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Increasing throughput of server applications by using asynchronous techniques

A case study on CoAP.NET

Philip Wille
Supervisors: Michael Felderer, Andreas Danek

1. Programming paradigms
2. Synchronous and asynchronous server
3. Task-based Asynchronous Pattern (TAP)
4. Constrained Application Protocol (CoAP)
5. Bachelor thesis

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Synchronous server

Figure: Sequence diagram of synchronous server

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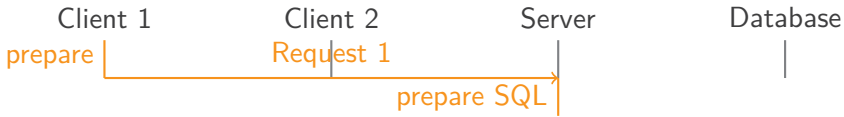

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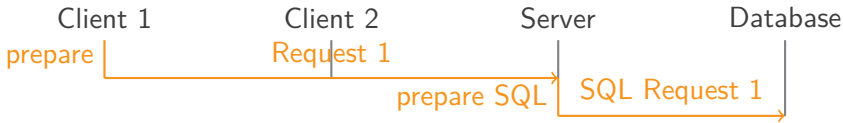

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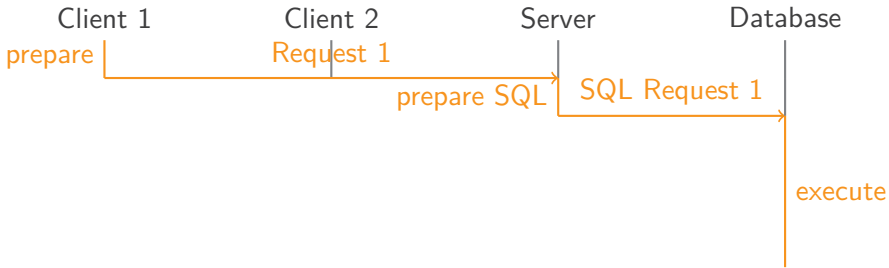

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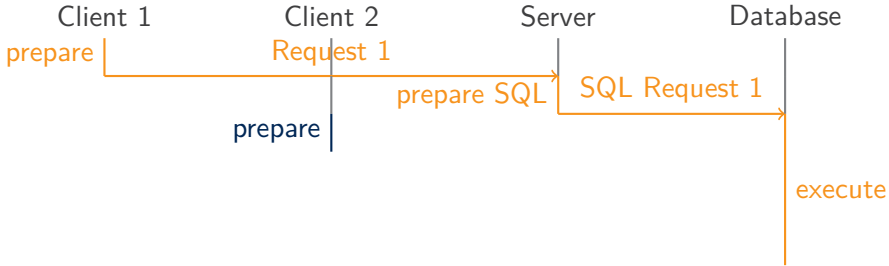

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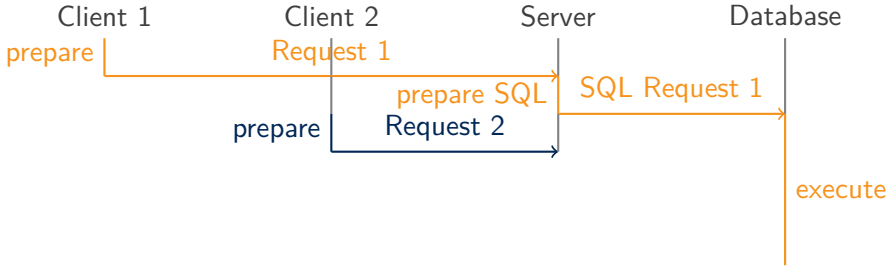

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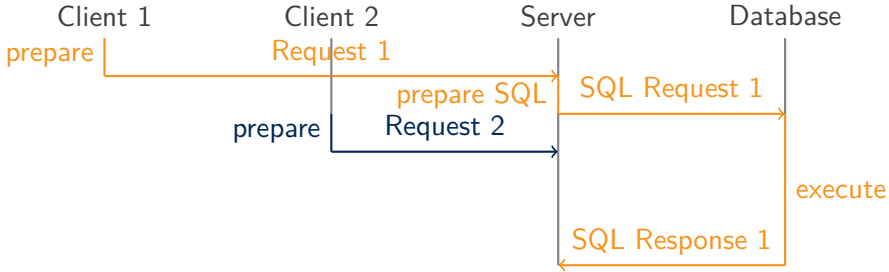

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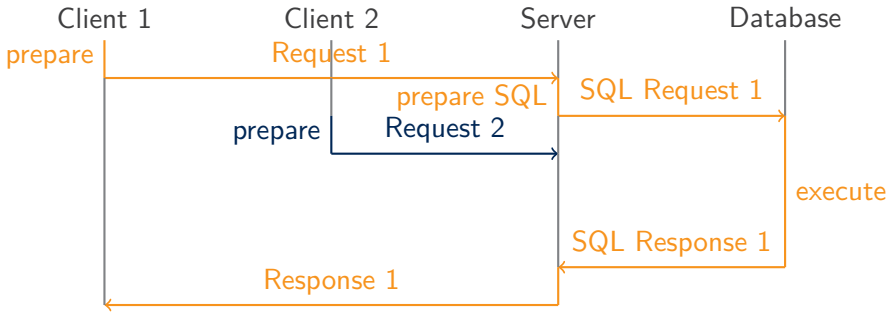

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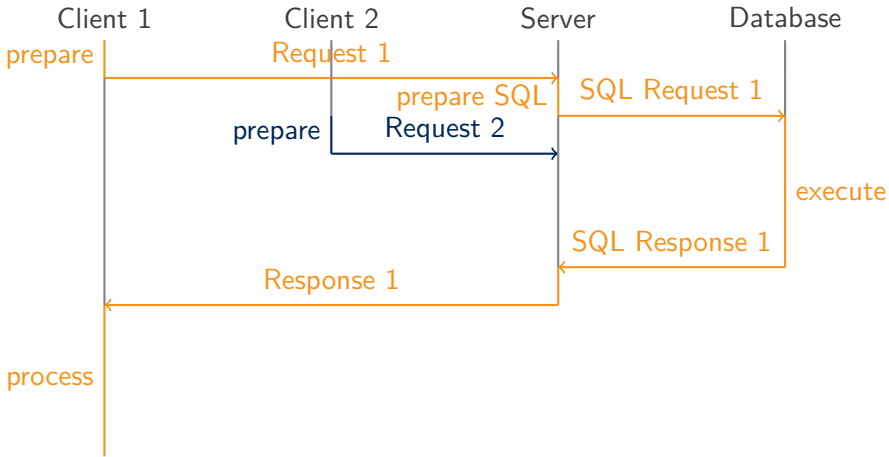

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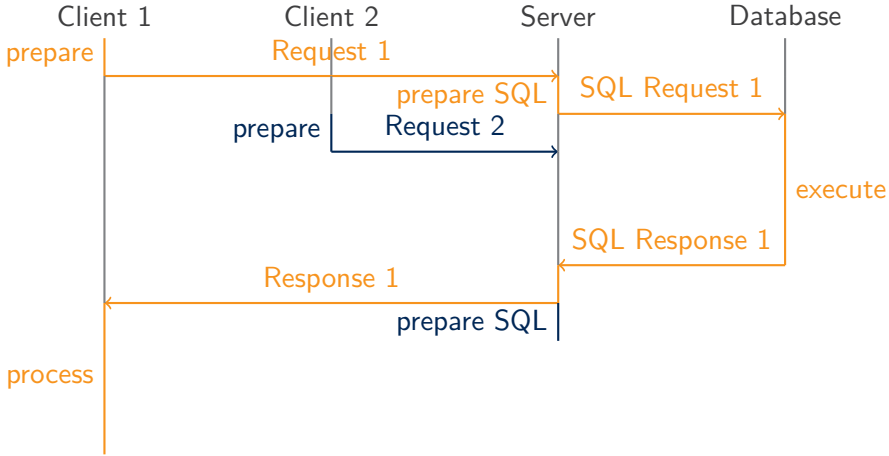

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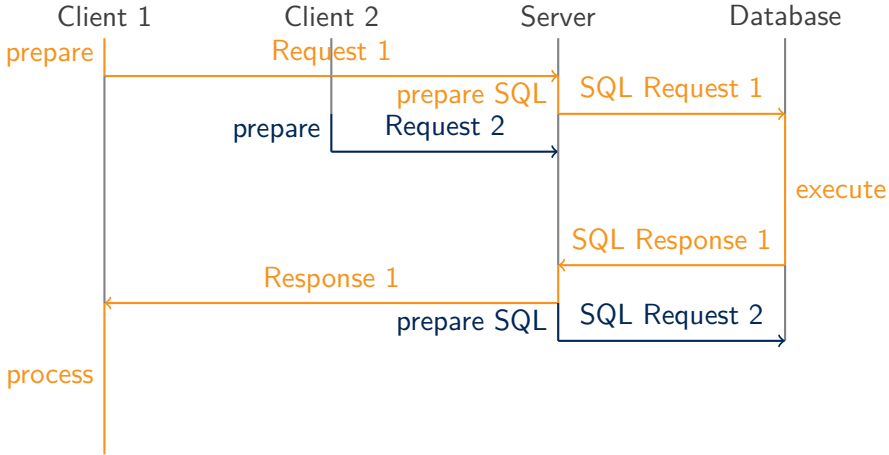

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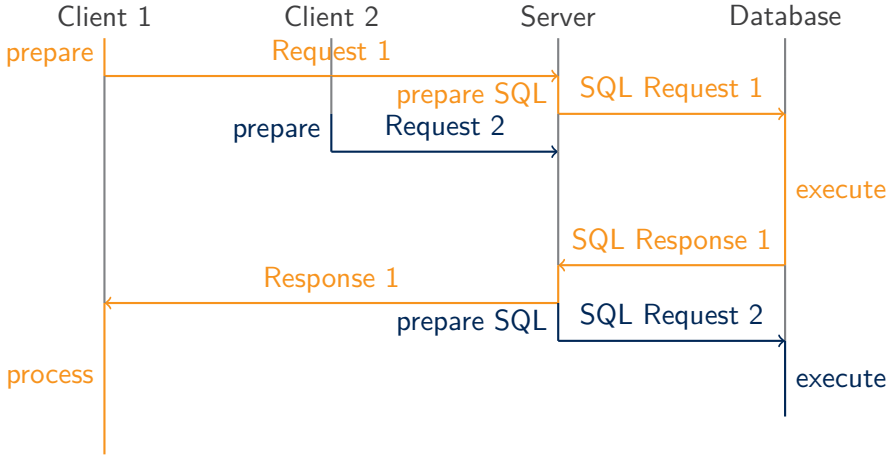

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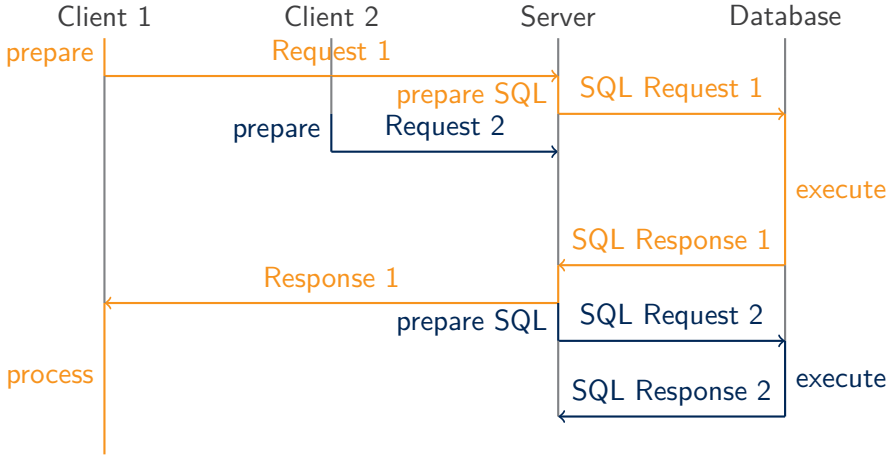

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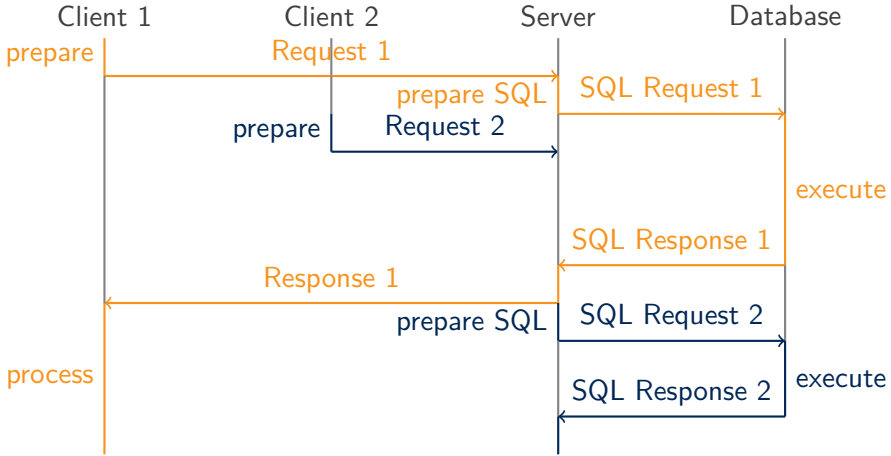

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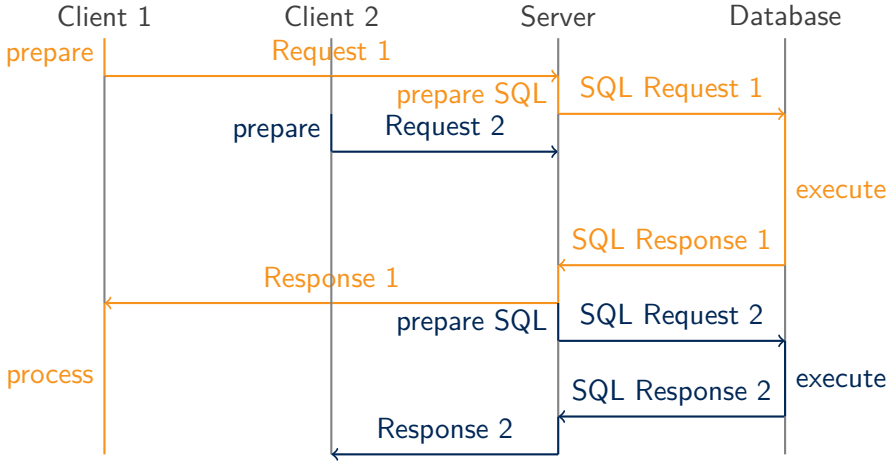

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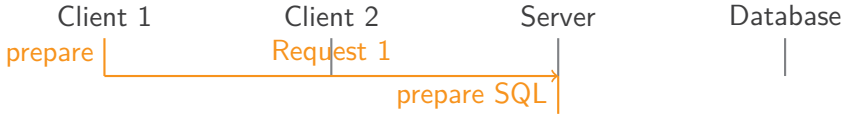

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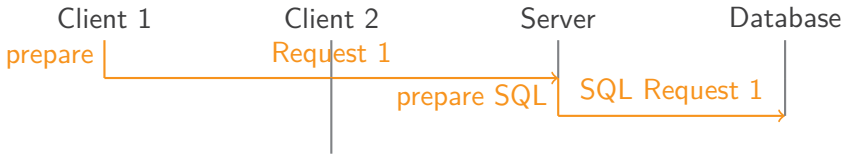

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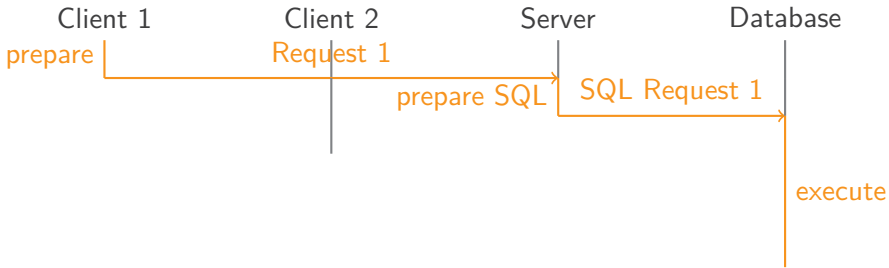

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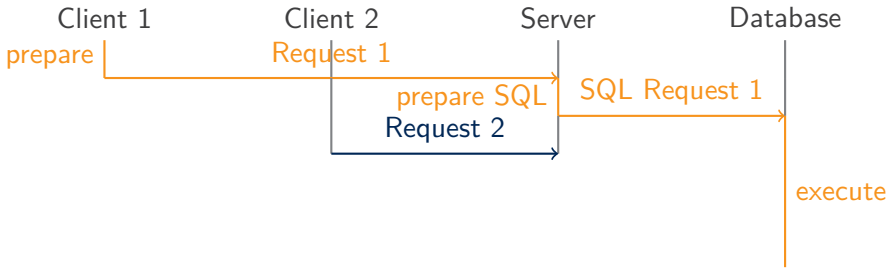

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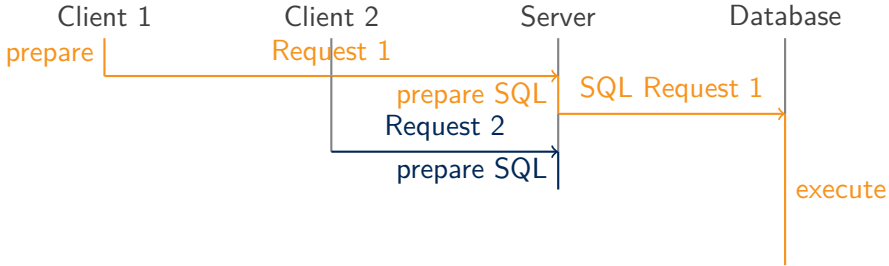

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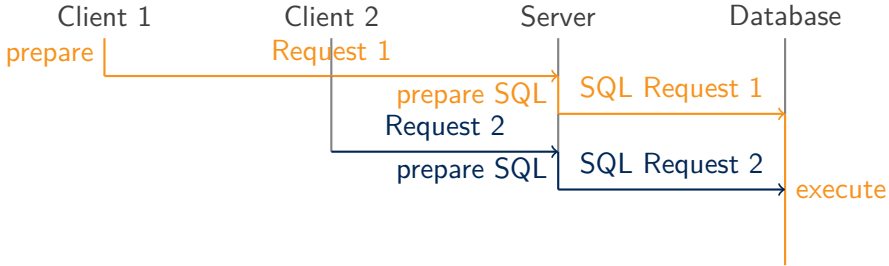

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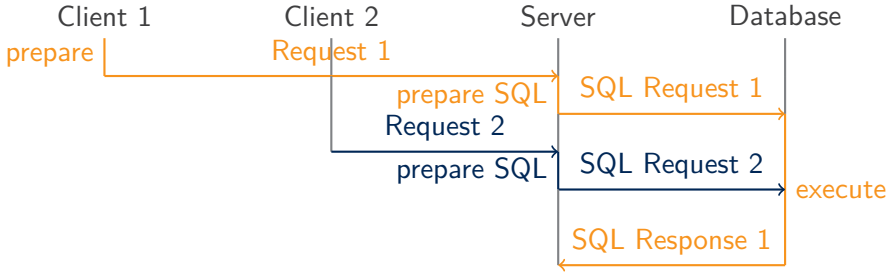

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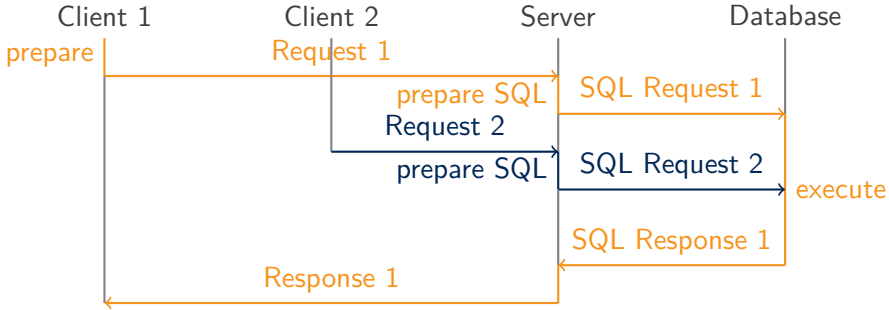

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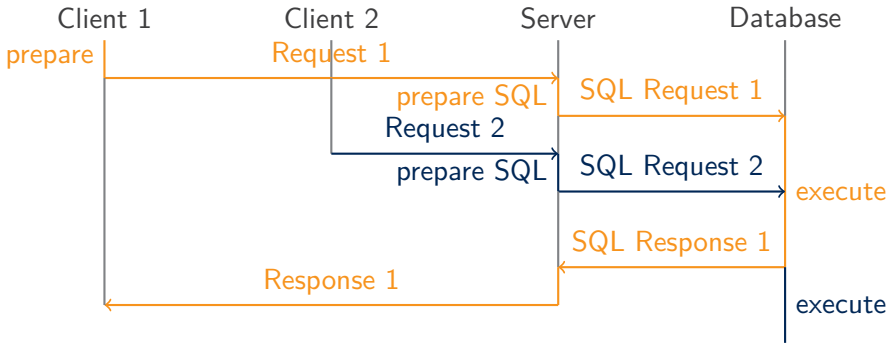

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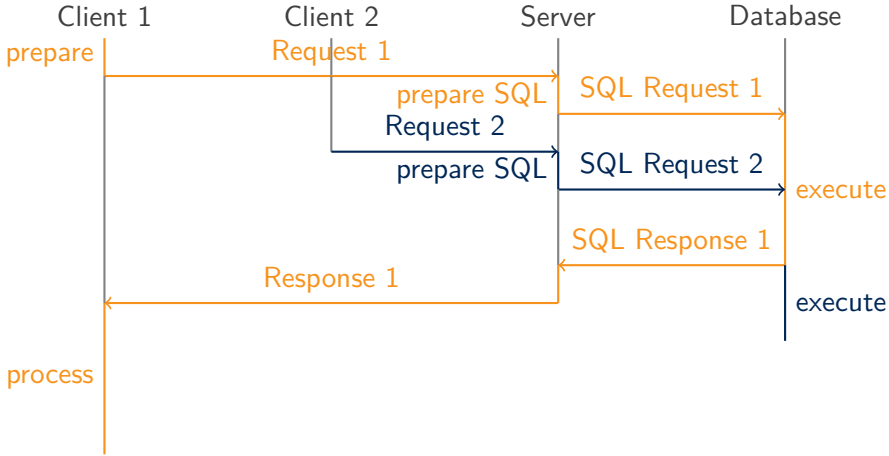

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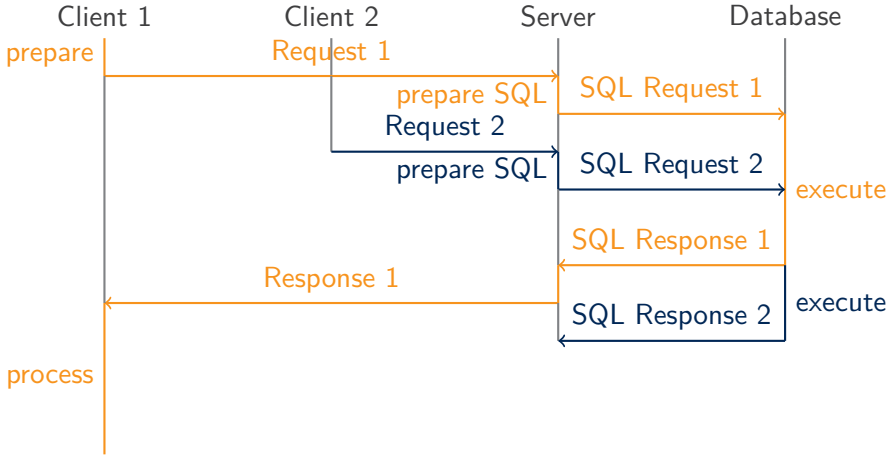

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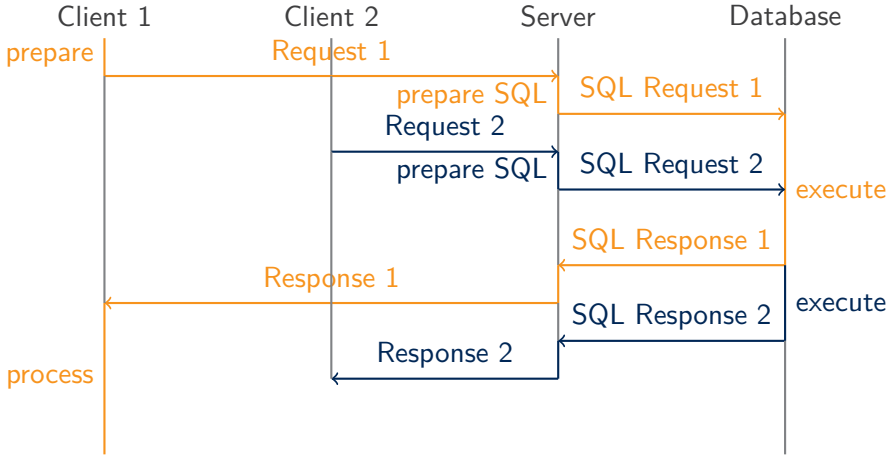

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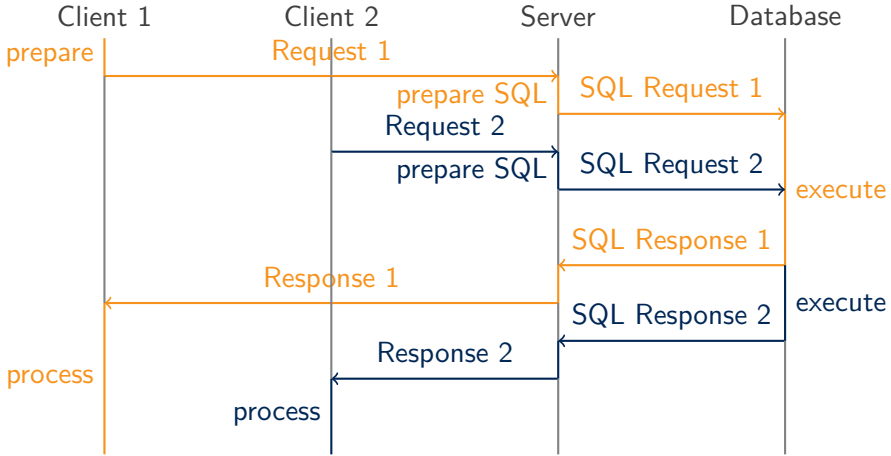

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  - Task<TResult>
  - CancellationToken
  - async/await keyword

Synchronous execution in C#

```
1  public string Download(Uri uri) {
2      var client = new DownloadClient();
3      var result = client.Download(uri);
4
5      return result;
6  }
```

Listing 1: Synchronous usage in C#

Event-based execution in C#

```
1  public DownloadResult Download(Uri uri) {
2      var client = new DownloadClient();
3      var result = new DownloadResult();
4
5      client.DownloadComplete += (content) => result.SetComplete(content);
6      client.StartDownload(uri);
7
8      return result;
9  }
```

Listing 2: Usage of events in C#

Asynchronous execution in C#

```
1  public async Task<string> DownloadAsync(Uri uri, CancellationToken ct) {
2      var client = new DownloadClient();
3      var result = await client.DownloadAsync(uri, ct).ConfigureAwait(false);
4
5      return result;
6  }
```

Listing 3: Asynchronous usage in C#

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- Implementation for several programming languages.

Example of CoAP message

0101**0100**01000101**11011111**00011001**00000000**00000000**00001110**11110001**1110**
....11111111**00000010**

- **Version**: 1 (01......)
- **Type**: Non-Confirmable (..01....)
- **Token Length**: 4 (....0100)
- **Code**: 2.05 Content (01000101)
- **Message ID**: 51773 (11011111 00011001; Big endian)
- **Token**: 61326 (00000000 00000000 11101111 10001110)
- **Options**: Set of options
- **Payload marker**: 255 (11111111)
- **Payload**: 2 (00000010)

CoAP.NET

- Implementation of CoAP for C#.

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- Partially asynchronous.
- Offers a client and server implementation.

Bachelor thesis

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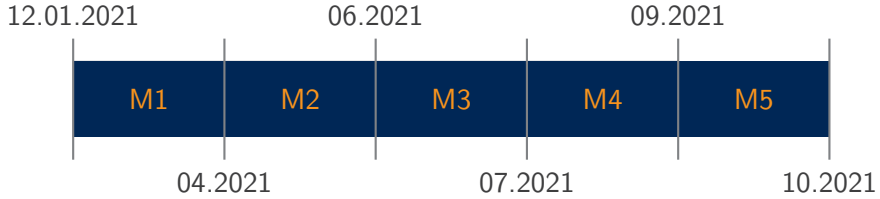
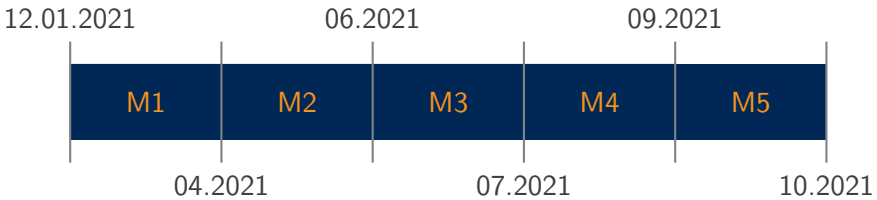


Figure: Phase-Milestone plan

Bachelor thesis



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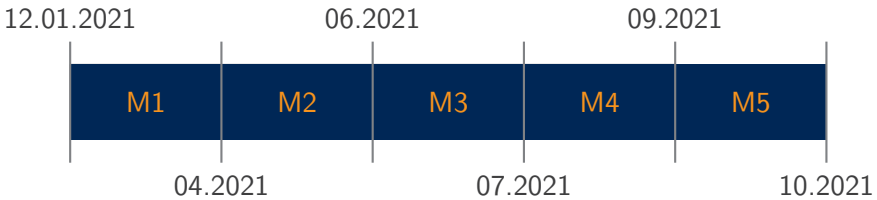

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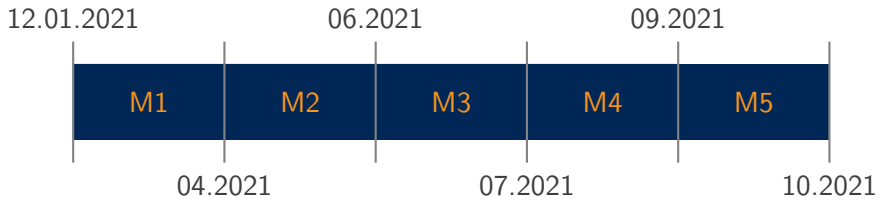
Bachelor thesis



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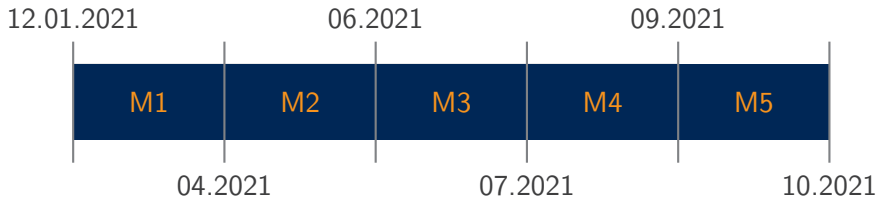

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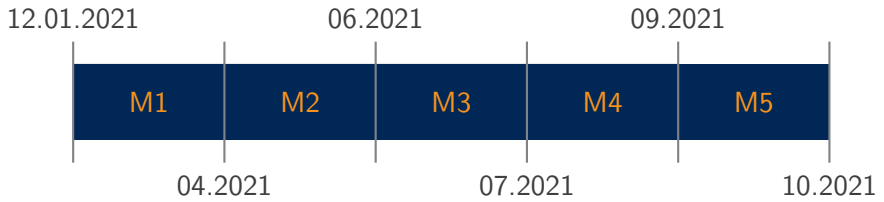

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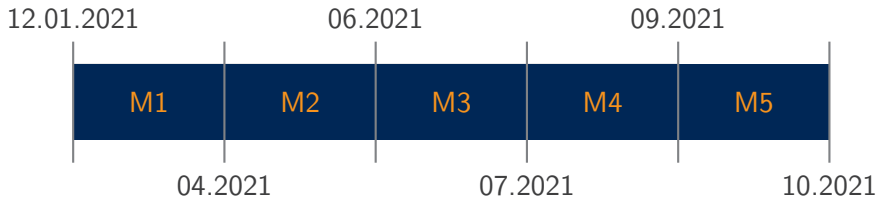

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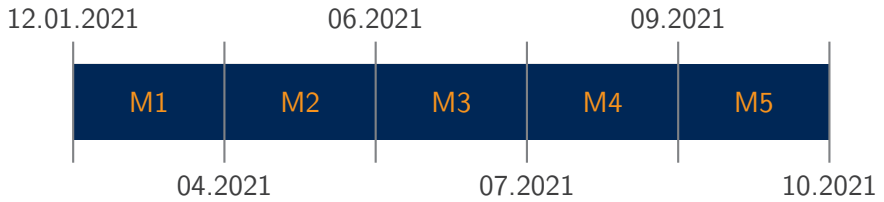

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6. 10.2021: Final presentation.

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Ordering a book

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  2. You are sitting on the couch and waiting for the book.
  3. Postman is knocking on your door and giving you the book.
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