Top Performance

For Angular & .NET Core Applications

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Hi, I'm J.

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What We’ll Cover

- This Introduction
- 12 Angular Performance Tips
- 14 .NET Core (.NET 5) Performance Tips

Ask questions at any time

What We WON'T Cover

- Angular basics

  angular.io/docs

- .NET 5/Core Basics

  dotnet.microsoft.com/learn

If You Give $250, So Will I!

bit.ly/wi-water

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"4/4 Stars"
- CharityNavigator.org

charity: water

Angular

Performance Tips

CDN Hosting Tips

- Blob storage + CDN = Fast, cheap web site
- CDNs also allow localized delivery
- CDN rules allow
  - HTTP-to-HTTPS redirect
  - URL Rewrite rule for Angular routes
- Very inexpensive to use

OnPush Change Detection

- ChangeDetectionStrategy.Default is the default
- ChangeDetectionStrategy.OnPush is faster, but trickier
  - DOM events
  - Properties marked as @Input() in Component

```
@Component({
    changeDetection: ChangeDetectionStrategy.OnPush
})
```

Avoid Functions in Templates

- Except event handlers like click
- Instead of:

```
<div [class.some-class]="someHeavilyHitFunction()">
     {{anotherHeavilyHitFunction()}}
</div>
```

- Use:

```
<div [class.some-class]="someProp">
     {{anotherProp}}
</div>
```

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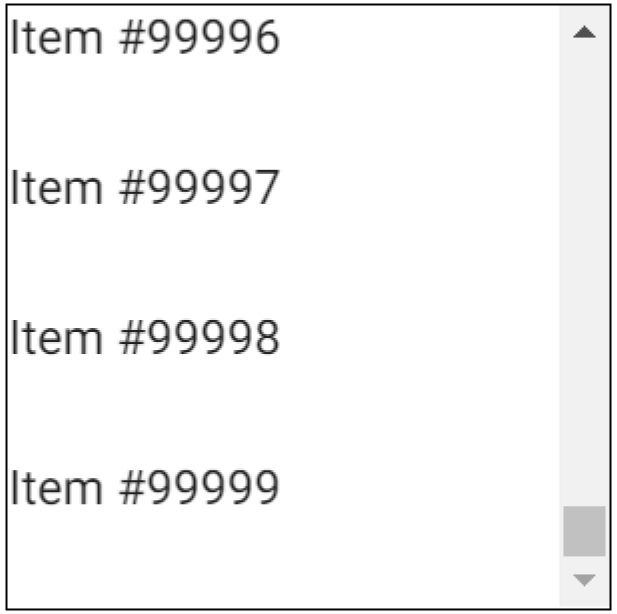
Lazy Load Modules

- Monolithic bundle → multiple on-demand downloads
- Initial app load time
- Lazy loading libraries

```
const routes: Routes = [
  { path: 'first-component', component: FirstComponent },
  {
    path: 'second-component',
    loadChildren: () => import('./second/second.module').then(m => m.SecondModule)
  }
];
```

Lazy Loading/Rendering

- Infinite scroll / virtual scroll
- Components often include have some specific lazy-loading features https://material.angular.io/cdk/scrolling/overview
- Example: render popup only when a user clicks on it


Item #99996
Item #99997
Item #99998
Item #99999

Browser Events Handling

- Some browser events like scroll generate many events per second
- Consider using rxjs operators: **debounceTime**, **auditTime**, **throttleTime**

Use Pure Pipes

- Deterministic - same inputs, same output
- Angular skips redundant change detection run

```
@Pipe({
    name: 'filterPipe’,
    pure: true
})
export class FilterPipe {}
```

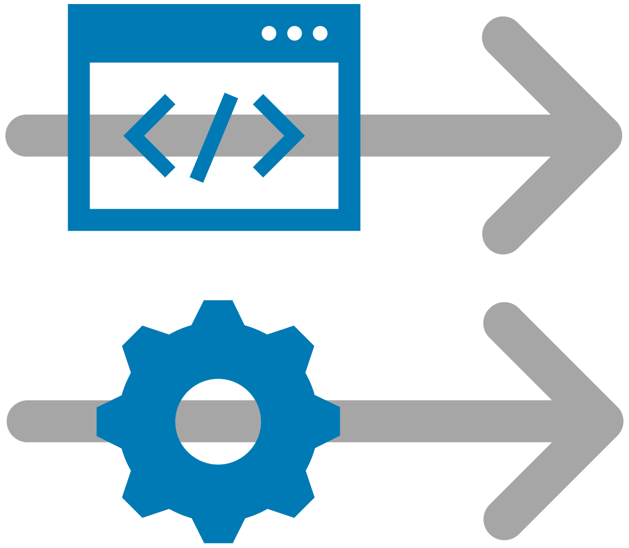
Web Workers for Heavy Processing

- JS runs on UI thread
- Web workers run on separate thread

```
var myWorker = new Worker('worker.js');
myWorker.postMessage(...);
```

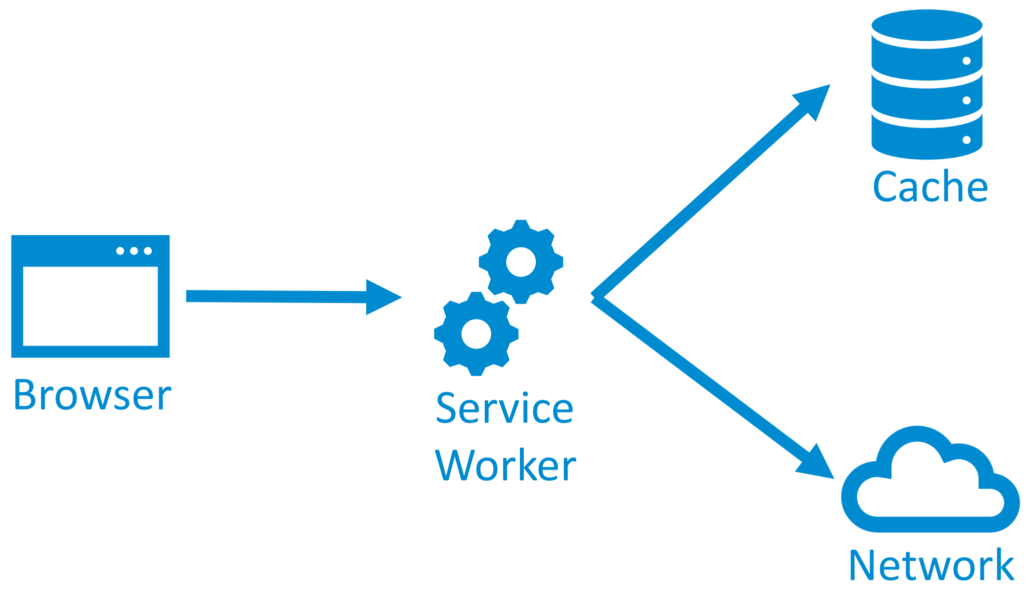
worker.js

```
onmessage = function(e) {
    // do work with e.data
}
```



Service Workers

- Middleware
- No DOM access
- Can cache application assets, API responses etc.
- Customize caching logic



Use CSS Animations Carefully

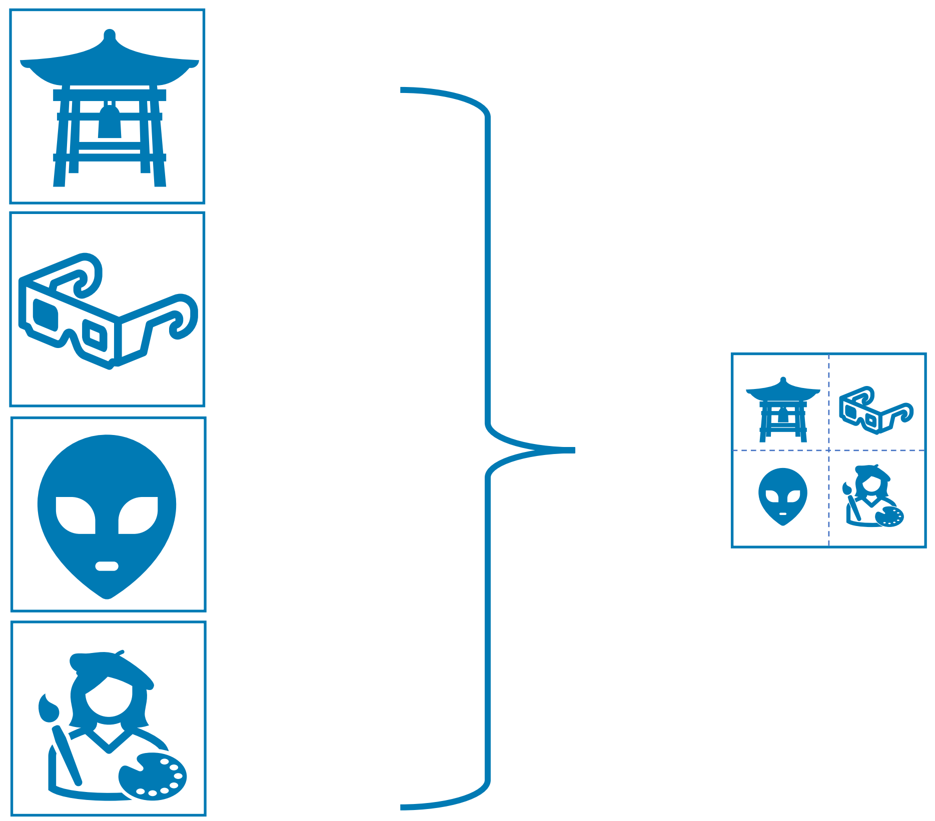
1. Affect a page layout (width, height, padding, margin, etc.)
2. Affects only a single element (transform, opacity, color)

Use CSS Animations Carefully

1. ~~Affect a page layout (width, height, padding, margin, etc.)~~ SLOW
2. Affects only a single element (transform, opacity, color)

Combine Icons Into a Sprite

- Loads fewer image files
- Icons appear immediately
- npm packages
  - svg-sprite
  - node-sprite-generator



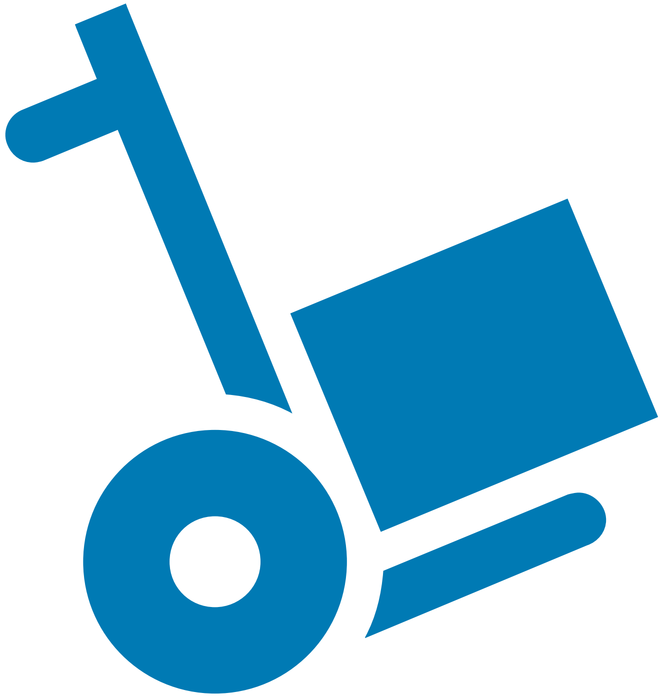
Third Party Libraries

- Remove unused libraries
- Lodash-es vs Lodash
- Remove Moment.js localization data (~300KB)

.NET 5 (Core)

Performance Tips

Move to .NET Core (.NET 5)



What is .NET Core?

- Fast, modern, cross-platform version of .NET
- Future of .NET – .NET Core is now just called .NET
- No new .NET Framework development after v 4.8.x

Why Migrate

- Performance – major memory and processing improvements
- Ongoing support
- Modernized code base

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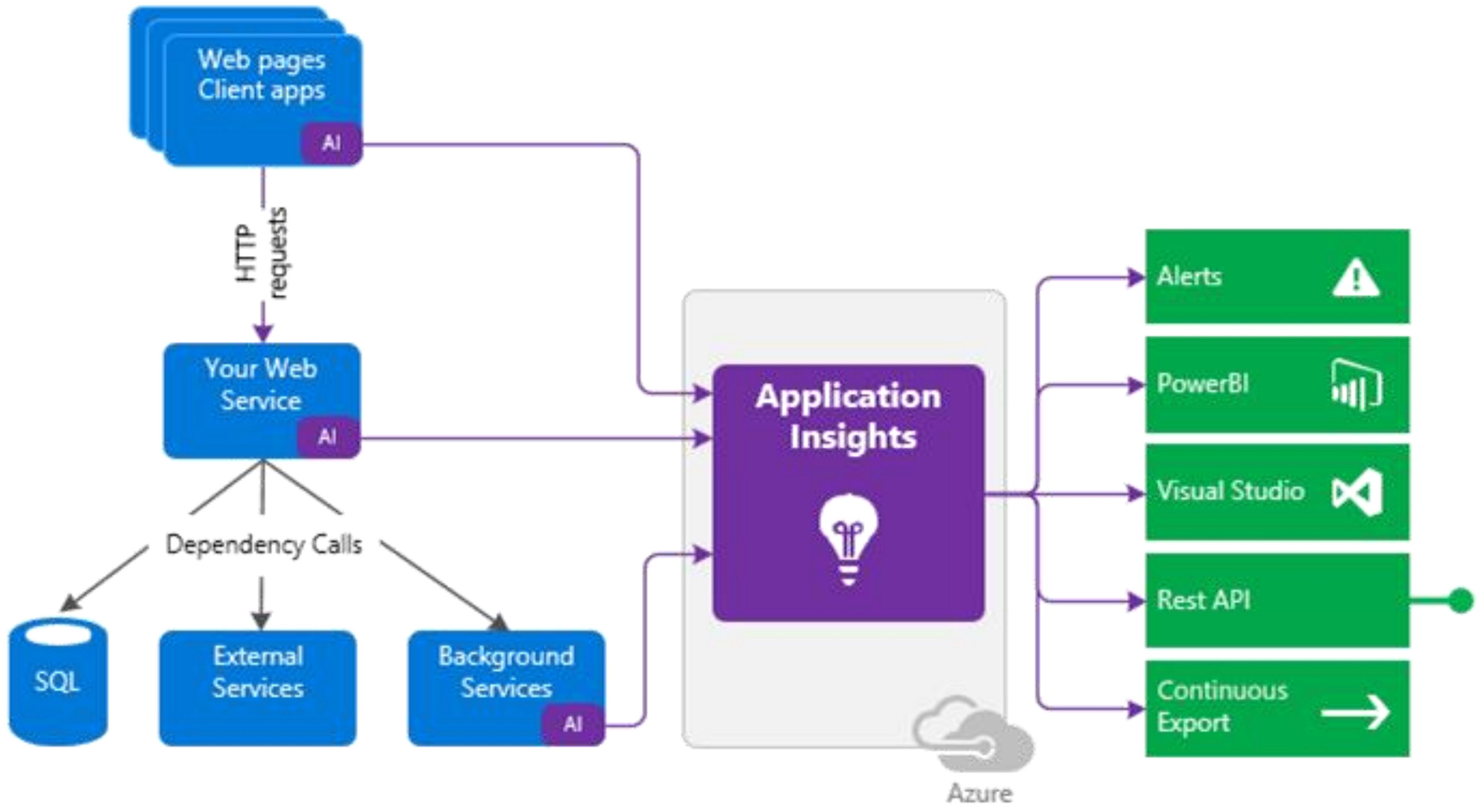
Application Insights

1. Request rates, response times, and failure
2. Dependency rates, response times, and failure rates
3. Exception logs with stack trace
4. Page views and load performance
5. User and session counts
6. Performance counters - Windows and Linux
7. Diagnostic trace logs
8. Custom events



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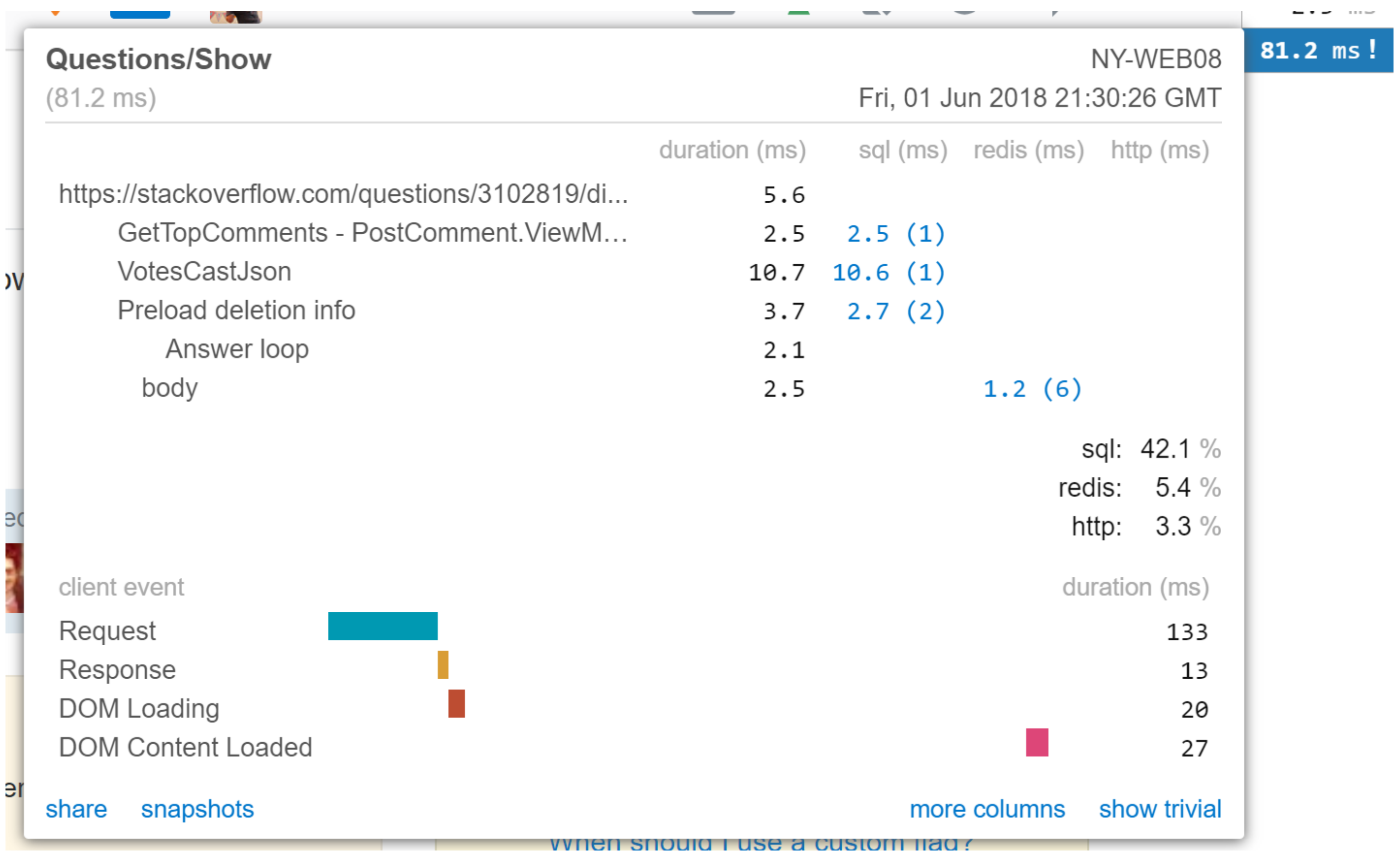
MiniProfiler

- Simple. Fast. Pragmatic. Useful.
- SQL profiler for all ADO.NET, LINQ-to-SQL, and Entity Framework queries
- Step instrumentation to add to code you want to profile—doesn't attach to every single method call automatically



Questions/Show NY-WEB08
(81.2 ms) Fri, 01 Jun 2018 21:30:26 GMT

	duration (ms)	sql (ms)	redis (ms)	http (ms)
https://stackoverflow.com/questions/3102819/di...	5.6			
GetTopComments - PostComment.ViewM...	2.5	2.5 (1)		
VotesCastJson	10.7	10.6 (1)		
Preload deletion info	3.7	2.7 (2)		
Answer loop	2.1			
body	2.5		1.2 (6)	

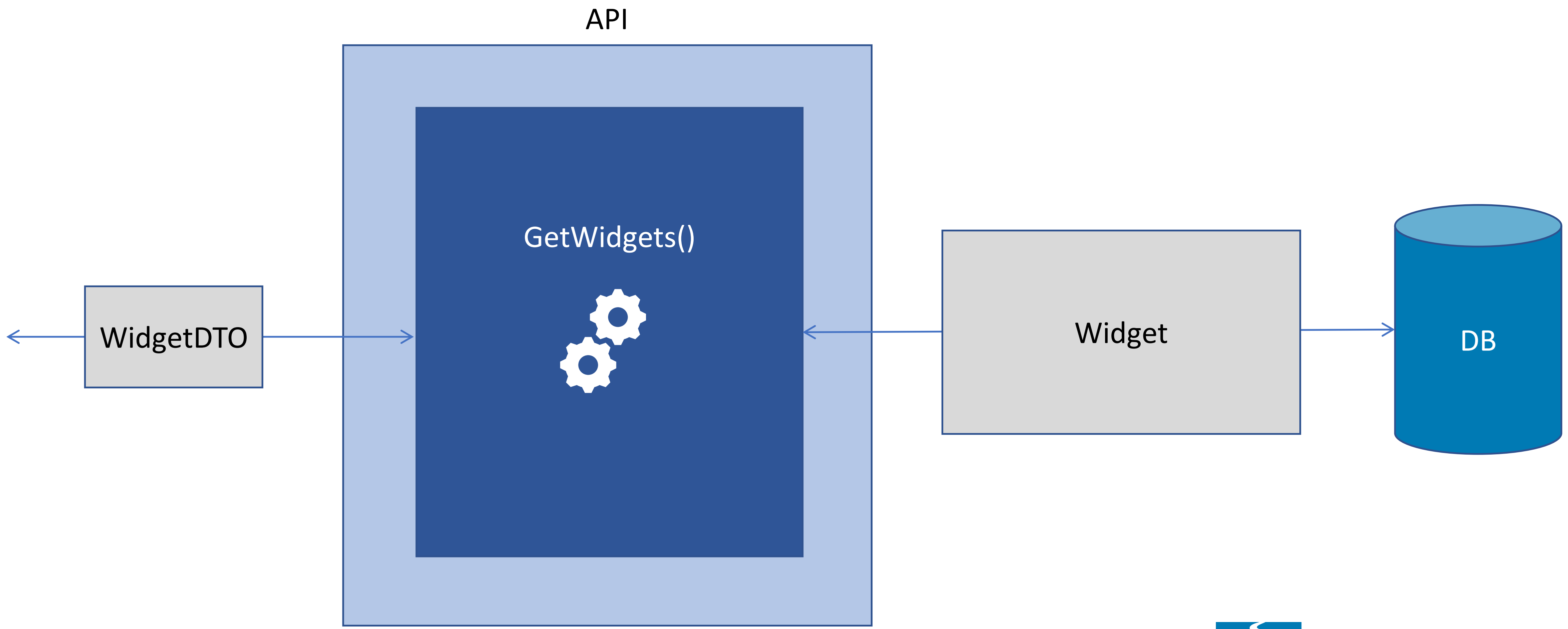
sql: 42.1 %
redis: 5.4 %
http: 3.3 %

client event	duration (ms)
Request	133
Response	13
DOM Loading	20
DOM Content Loaded	27

DTO Width and AutoMapper

- Change query to get fewer columns
- Use Automapper to map model to DTO with fewer columns

Reduce DTO Width with AutoMapper



Half-Way Check

bit.ly/wi-water

"charity:water is a non-profit organization that provides clean and safe drinking water to people in developing nations. The organization was founded in 2006 and has helped fund 22,936 projects in 24 countries, benefiting over 4.6 million people." - Wikipedia

"4/4 Stars"
- CharityNavigator.org

charity: water

Reduce DTO Width with AutoMapper

- Matching properties by name and type
- Recursive
- Simple custom mappings

Reduce DTO Width with AutoMapper

```
// globally once
var config = new MapperConfiguration(cfg =>
    cfg.CreateMap<Widget, WidgetDto>());
var mapper = config.CreateMapper();

// anywhere in your code
var dto = mapper.Map<WidgetDto>(myWidget);
```

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Use Entity Framework or Not?

Entity Framework Core *can* be good perf choice

EF also encourages some bad architectures and developer habits

Micro ORMs like Dapper can simplify data access and get you "closer to the metal"

Dapper – Micro ORM

```
var dog = cn.QueryFirstOrDefault<Dog>(
    @"SELECT * FROM Dog WHERE Id = @Id",
    new { Id = 123 });

var count = cn.Execute(
    @"INSERT INTO MyTable(a, b) VALUES (@a, @b)",
    new { a = "sample", b = 123 });
```

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Tips for Using Entity Framework

- Know the difference between **IQueryable** and **IEnumerable**
- Use AutoMapper's **ProjectTo** method
- Disable lazy loading (default in EF Core)
- Use **AsNoTracking()**

Tips for All SQL Queries

- Minimize column-width of queries
- Batch data deletion and updates
- Don't double-dip
- Pre-stage data
- Don't do negative searches
- Make sure all JOIN columns are indexed

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Faster JSON Serialization

New, faster JSON serializer in .NET Core: **System.Text.Json**

Scenario	Speed	Memory
Deserialization	2x faster	Parity or lower
Serialization	1.5x faster	Parity or lower
Document (read-only)	3-5x faster	~Allocation free for sizes < 1 MB
Reader	2-3x faster	~Allocation free (until you materialize values)
Writer	1.3-1.6x faster	~Allocation free

Source https://devblogs.microsoft.com/dotnet/try-the-new-system-text-json-apis

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Log Carefully

- In production:
  - Beware Trace or Information levels
  - Log Warning to Critical levels
- In development:
  - Set to Warning
  - Add Trace or Information for troubleshooting

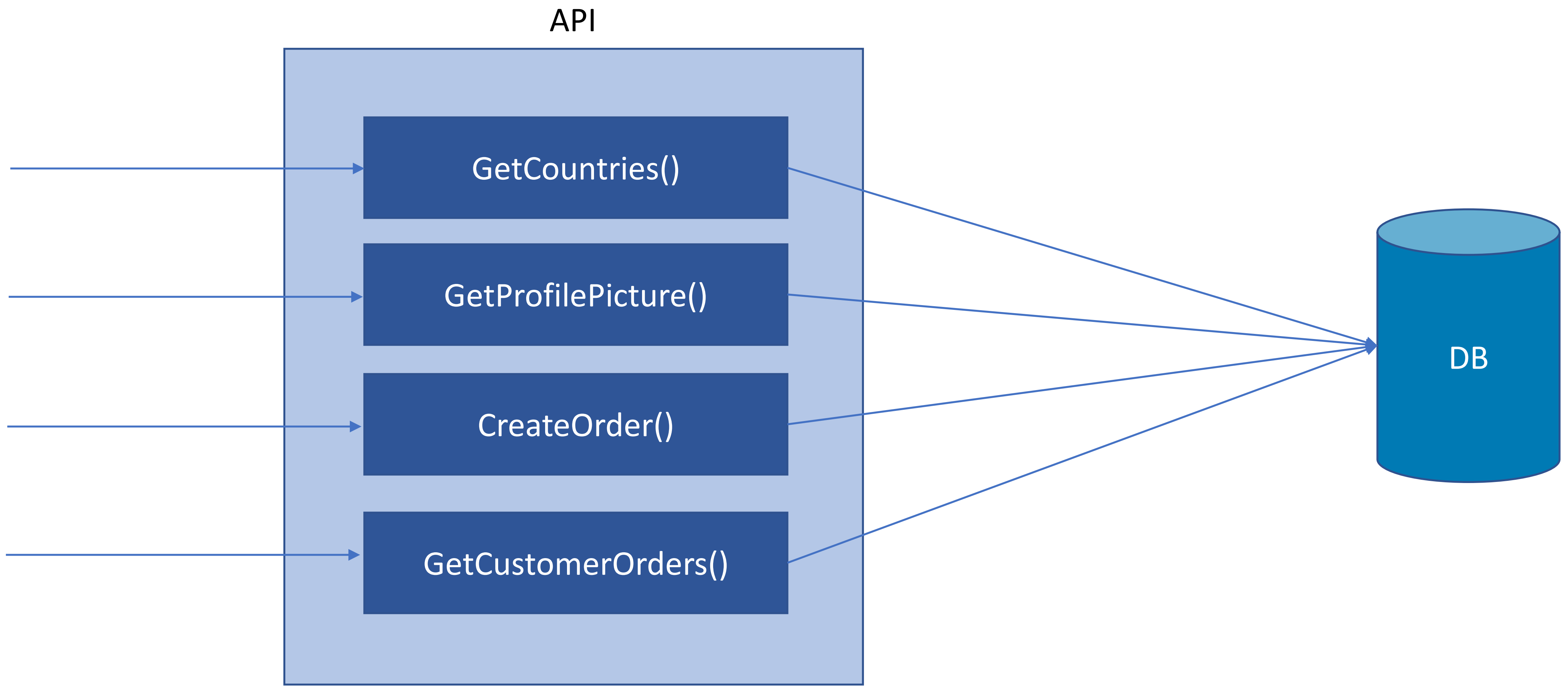
Memory Caches

- Data store focused on **unique queries** and **writes**
- Cache for **fast retrieval** of **common**, and **infrequently changing** data
- Useful caching servers

NCache®
Distributed Cache for .NET

redis

Caching Sample



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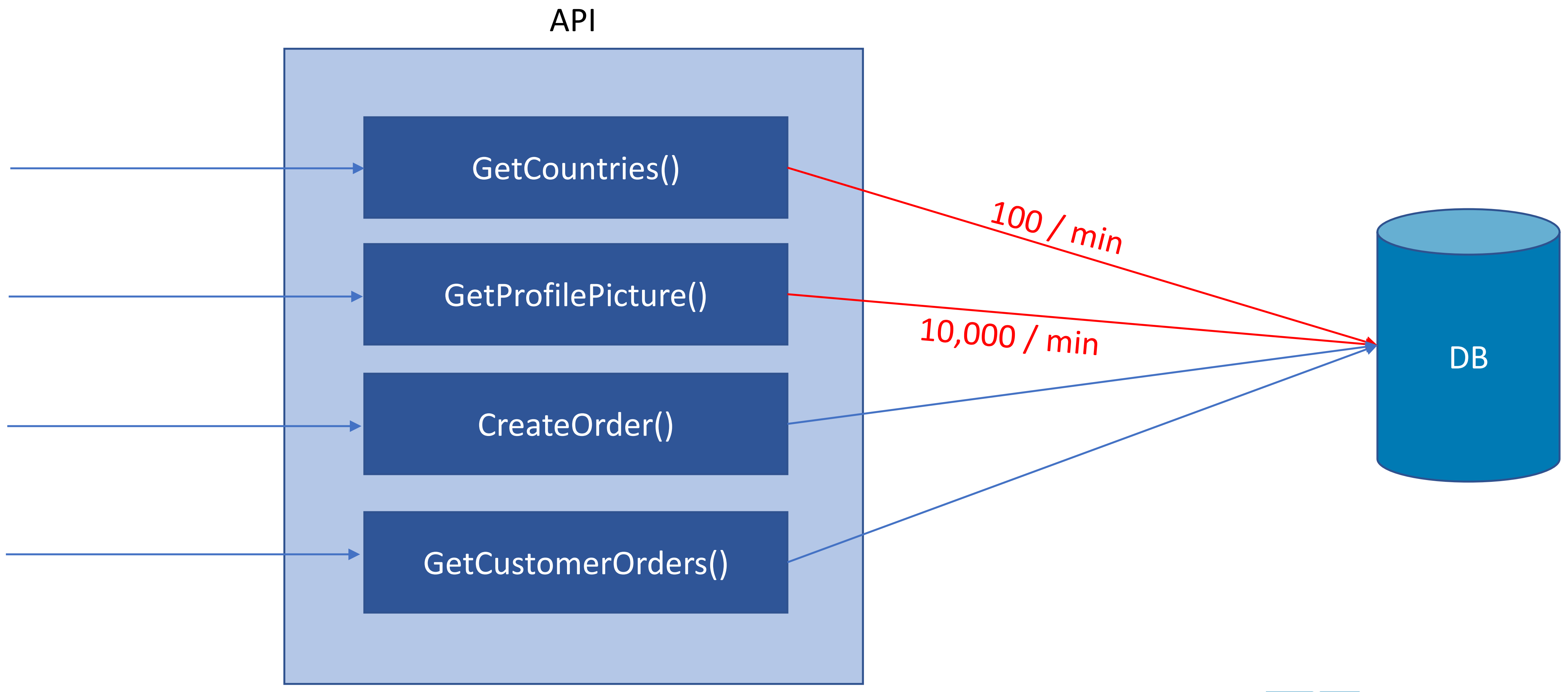
Caching Sample



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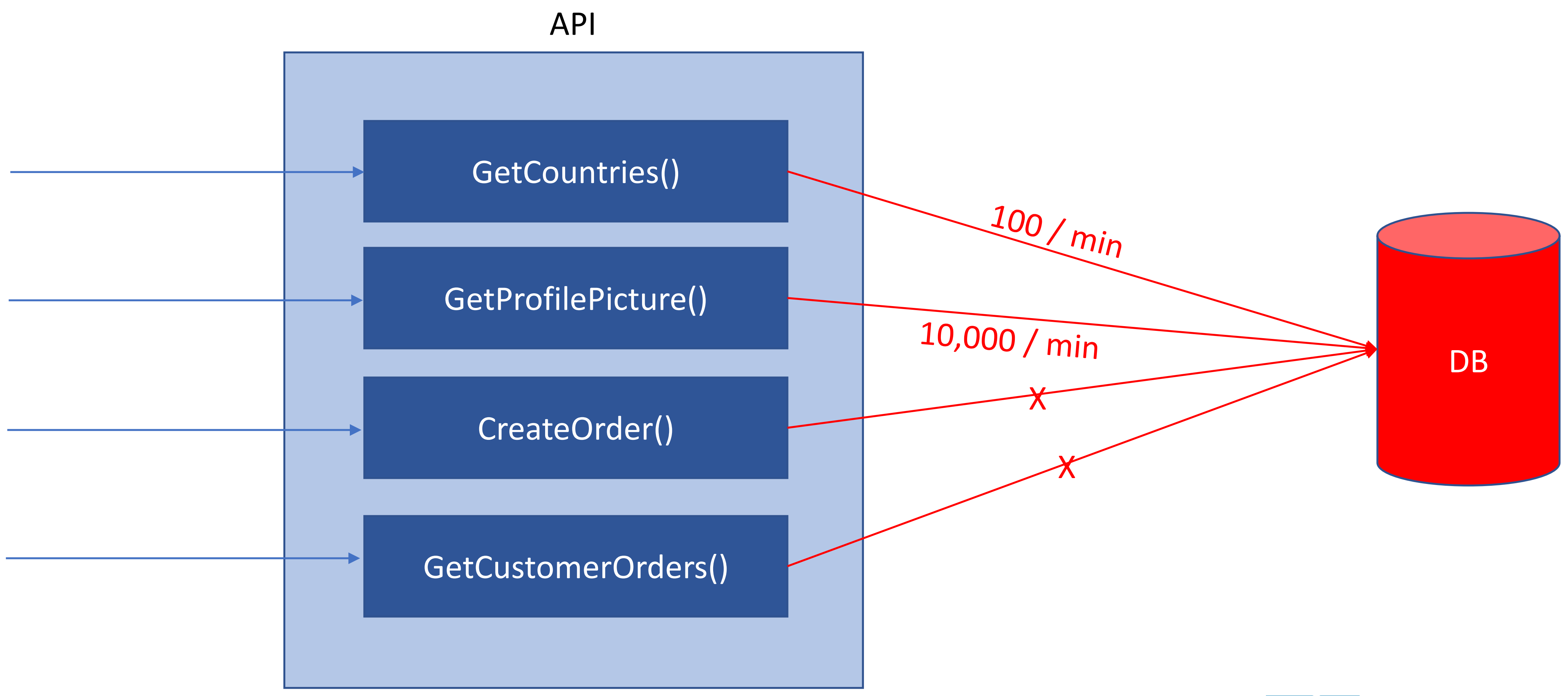

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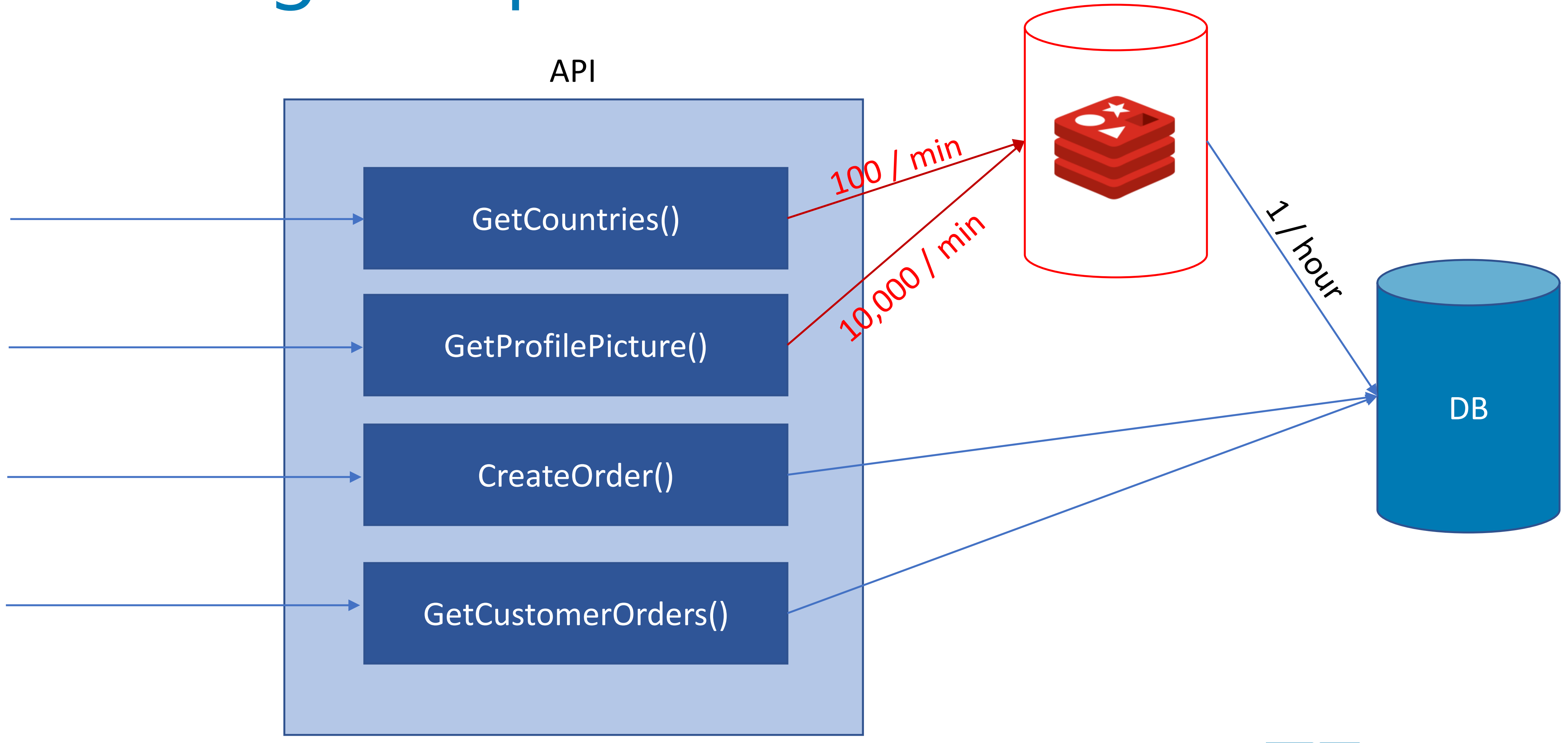

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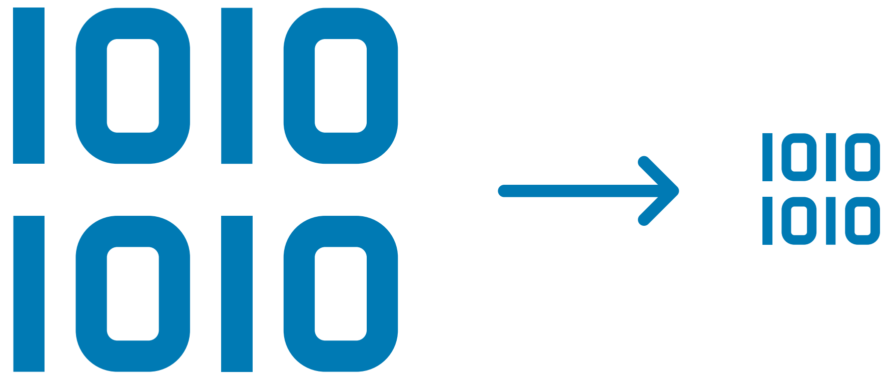
Response Compression



+ Faster network transfers

- More processor load

- GZip
  - ~ 95% compression
- Brotli
  - ~15% more compression than GZip
  - ~20% faster than GZip

Response Compression

```
public class Startup
{
    public void ConfigureServices(IServiceCollection services) {
        // adds compression services to injection
        services.AddResponseCompression();
    }

    public void Configure(IApplicationBuilder app, IHostingEnvironment env)
    {
        // middleware
        app.UseResponseCompression(); // <-- at the top of the middleware stack
    }
}
```

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Async/Await

```
[HttpGet("sync")]
public IActionResult Get() { }

[HttpGet("async")]
public async Task<IActionResult> AsyncGet() { }
```

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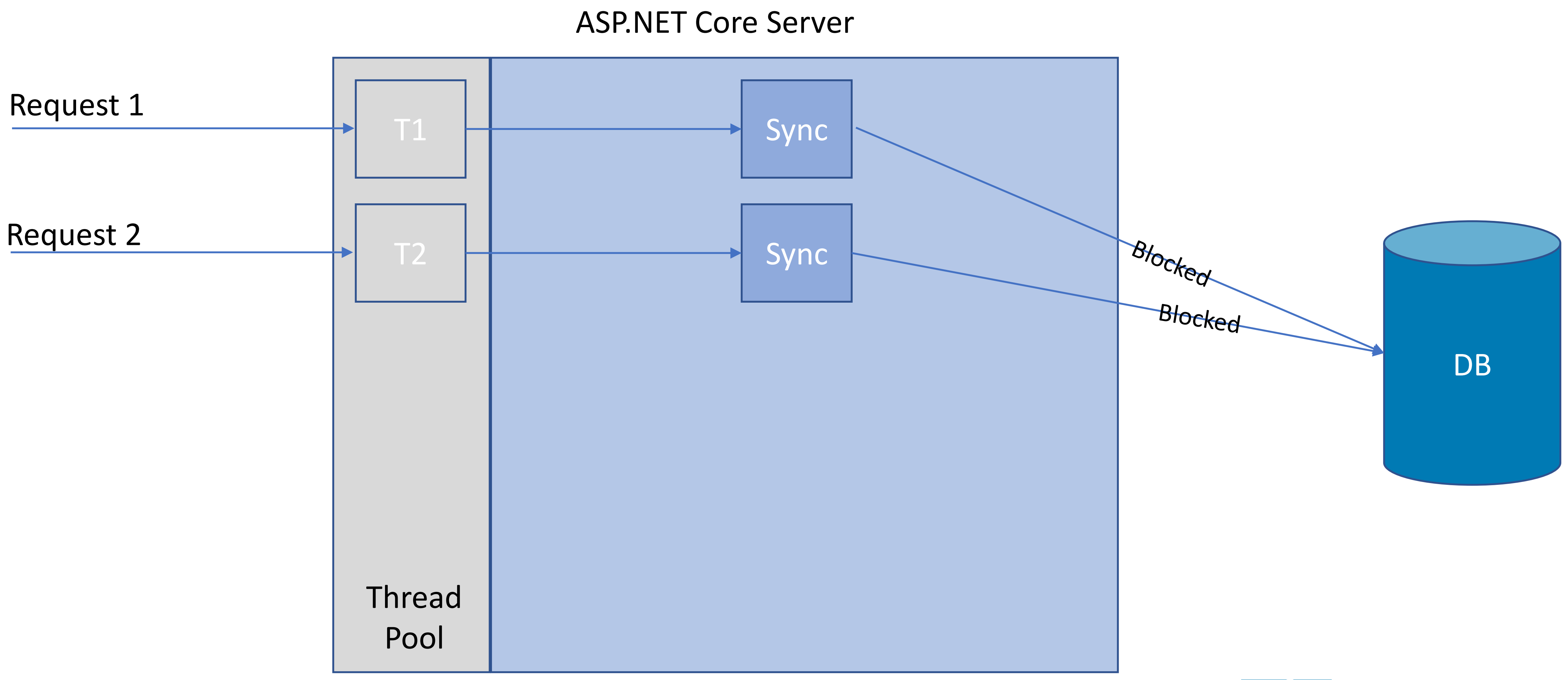
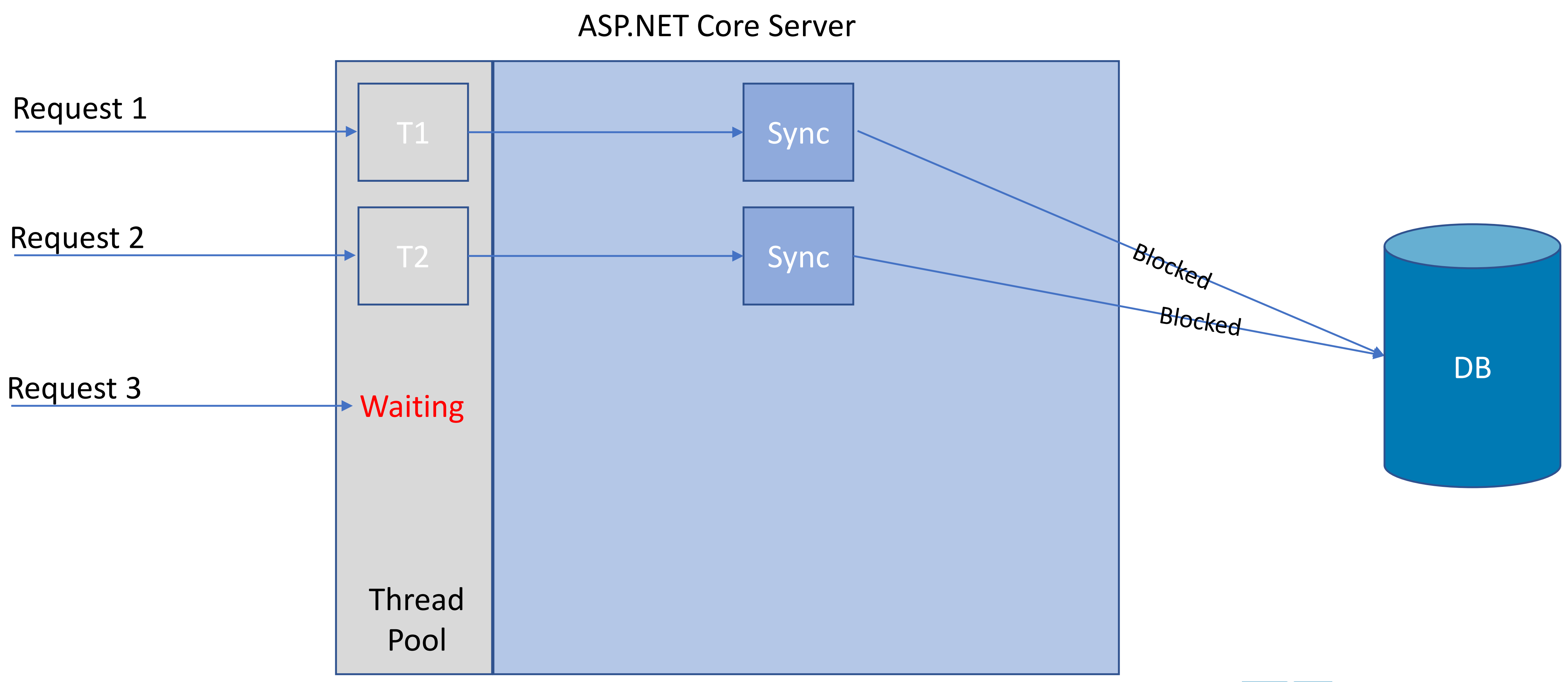
Async/Await Example



Async/Await Example



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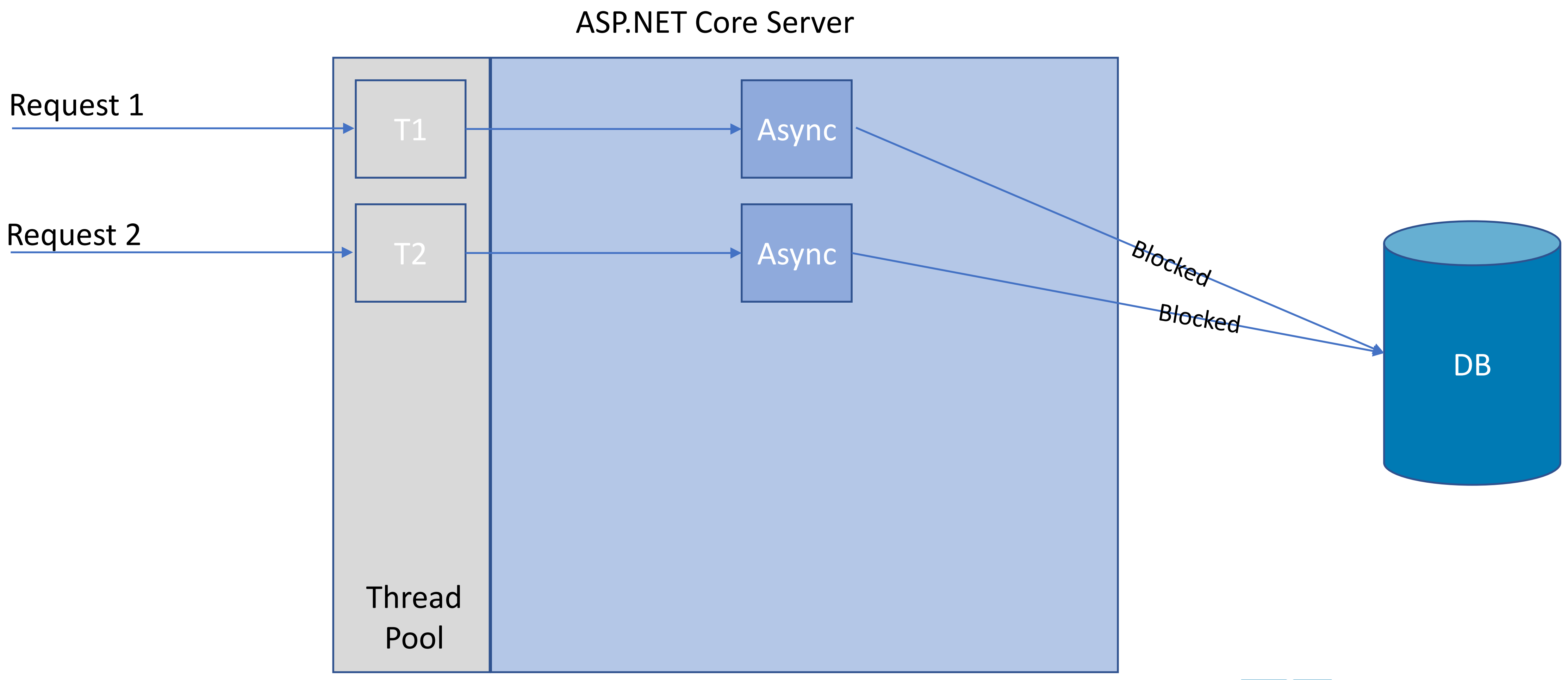
Async/Await Example



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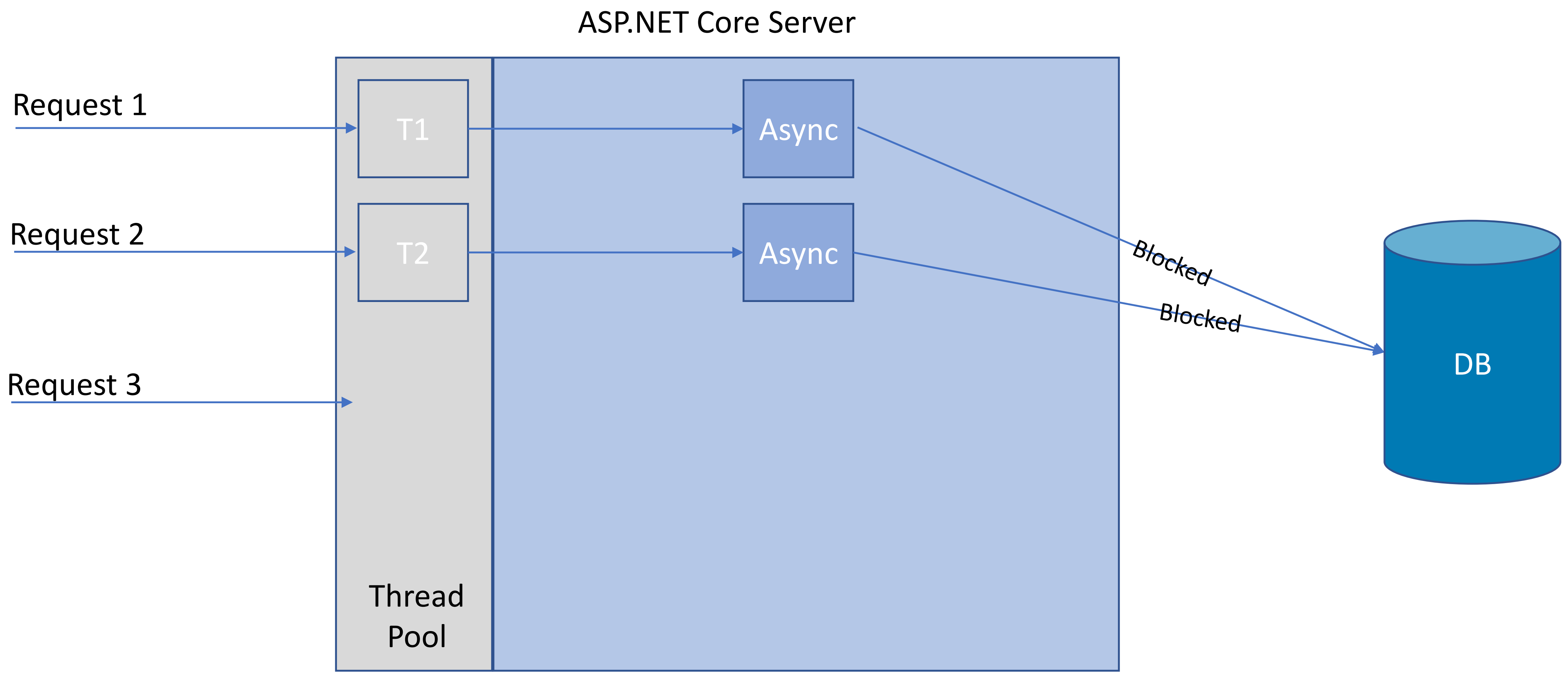

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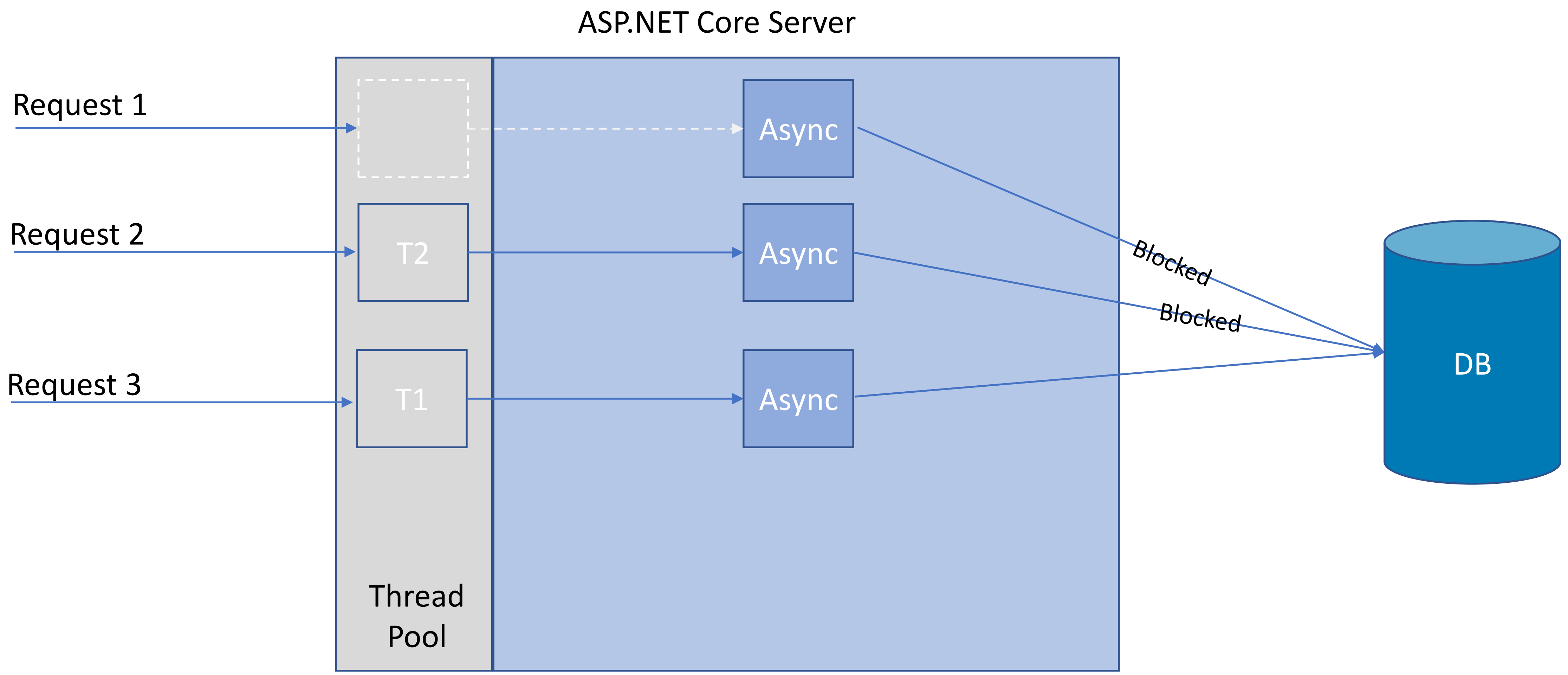

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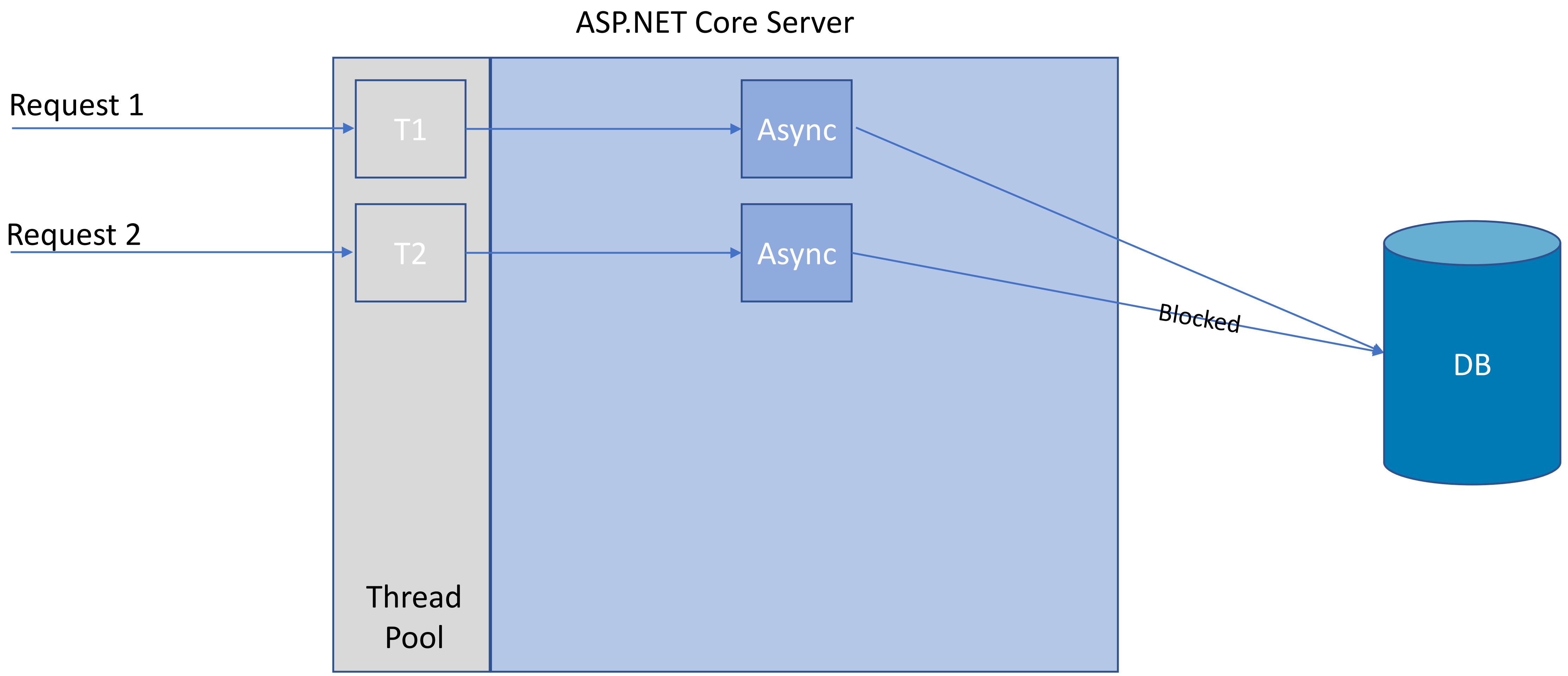
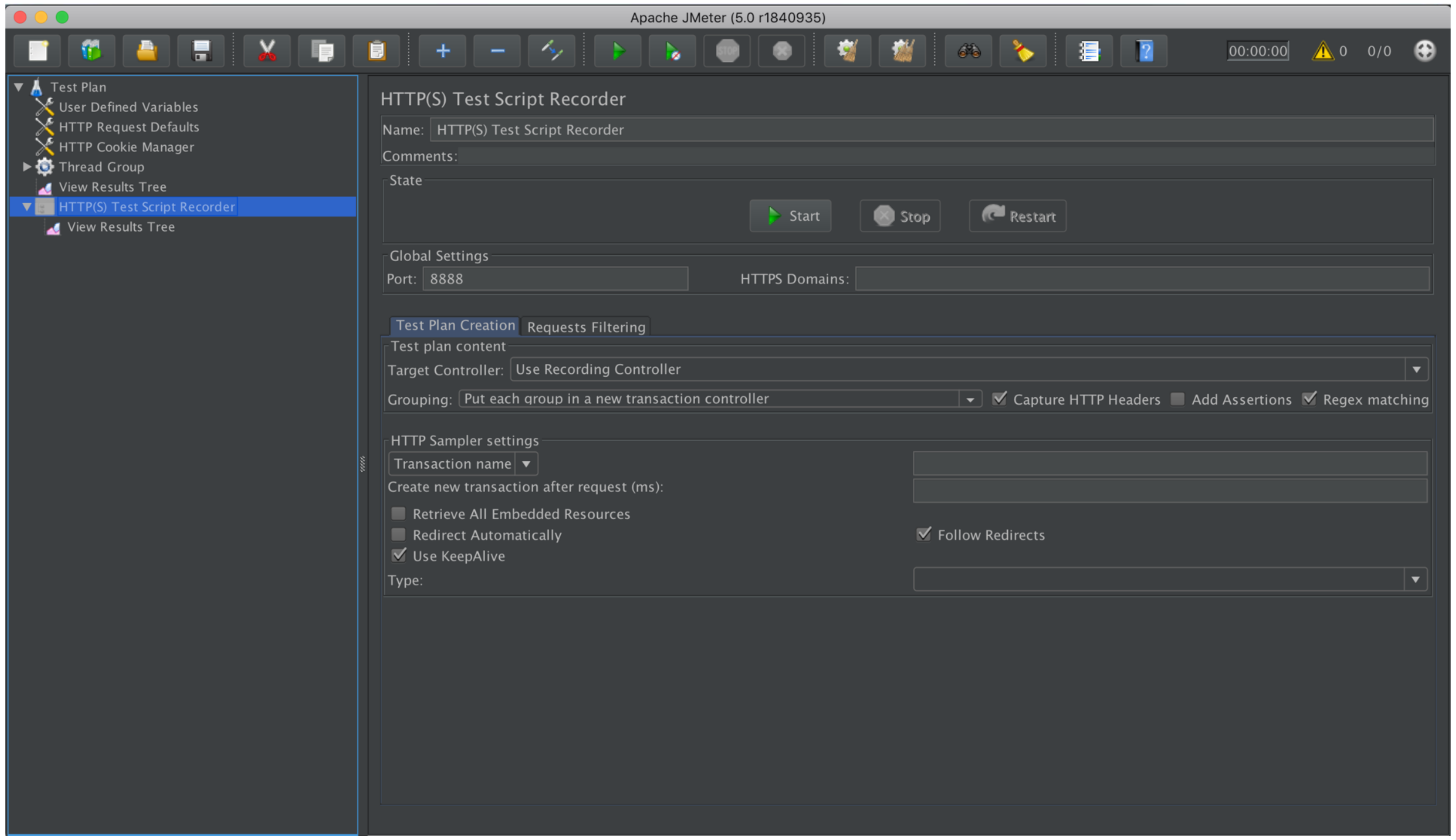
Async/Await Example



Limited Exception Use

- No exceptions for flow control
- Terrible performance (100s of times slower)
- High memory use

Load Testing with jMeter


Apache JMeter (5.0 r1840935)

00:00:00 0 0/0

- Test Plan
  - User Defined Variables
  - HTTP Request Defaults
  - HTTP Cookie Manager
  - Thread Group
  - View Results Tree
  - HTTP(S) Test Script Recorder
    - View Results Tree

HTTP(S) Test Script Recorder

Name: HTTP(S) Test Script Recorder

Comments:

State

Start Stop Restart

Global Settings

Port: 8888 HTTPS Domains:

Test Plan Creation | Requests Filtering

Test plan content

Target Controller: Use Recording Controller

Grouping: Put each group in a new transaction controller ✓ Capture HTTP Headers Add Assertions ✓ Regex matching

HTTP Sampler settings

Transaction name

Create new transaction after request (ms):

Retrieve All Embedded Resources

Redirect Automatically ✓ Follow Redirects

✓ Use KeepAlive

Type:

- Automate HTTP calls
- Load testing
- Includes HTTP traffic recorder

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Recap

- ✓ Introduction
- ✓ 12 Angular Performance Tips
- ✓ 14 .NET Core (.NET 5) Performance Tips

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Thank You! Questions?

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🌐 trailheadtechnology.com/blog

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