

# SESSION

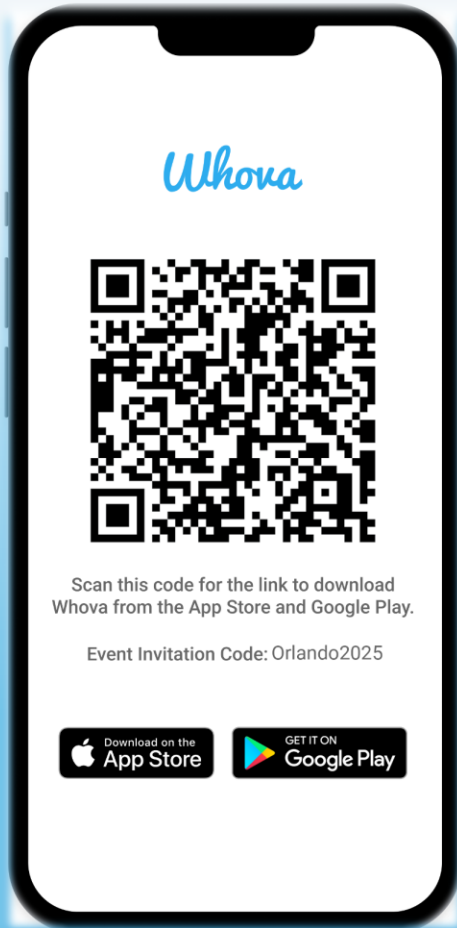
## The Background on Background Tasks in .NET 9

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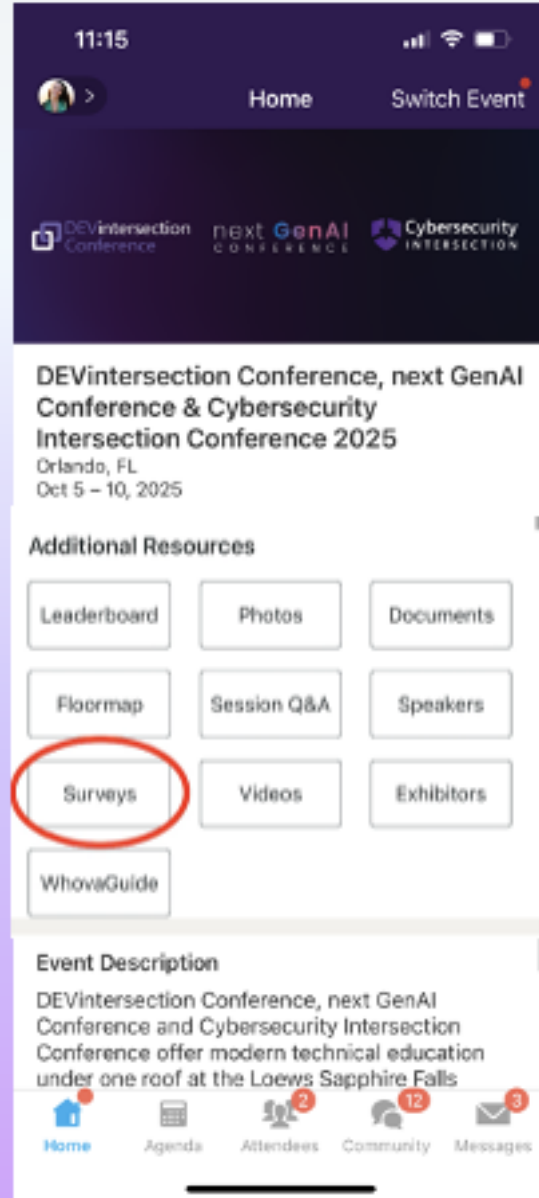
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*We really want to hear from YOU!*

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*Here's How -*

- *Simply go to the Whova App on your smartphone*
- *Scroll down on the Homepage to 'Additional Resources' to click "Surveys".*
- *Click Session Feedback.*
- *Scroll down to find this session title.*
- *Complete the session feedback survey.*
- *Finally, click 'Submit'*

*It's just that easy!*

# Audience

- .NET Developers
- In need of running a background task
- This is not a talk about how Tasks work in async/await

# Agenda

- What are background tasks/jobs?
- What type of problems are suitable for a background task/job?
- What options are out there?
  - IHostedService
  - BackgroundService
  - Worker Service
  - Hangfire
- Why would I choose one over the other?
- Deep dive into each
- Demos
- Questions

# Goal

- Know all your options for running background tasks
- Why choose one over another

# Who am I?

- Director of Engineering at [Lean TECHniques](#)
- [Microsoft MVP](#)
- [Dometrain Author](#)
- Redgate Community Ambassador
- Co-organizer of [Iowa .NET User Group](#)



# What problem do background tasks solve?

- Cron jobs
  - Process messages from a queue every X minutes
  - Clean up database or file system every X minutes
  - Send email notification every X minutes under certain circumstances
  - Refresh cache every X minutes
  - Check for updates to database every X minutes and push updates via SignalR
- Perform some CPU intensive work asynchronously
- Eventual consistency
- Re-train ML datasets



# Options

- IHostedService
- BackgroundService
- WorkerService
- Hangfire
- Cloud options



These options are  
kind of like  
baking cookies



COCONUT

BUTTER

FLOUR

# I Hosted Service

“Make Your Own Recipe”  
(Cookie Jar Included)

PECANS

BROWN  
SUGAR

EGGS

BAKING SODA

SALT

SUGAR

CHOCOLATE  
CHIPS

# What is an IHostedService?

- Lets you host a background job inside an ASP.NET Core App
  - ASP.NET Core app is your cookie jar
- Interface with StartAsync and StopAsync
- Raw, fundamental building block for other options
- Register via dependency injection and `services.AddHostedService<T>`



Demo

**COOKIE**  
**TASTE TEST**

# How does an IHostedService work?

- Register with DI
- StopAsync's cancellation token has 5 seconds to shutdown gracefully
- StopAsync might not be called if the app shuts down unexpectedly

```
services.AddHostedService<HostedServiceExample>();
```



# How does an IHostedService work?

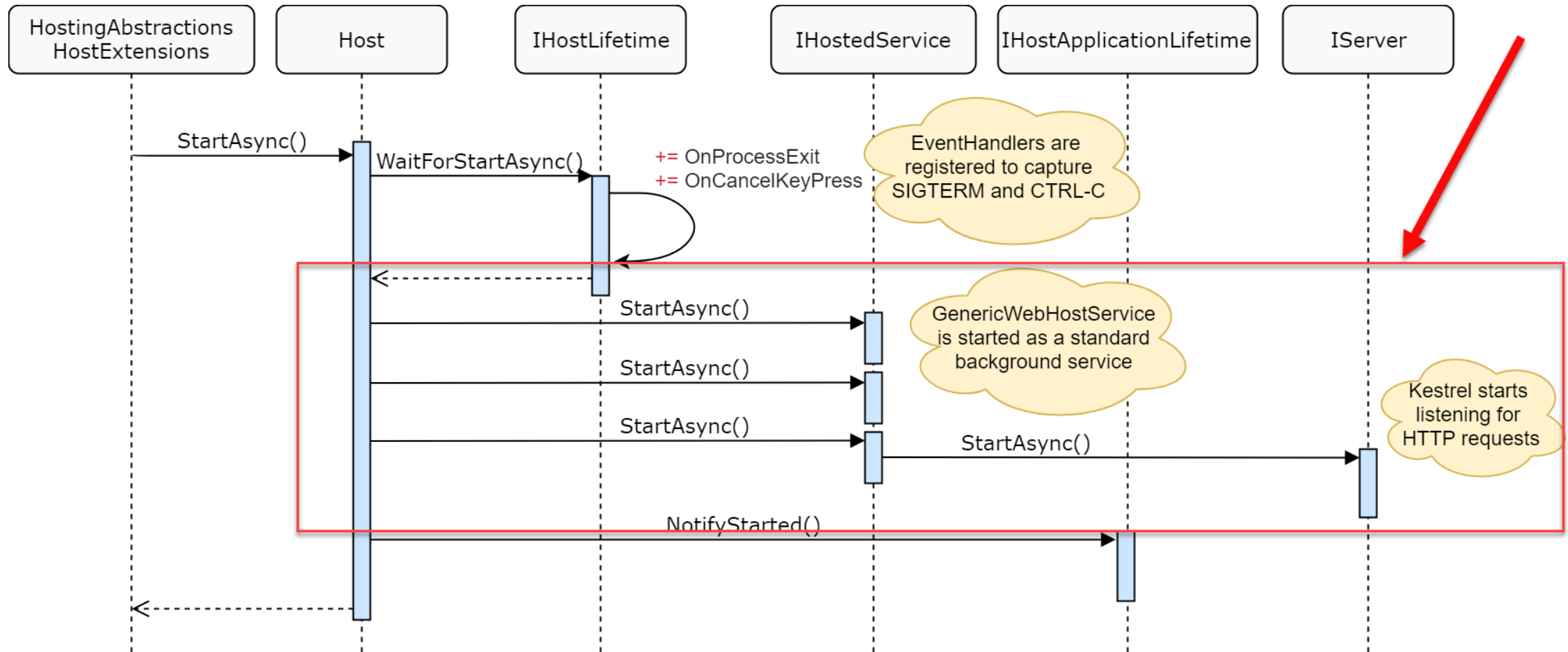


Image Credit: [Andrew Lock](#)

# How does an IHostedService work?

- StartAsync blocks the rest of your app from starting
- Push **blocking** long-running work out of StartAsync
  - This goes for BackgroundService later

## DO THIS

```
public Task StartAsync(CancellationTokentoken)
{
    LongRunningThingAsync(cancellationTokentoken);

    return Task.CompletedTask;
}
```

## NOT THIS

```
public async Task StartAsync(CancellationTokentoken)
{
    await LongRunningThingAsync(cancellationTokentoken);
}
```

- UNLESS, you truly don't want your app to boot until this finishes
  - i.e. Database Migrations



# When do I use IHostedService?

- You will implicitly use it with BackgroundService and Worker Services
- You need full control over Starting and Stopping
  - AND will not use the base BackgroundService implementation

# When do I NOT use IHostedService?

- Should be using BackgroundService or WorkerService 95%+ of the time
- Other reasons will be the same as BackgroundService (next)

# BackgroundService

“Follow The Recipe”  
(Cookie Jar Included)



# What is a BackgroundService?

- Lets you host a background job inside an ASP.NET Core App
  - ASP.NET Core app is your cookie jar
- Abstract class, implements IHostedService
- Exposes ExecuteAsync abstract method
- Handles Starting and Stopping



Demo

**COOKIE**  
**TASTE TEST**

# How does a BackgroundService work?

- Register with DI `services.AddHostedService<BackgroundServiceExample>();`
- Exposes ExecuteAsync abstract method
- Can still override StartAsync and StopAsync

```

public abstract class BackgroundService : IHostedService, IDisposable
{
    private Task _executingTask;
    private readonly CancellationTokenSource _stoppingCts = new CancellationTokenSource();

    1 usage 1 override
    protected abstract Task ExecuteAsync(CancellationToken stoppingToken);

    public virtual Task StartAsync(CancellationToken cancellationToken)
    {
        // Store the task we're executing
        _executingTask = ExecuteAsync(_stoppingCts.Token);

        // If the task is completed then return it, this will bubble cancellation and failure to the caller
        if (_executingTask.IsCompleted)
        {
            return _executingTask;
        }

        // Otherwise it's running
        return Task.CompletedTask;
    }

    public virtual async Task StopAsync(CancellationToken cancellationToken)
    {
        // Stop called without start
        if (_executingTask == null)
        {
            return;
        }

        try
        {
            // Signal cancellation to the executing method
            _stoppingCts.Cancel();
        }
        finally
        {
            // Wait until the task completes or the stop token triggers
            await Task.WhenAny(
                params tasks: _executingTask, Task.Delay(Timeout.Infinite, cancellationToken));
        }
    }

    public virtual void Dispose()
    {
        _stoppingCts.Cancel();
    }
}

```

# When do I use BackgroundService?

- Need a simple background task runner
  - Either as part of your ASP.NET Core application or by itself
- Less gotchas than IHostedService
  - Can't accidentally prevent app from booting unless override StartAsync
  - Handles cancellations
- Want an ASP.NET Core endpoint to health check your background task
  - Instead of WorkerServices



# When do I NOT use BackgroundService?

- Too much co-location with your app/API can get unruly and outweigh the convenience of co-location
  - It Depends
- Scaling out can be a problem if your code isn't idempotent
  - Fix by making code idempotent or not allowing scale out

# WorkerService

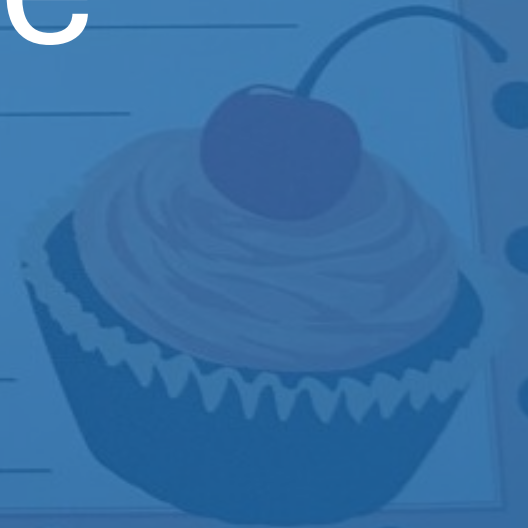
## “Follow The Recipe” (BYO Cookie Jar)

*A Recipe For Chewy Chocolate Chip Cookies*

325° F

*Ingredients ~ for 16 large cookies*

- 2 1/4 c. flour (spooned & leveled)
- 1 tsp. baking soda
- 1 1/2 tsp. corn starch
- 1/2 tsp. salt
- 3/4 unsalted butter (melted)
- 3/4 c. brown sugar (loosey packed)
- 1/2 c. granulated sugar
- 1 egg + egg yolk
- 2 tsp. vanilla
- 1 c. choc. and white choc. chips



# What is a WorkerService?

- Enhanced .NET Console App template
  - `dotnet new worker -o my-custom-worker`
- Allows you to have an `IHost`
  - Configuration, Dependency Injection, Logging, etc.
- Registers a `Worker` class as a `HostedService`
- Does not take an opinion on how to host console app
  - No cookie jar
  - Console app called from scheduler
  - Windows Service
  - `systemd`




Demo

**COOKIE**  
**TASTE TEST**

# How does a WorkerService work?

- Project Sdk of Microsoft.NET.Sdk.Worker
- PackageReference to Microsoft.Extensions.Hosting

```
<Project Sdk="Microsoft.NET.Sdk.Worker">  
  <PropertyGroup>  
    <TargetFramework>net9.0</TargetFramework>  
    <ImplicitUsings>enable</ImplicitUsings>  
    <Nullable>enable</Nullable>  
  </PropertyGroup>  
  
  <ItemGroup>  
    <PackageReference Include="Microsoft.Extensions.Hosting" Version="9.0.0" />  
    <PackageReference Include="Microsoft.Extensions.Hosting.Systemd" Version="9.0.0" />  
    <PackageReference Include="Microsoft.Extensions.Hosting.WindowsServices" Version="9.0.0" />  
  </ItemGroup>  
  
  <ItemGroup>  
    <ProjectReference Include="..\Shared\Shared.csproj" />  
  </ItemGroup>  
</Project>
```



# How do I host WorkerServices?

- Scheduler calls Console App
  - Windows Scheduled Tasks, k8s cron jobs, Azure Logic Apps, AWS Scheduled Tasks, GCP Cloud Scheduler
- Windows Service or Systemd (Windows or Linux)

```
public static IHostBuilder CreateHostBuilder(string[] args) =>
    Host.CreateDefaultBuilder(args)
        .UseWindowsService() // Microsoft.Extensions.Hosting.WindowsService
        .UseSystemd() // Microsoft.Extensions.Hosting.Systemd
        .ConfigureServices((hostContext, services) => { services.AddHostedService<Worker>(); });
```

Pick one

# When do I use WorkerServices?

- Want an out-of-proc way of running background tasks
- Prefer hosting background services outside of a web app
  - Avoid app pool recycles
- Natural migration for a full .NET framework Windows Service

# When do I NOT use WorkerServices?

- Prefer deploying as a web app
- Want to co-locate with existing web app/API
- Want a healthcheck endpoint





# Hangfire

“Buy pre-packaged cookies”

# What is Hangfire?

- Full featured library for running jobs in ASP.NET Core
  - Free for commercial use but paid if you want support (\$500-\$4500/yr)
- Comes with UI for monitoring and history
- Supports Cron and ad-hoc running of jobs
- Allows for continuations
- Automatic retries
- Supports concurrency limiting
- Persists job state to database



Demo

**COOKIE**  
**TASTE TEST**

# How does Hangfire work?

- Serializes method call and all arguments
- Creates background job based on that information
- Saves job to persistent storage
- Starts background job if immediate

# When do I use Hangfire?

- Want to host jobs in ASP.NET Core
- Need features Hangfire offers
- Don't want to write plumbing code
- Ok with relying on a 3<sup>rd</sup> party library

# When do I NOT use Hangfire?

- Do not want to host jobs in ASP.NET Core
- Have basic needs and do not need Hangfire's features
- Do not want to rely on 3<sup>rd</sup> party library
- More control over what happens

# Cloud options

- Azure Functions
- Azure WebJobs
- AWS Lambdas
- GCP Cloud Scheduler + Cloud Functions
- Didn't cover these to avoid cloud specific

# Takeaways

- Awareness to all the options available to you
- More information to make the best decision for you and your company



# Resources

- <https://docs.microsoft.com/en-us/dotnet/architecture/microservices/multi-container-microservice-net-applications/background-tasks-with-ihostedservice>
- <https://www.hangfire.io/>
- <https://app.pluralsight.com/library/courses/building-aspnet-core-hosted-services-net-core-worker-services/>
- This slide deck

# Questions?

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Add me on LinkedIn:



<https://bit.ly/scottsauer>

Slides at [scottsauer.com](https://scottsauer.com)

# Thanks!

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