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Reimplementing CoAP for C# with the Task-based Asynchronous Pattern

Is it worth to await?

Philip Wille

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  - Specialized for **I**nternet **o**f **T**hings (IoT) and **M**achine-**t**o-**M**achine (M2M) devices.

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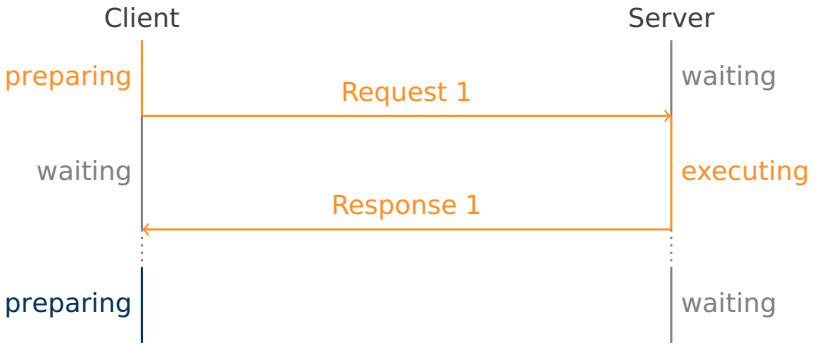

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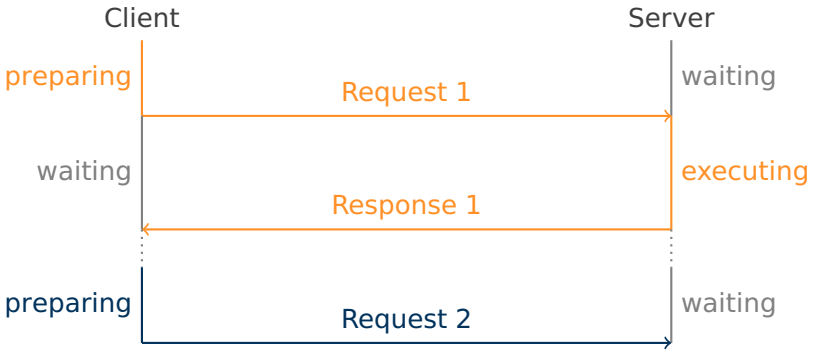

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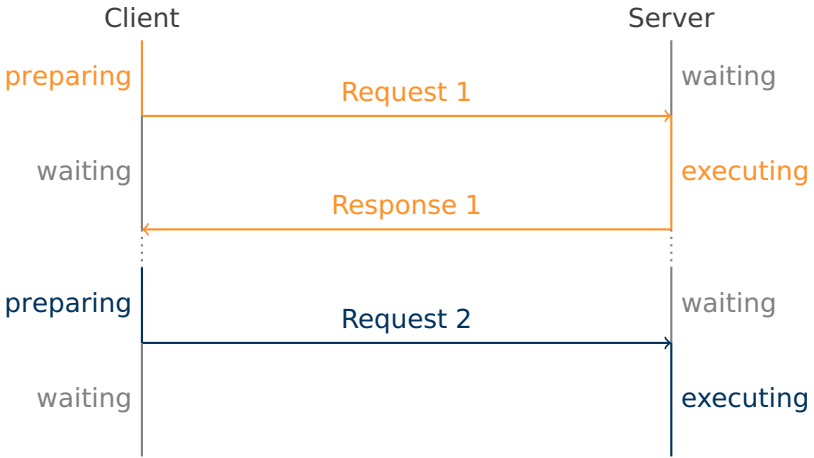

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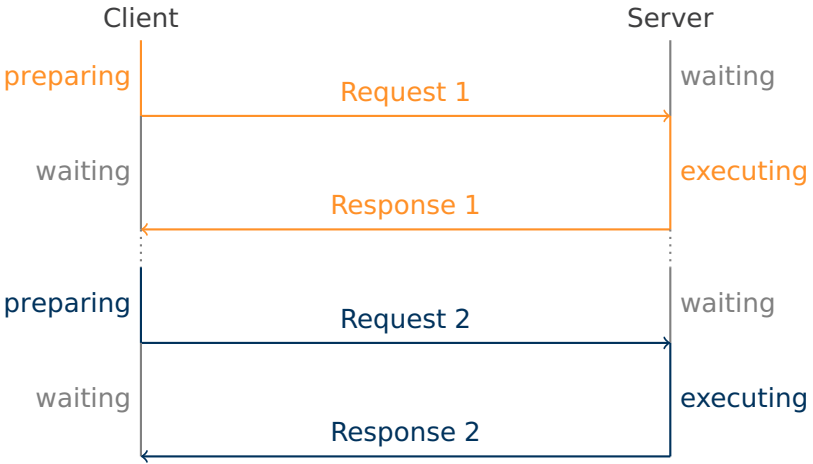

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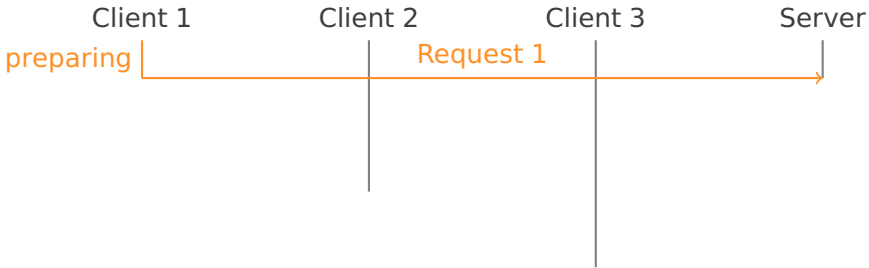

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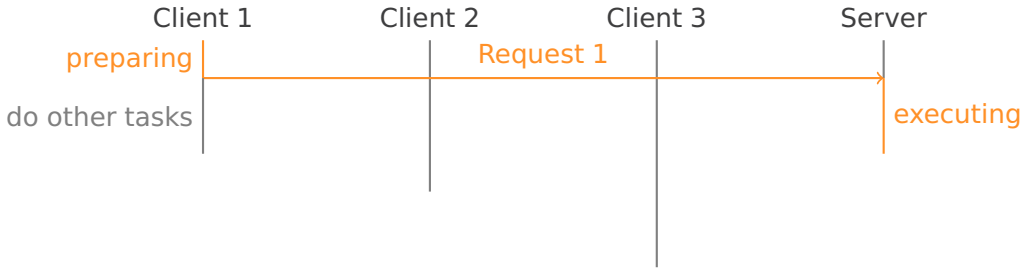

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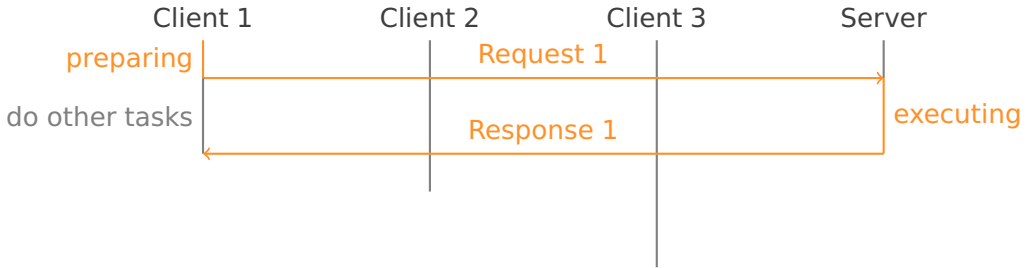

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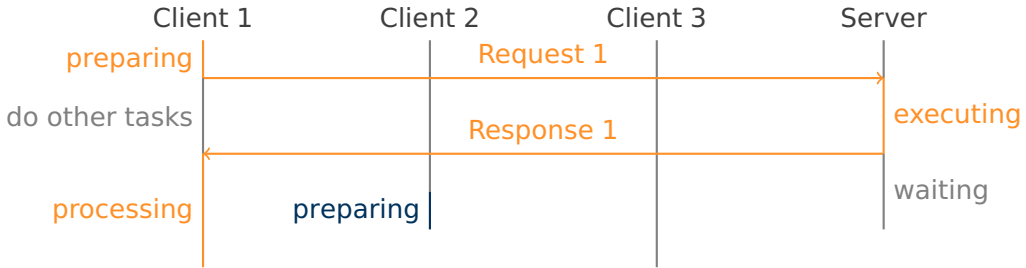

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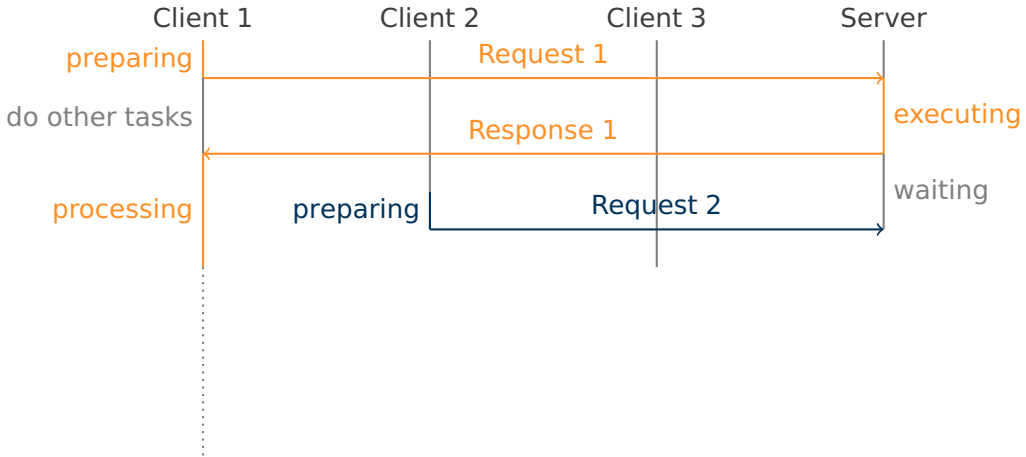

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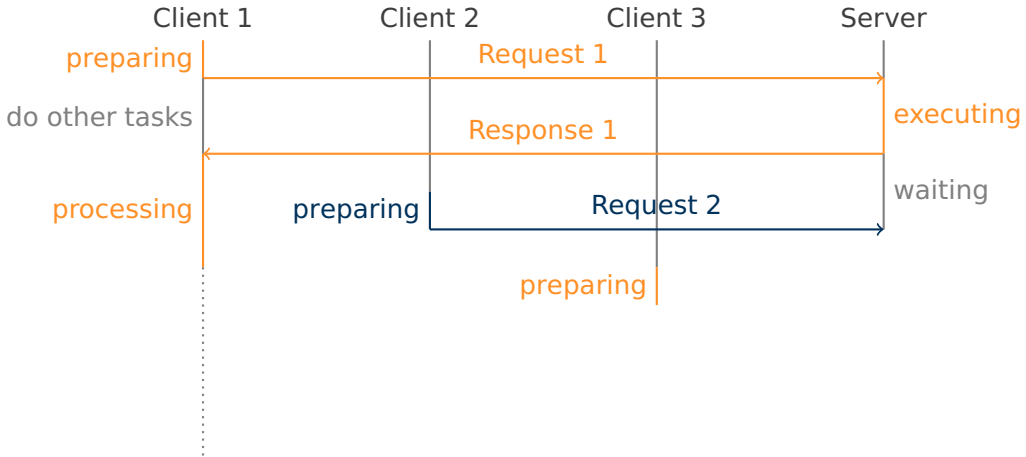

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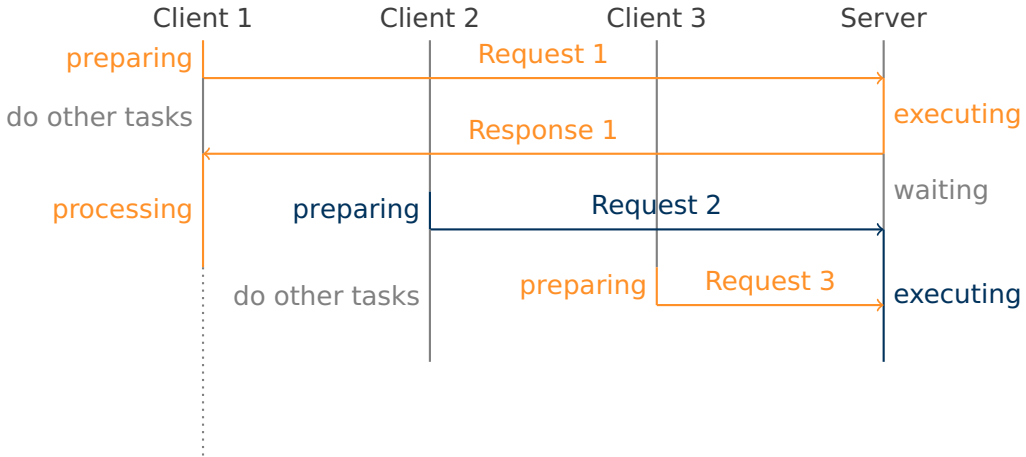

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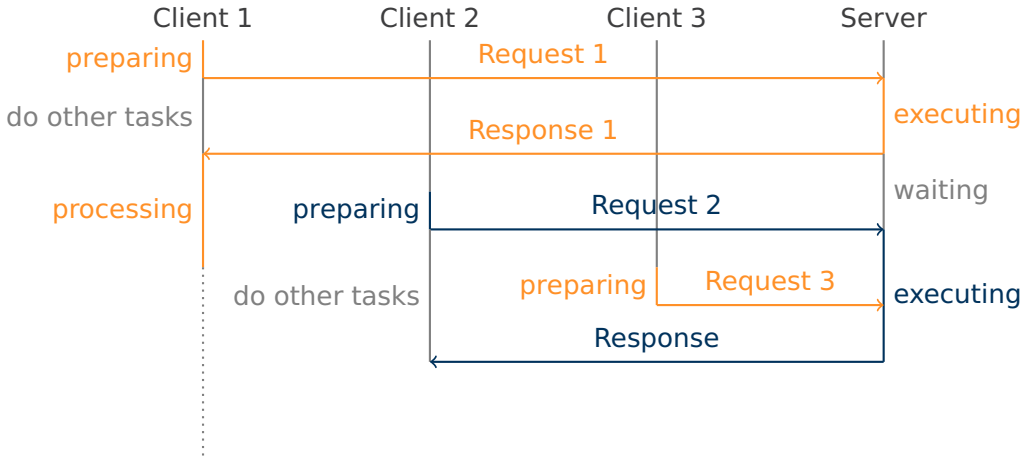

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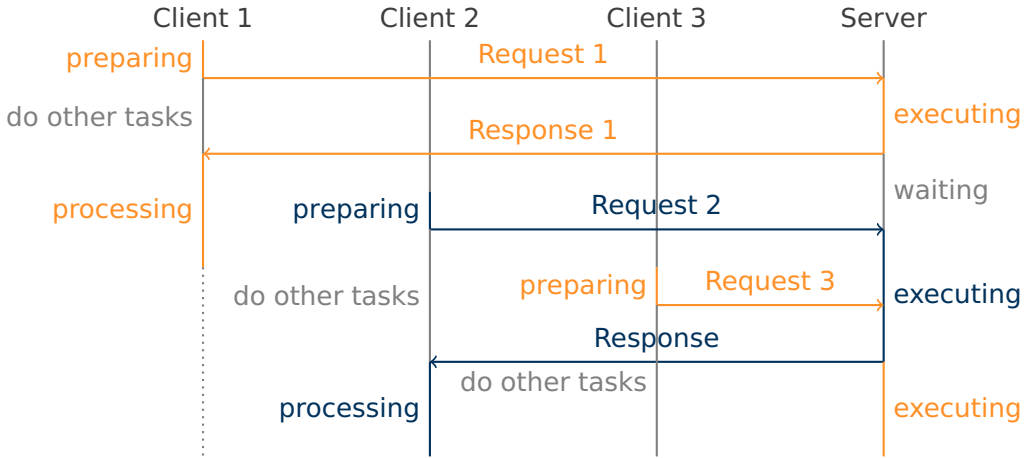

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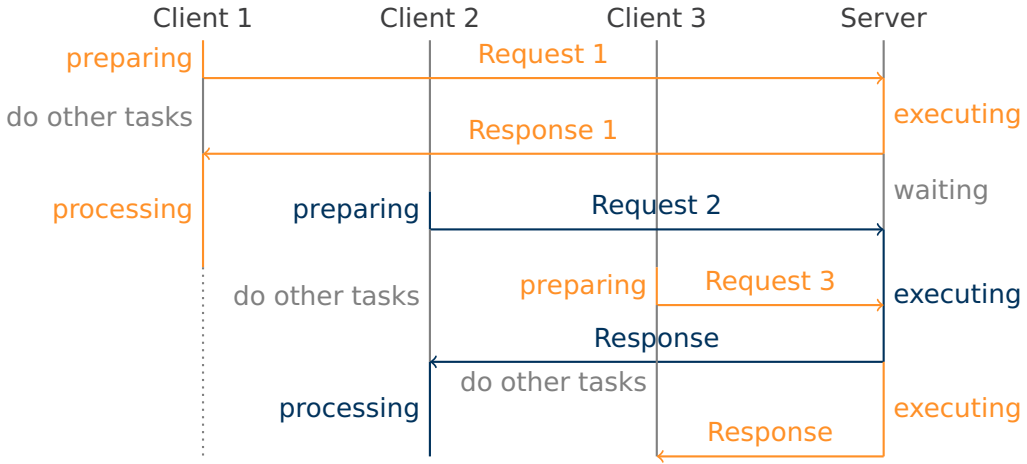

Asynchronous execution in Java

```
1  public CompletableFuture<Integer> calculateAsync() throws InterruptedException {
2      CompletableFuture<Integer> completableFuture = CompletableFuture.supplyAsync(() -> {
3          Thread.sleep(1000);
4          return 1;
5      });
6      return completableFuture;
7  }
8
9  public static void main(string[] args) {
10     CompletableFuture cf = calculateAsync();
11     while (!cf.isDone) {
12         System.out.println("CompleteableFuture is not finished yet...");
13     }
14     long result = cf.get();
15 }
```

Listing 1: Asynchronous usage in Java

Asynchronous execution in C#

```
1  public async Task<int> CalculateAsync() {
2      await Task.Delay(1000).ConfigureAwait(false);
3      return Task.FromResult(1);
4  }
5
6  public static Task Main(string[] args) {
7      var result = await CalculateAsync().ConfigureAwait(false);
8  }
```

Listing 2: Asynchronous usage in C#

Short introduction into CoAP

- URI scheme based
  - "coap:" "//" host [":" port] path-abempty ["?" query]
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- REST-like
  - GET, PUT, POST, DELETE, PATCH, ...
- Specialized for using with constrained nodes and constrained networks.
- Works with HTTP.
- Fulfills requirements of environments like energy, building automation, and other machine-to-machine (M2M) applications.
- Several implementations for many programming languages like C# (CoAP.NET), Java (Californium), Python (CoAPthon), C (FreeCoAP) ...

Example request in CoAP

Figure: GET request

Example request in CoAP

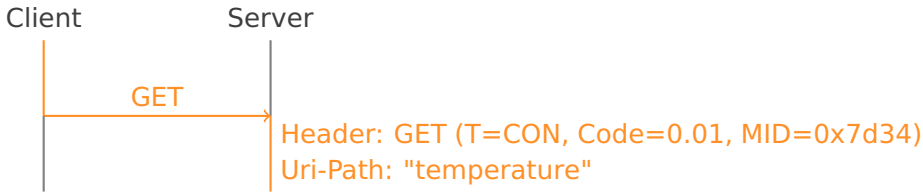

Figure: GET request

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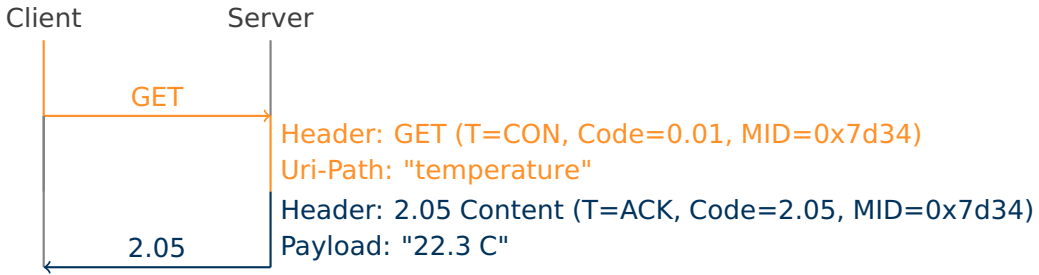

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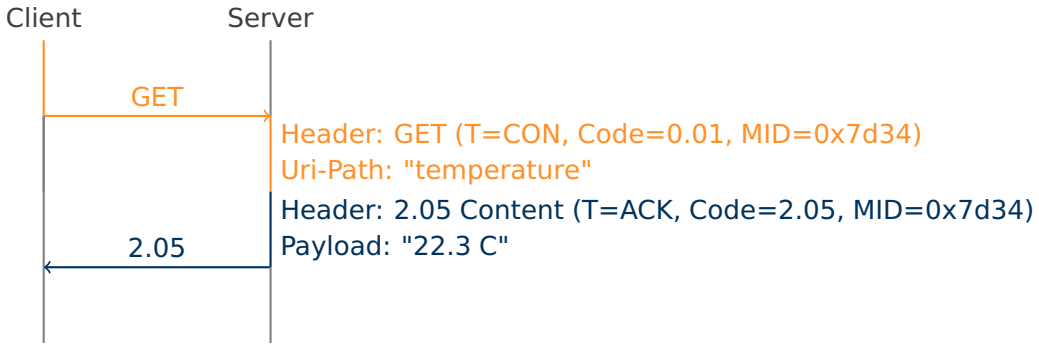

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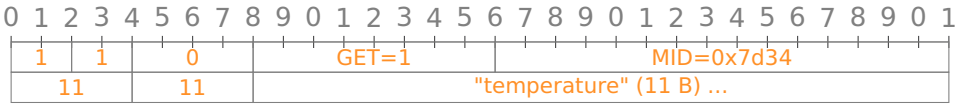

Figure: Confirmable Request

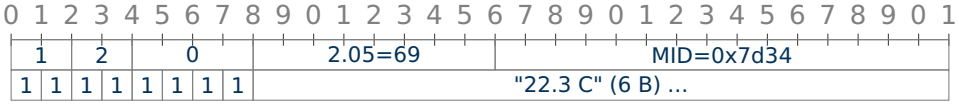

Figure: Piggybacked Response

CoAP.NET

- Implementation of CoAP for C#.
- Development inactive.
- Partially asynchronous.
- Memory leaks.
- Poor diagnostic capabilities.
- Only .NET Framework.

Goal thesis

- Goals
  - Rewrite CoAP.NET to fully asynchronous version.
  - Fixing memory leaks.
  - Enhancing diagnostic capabilities.
  - Upgrading to .NET Standard 2.0.
  - Several improvements.
- Supervisors
  - assoc. Prof. Dr. Michael Felderer (University Innsbruck).
  - Andreas Dânek (World-Direct eBusiness solutions GmbH)