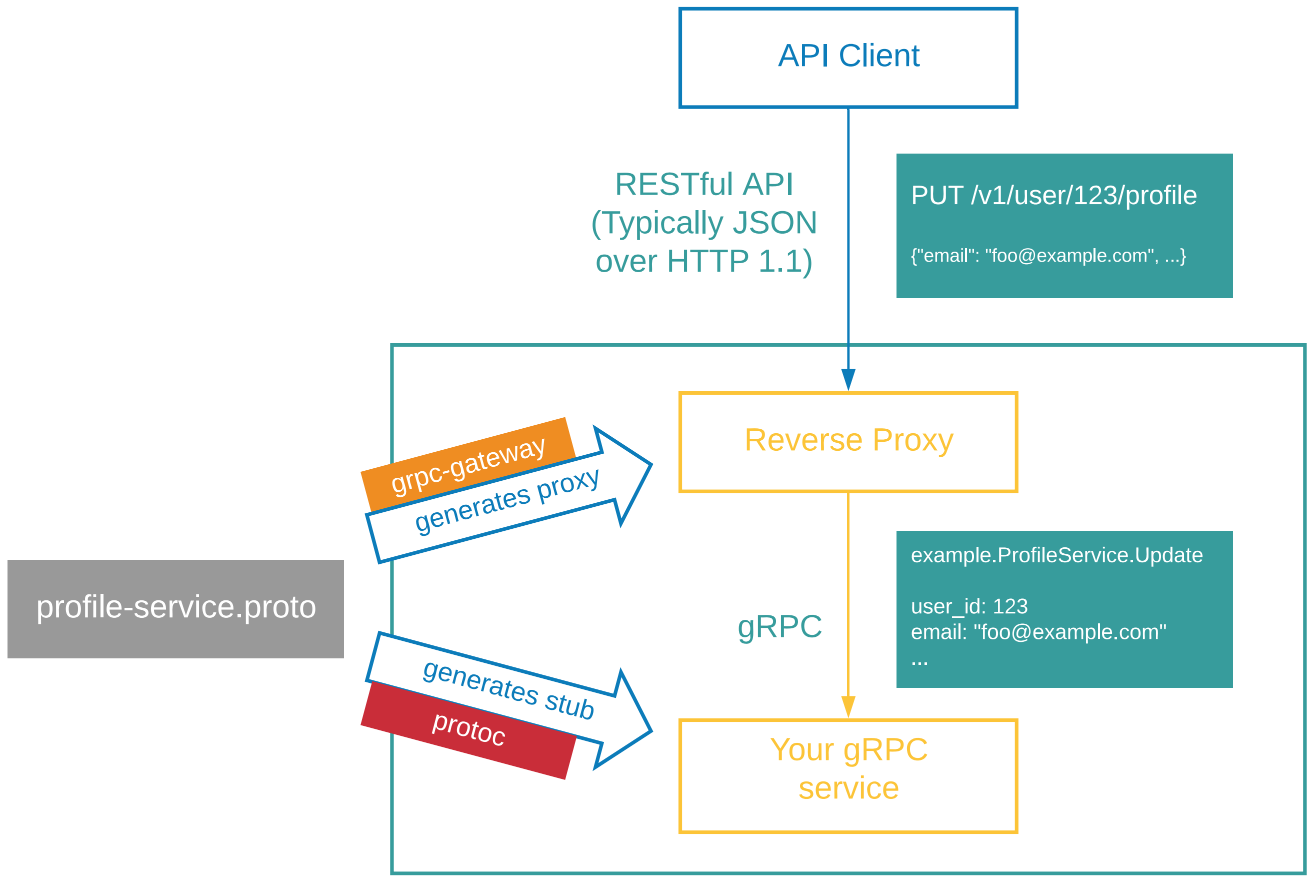
gRPC 限制

- 預設情況下，無法從瀏覽器呼叫 gRPC HTTP/2 服務
- 常見解決方法
  - gRPC Gateway
  - gRPC Web
- .NET Core 解決方案
  - gRPC HTTP API (實驗性專案)
  - gRPC Web

gRPC Gateway

- 替 Protocol Buffer 內每個服務方法建立一個專屬的 API Endpoint
- 支援 Swagger / OpenAPI
- 原來的 gRPC 依然可以被呼叫
- Web Client 可以直接用 Web API 呼叫就好
- 資料格式為 JSON、非 binary，效能較差

gRPC Gateway



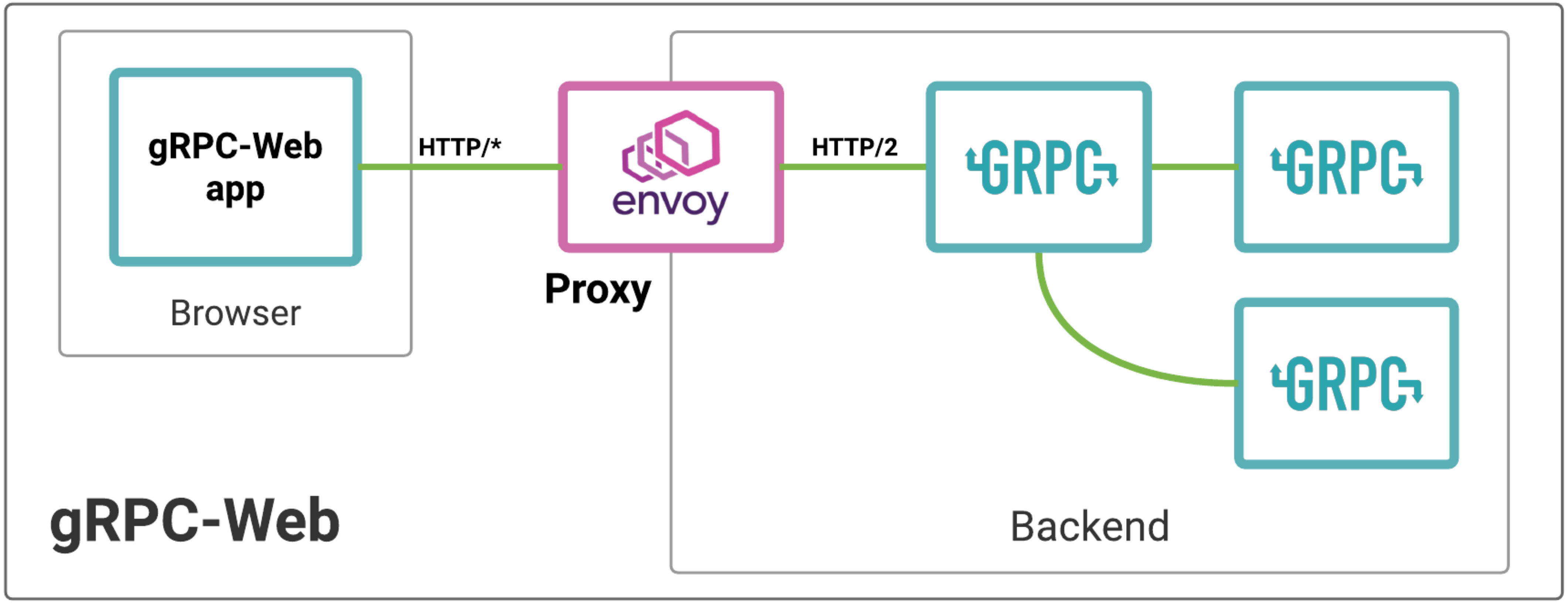
https://github.com/grpc-ecosystem/grpc-gateway

gRPC Web

- 透過 Reverse Proxy 處理 Client 傳送封包內容
- 傳送格式為 binary，速度較快，效能較好
- 對於一般前端開發支援較不友善

Microsoft STUDY4 Build School

gRPC Web



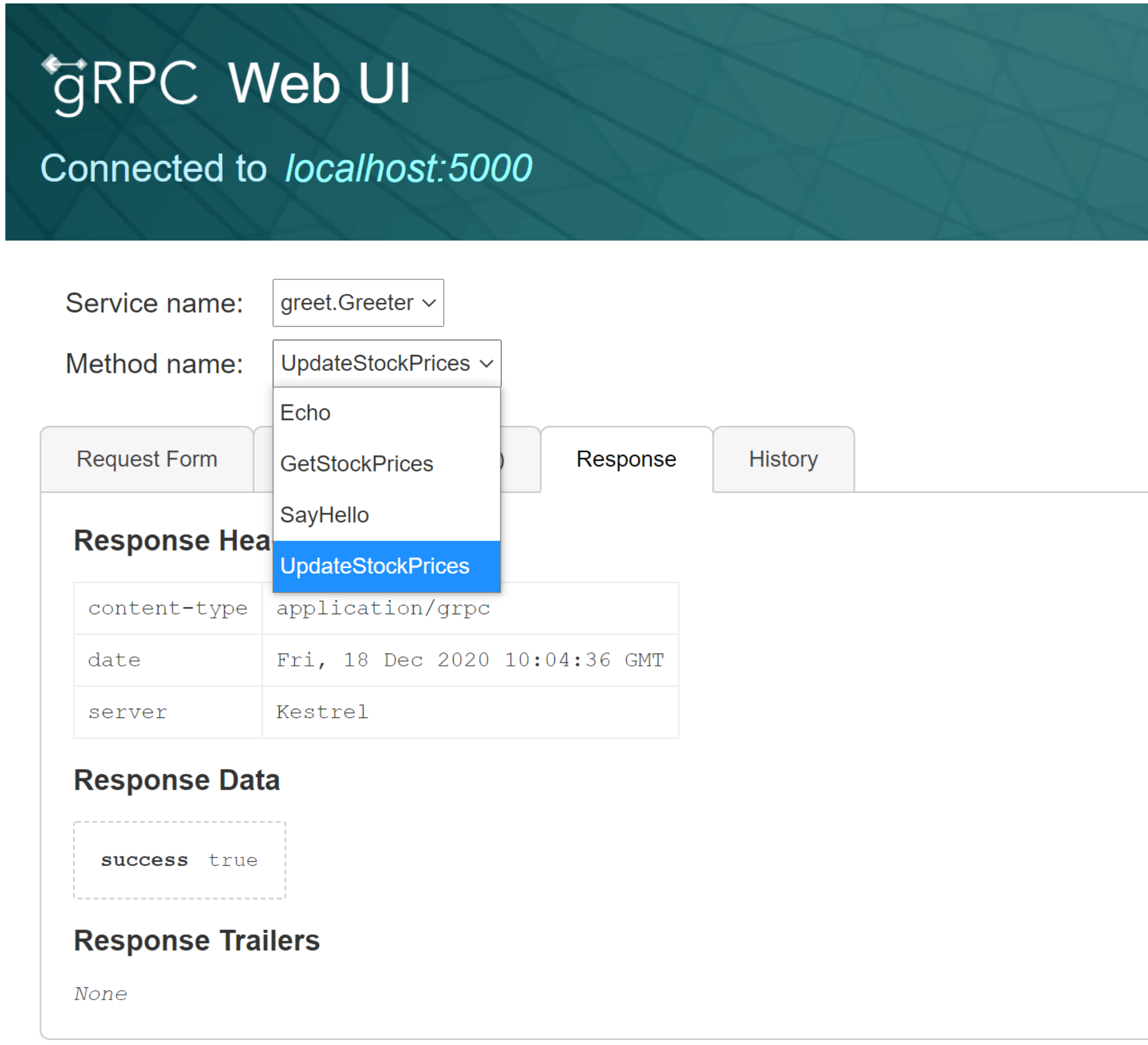
https://blog.envoyproxy.io/envoy-and-grpc-web-a-fresh-new-alternative-to-rest-6504ce7eb880

Microsoft STUDY4 Build School

gRPC UI

簡介 gRPC UI

- gRPC UI
- 提供 Web 介面與 gRPC 溝通
- 類似 Postman，但呼叫的是 gRPC


gRPC Web UI
Connected to *localhost:5000*
Service name: greet.Greeter
Method name: UpdateStockPrices
Echo
GetStockPrices
SayHello
UpdateStockPrices
Request Form
Response
History

Response Hea

content-type	application/grpc
date	Fri, 18 Dec 2020 10:04:36 GMT
server	Kestrel

Response Data

```
success  true
```

Response Trailers

None

.NET Core gRPC Server 設定

- 安裝套件
  - `dotnet add package Grpc.AspNetCore.Server.Reflection`
- `Startup.cs -> ConfigureServices()`
  - `services.AddGrpcReflection();`
- Startup.cs -> `Configure()`
  - endpoints.MapGrpcReflectionService();

啟動 gRPC UI

- 安裝 gRPC UI
  - https://github.com/fullstorydev/grpcui#installation
- 執行 gRPC UI
  - `grpcui -plaintext localhost:5000`

Microsoft STUDY4 Build School

DEMO

https://github.com/wellwind/dotnet-conf-2020-grpc-demo

Resources

Resources

- Documents
  - 開始使用 gRPC 服務
  - gRPC 版本策略
  - .NET Core gRPC Server
  - .NET Core gRPC Client
  - gRPC Web
  - gRPC HTTP API
  - gRPC Curl 與 gRPC UI
- Protocol Compilers
  - protoc
  - protoc-gen-grpc-web
- GitHub Sample
  - 今天的 DEMO
  - gRPC .NET Core Samples
  - gRPC Web Client Sample

Microsoft STUDY4 Build School

Thanks for joining!

Ask questions on Twitter using #dotNETConf

.NET Conf 2020

特別感謝

91APP Technical Network

Red Hat

KKTIX

JET BRAINS

HackMD

Microsoft® MVP Most Valuable Professional

Microsoft

Build School

STUDY4 為 學 習 而 生

以及各位參與活動的你們

Microsoft STUDY4 Build School

.NET Conf

探索 .NET 新世界