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# EventLoop을 이용한 WebServer 구현

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2018.04.27

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컴퓨터공학부 이승현

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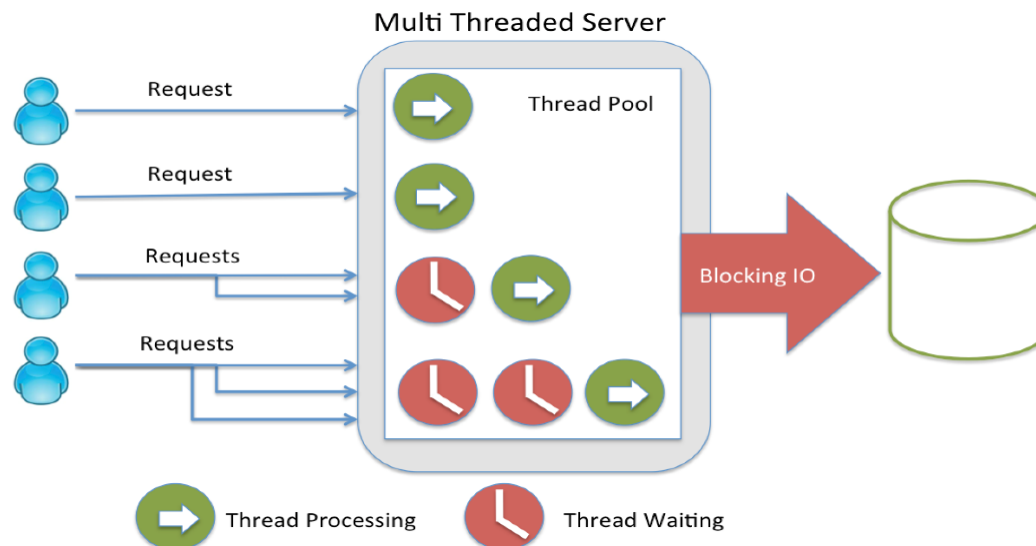
10. Division of Work

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# Problem Raised

## ✓ Vast concurrent connections to web server

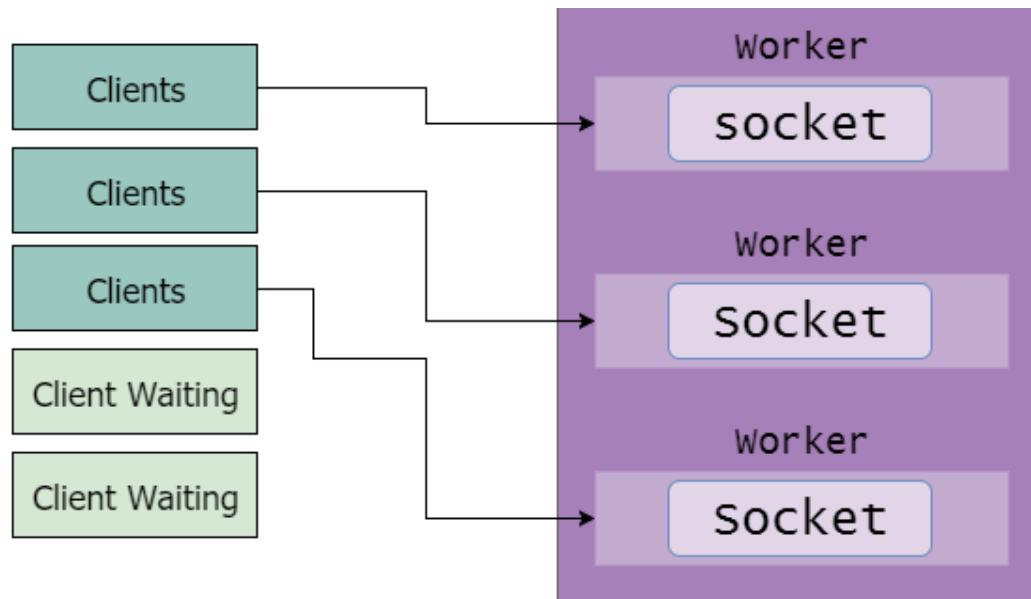
- 얼마나 많은 클라이언트를 동시에 처리할 수 있는가?
- 다량의 socket이 연결될 때 하드웨어가 충분하더라도 I/O 처리방식 때문에 서버가 제대로 동작하지 않을 수 있다.



# Existing Problems

## ✓ Limits of connection oriented model

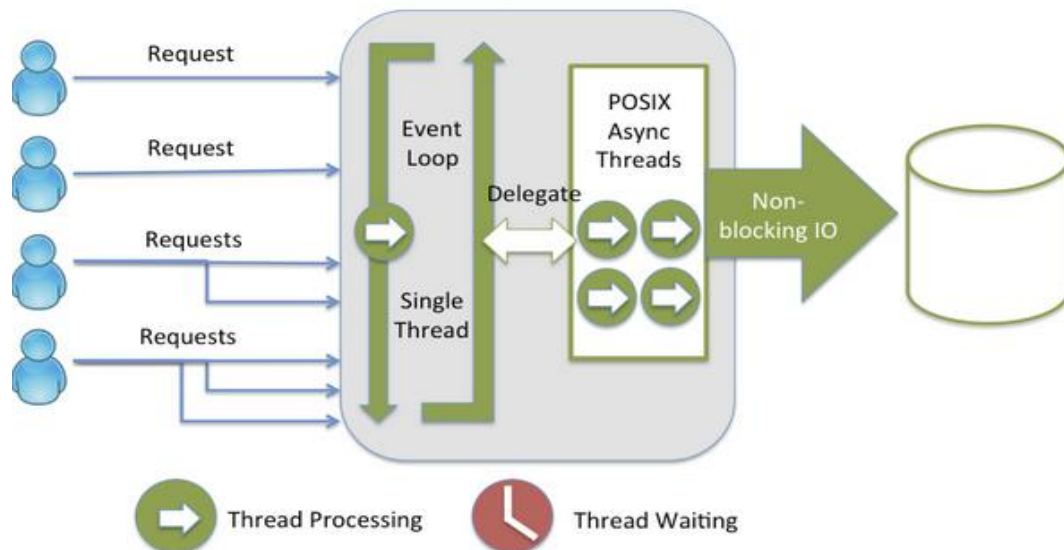
- Thread pool 크기만큼의 client만을 동시에 처리 가능
- Blocking I/O로 인한 저조한 CPU utilization
- Context switch overhead로 인해 performance 저하



# Approach

## ✓ Improvements with single threaded model

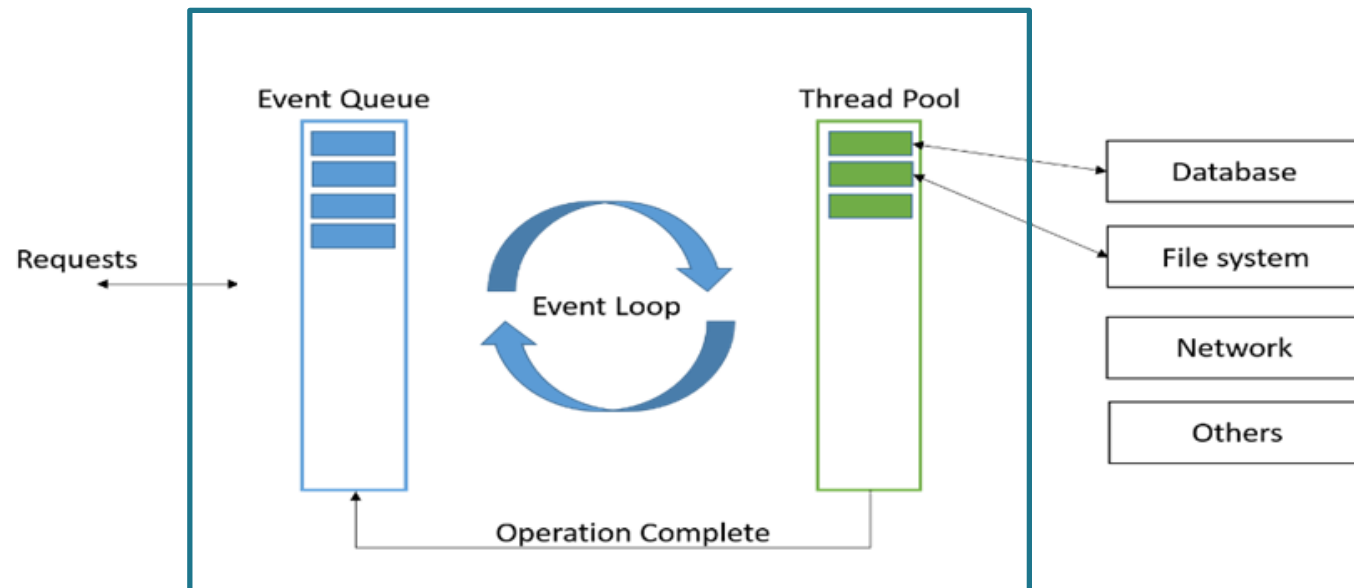
- 하나의 event loop thread가 infinite loop를 돌면서 request를 전담
- Block을 유발하는 I/O는 worker thread가 대신 처리
- Context switch 없이 infinite loop를 돌면서 callback을 받아서 처리



# Architecture(1)

## ✓ Components of single threaded model

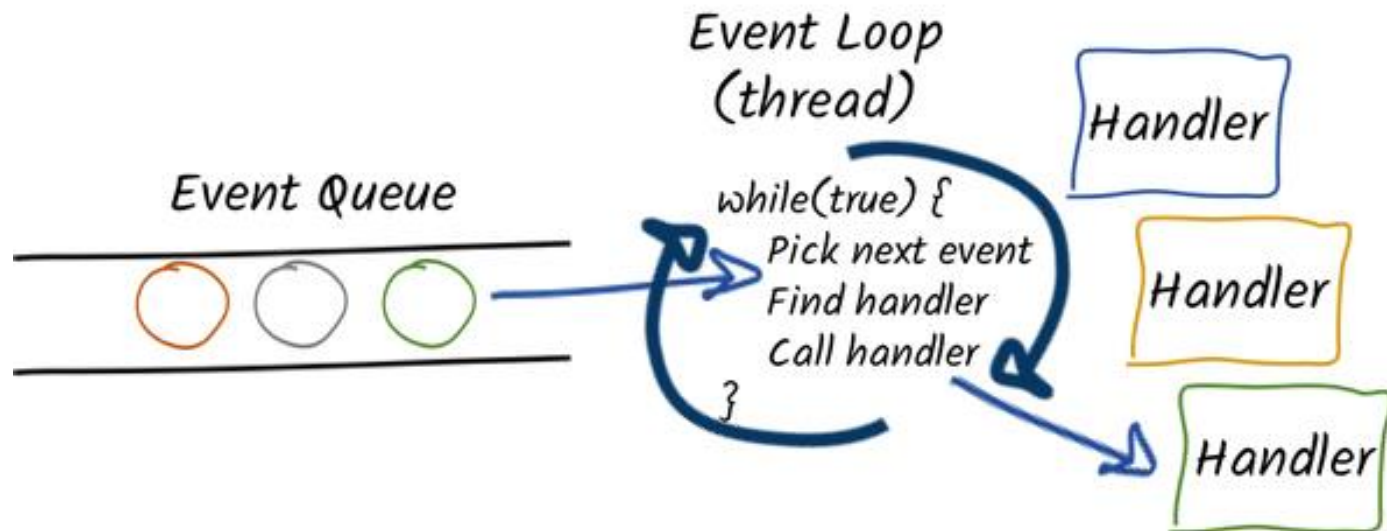
- Event queue  $\div$  to-do list
- Single event loop thread  $\div$  the exploited
- Internal multi thread pool  $\div$  helpers



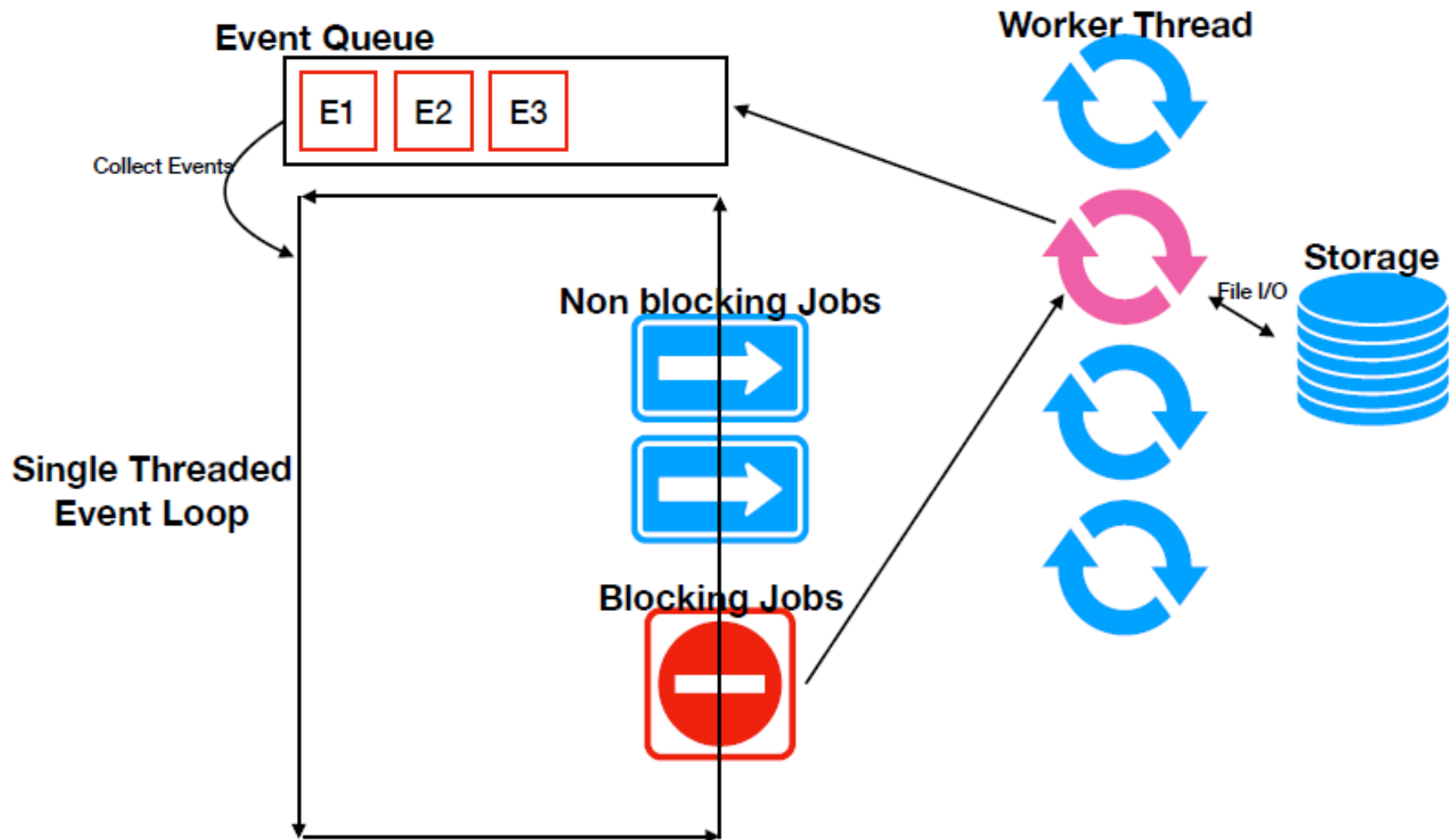
# Architecture(2)

## ✓ Event loop based architecture

- Event loop는 loop를 돌 때마다 event queue에 쌓인 일을 하나씩 처리
- Blocking job은 worker thread에게 맡기고 곧바로 다른 job을 dequeue
- Worker thread가 I/O를 완료하면 다시 event queue에 enqueue

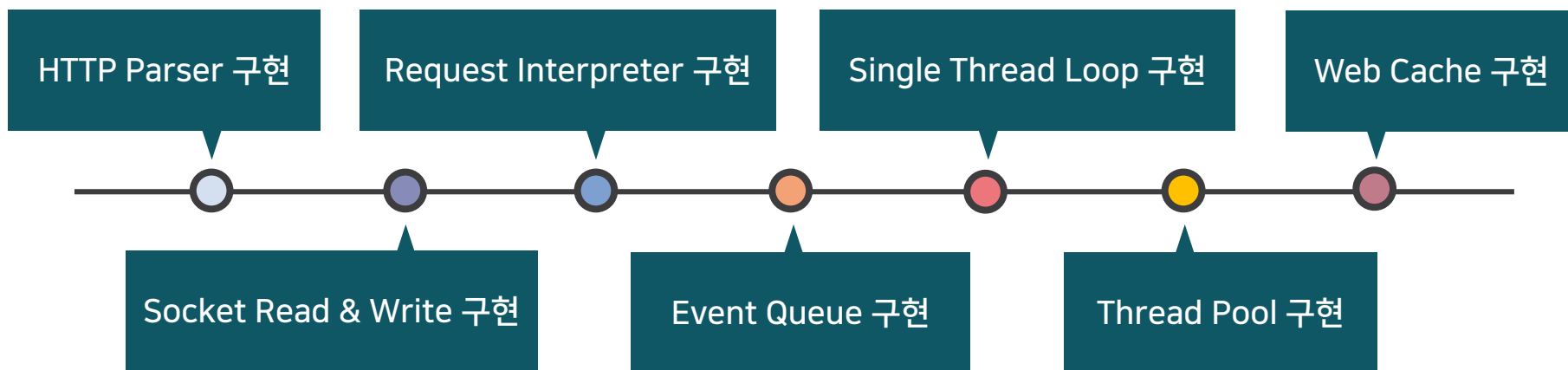


# Architecture(3)

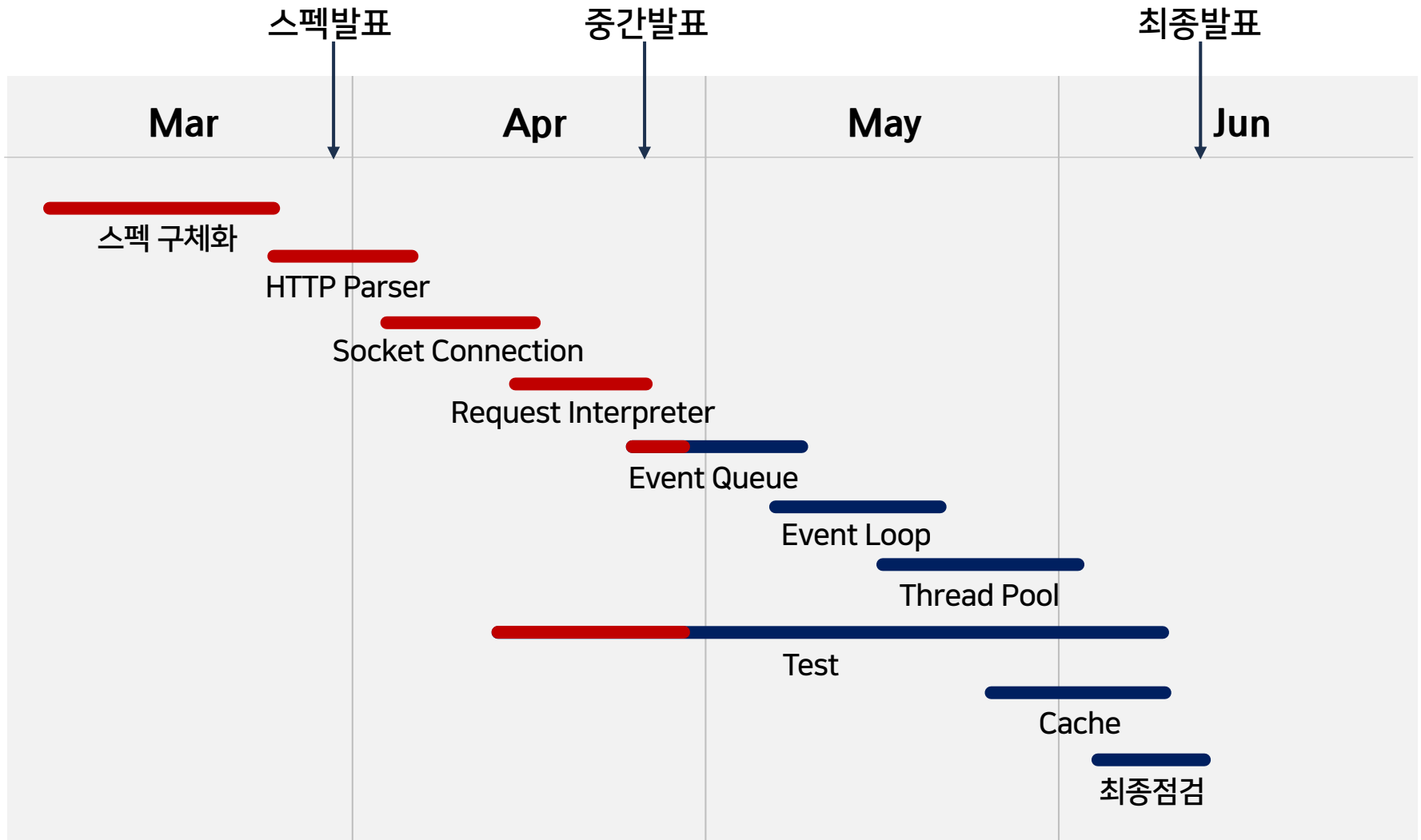




# Implementation Flow



# Schedule



# Development Environment

운영체제

저장소

언어

테스트 툴

오픈소스



**GitHub**

**Java**

**JMeter**

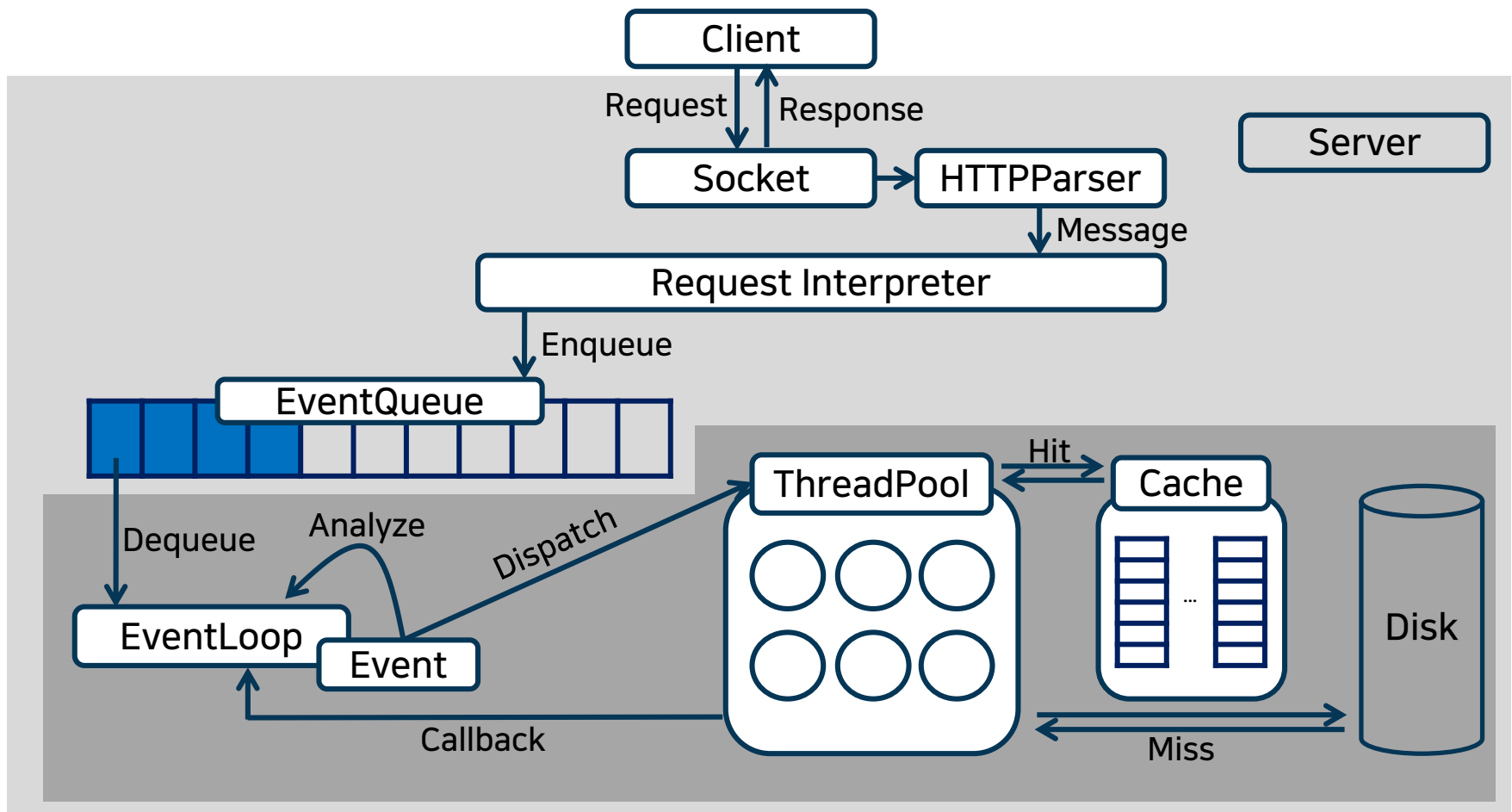


Performance Testing tool



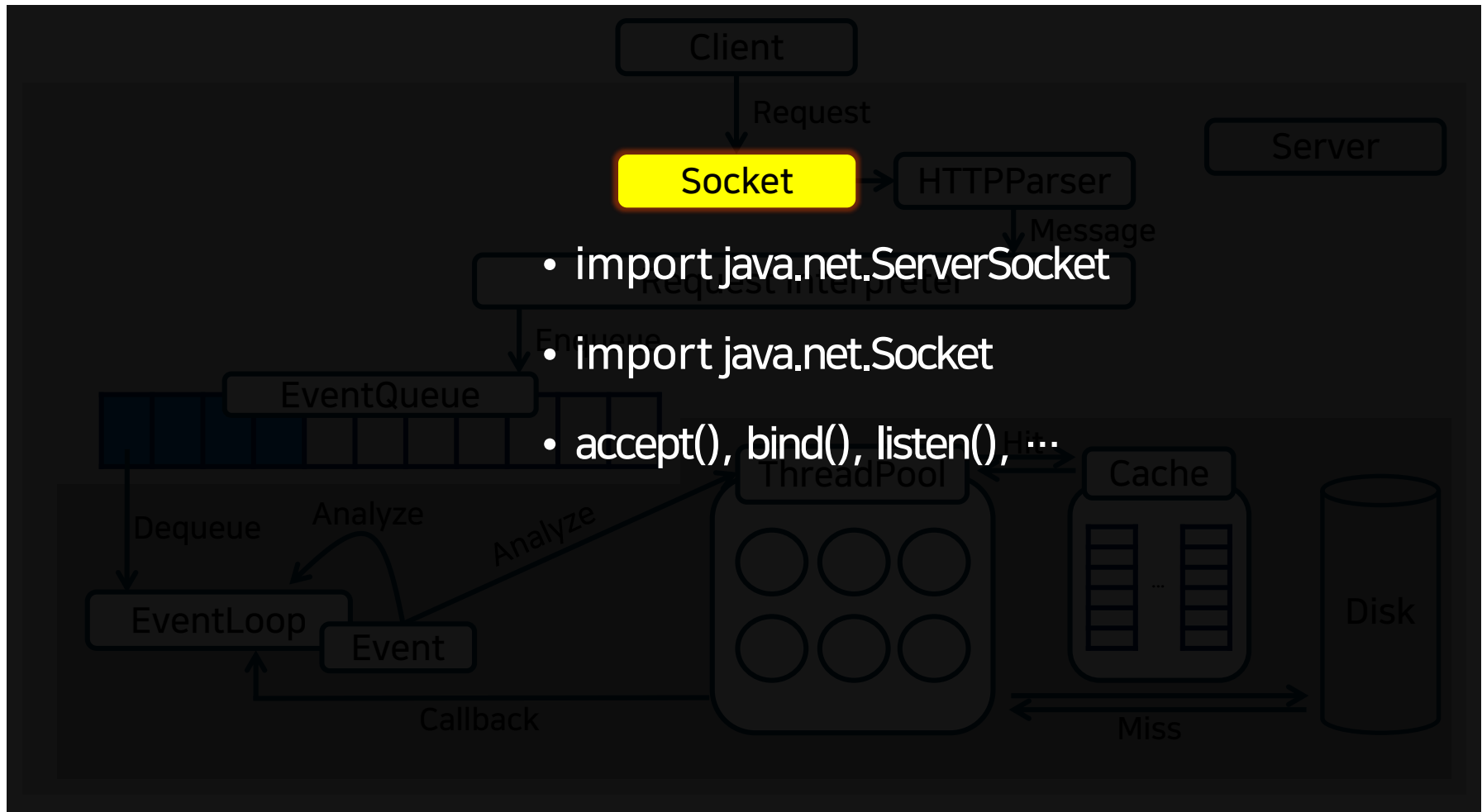
# Current Status(1)

## ✓ Big Picture



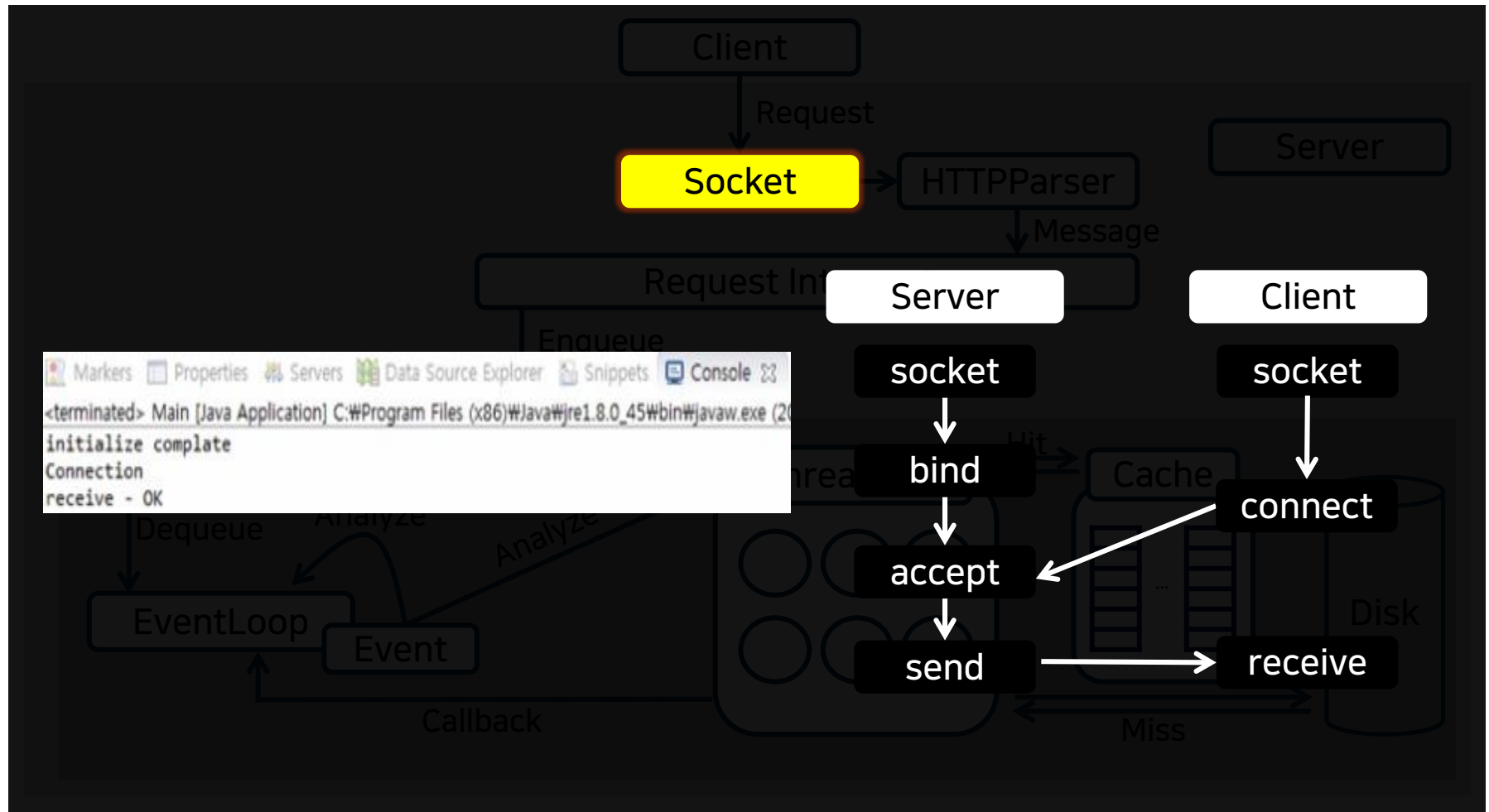
# Current Status(2)

## ✓ Socket Binding



## Current Status(3)

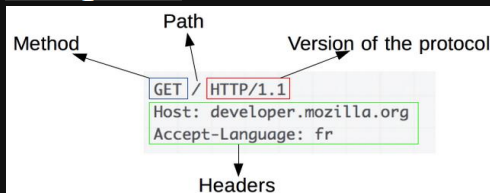
## ✓ Socket Binding



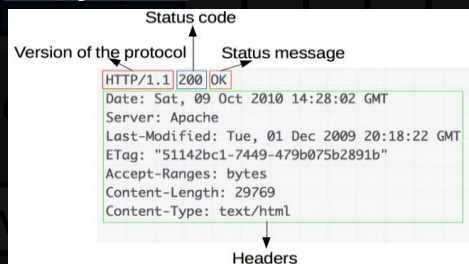
# Current Status(4)

## ✓ Parser

### Request



### Response



- Event parse(Request)

- String makeResponse(respType, Event)

- *respType* = {supported response type}

- *Event* = {method, uri, connection, io}

# Current Status(5)

## ✓ Parser

▼ Response Headers view source

```
Access-Control-Allow-Origin: *
Cache-Control: s-maxage=300, public, max-age=0
Connection: keep-alive
Content-Encoding: br
Content-Length: 20220
Content-Type: text/html; charset=utf-8
Date: Wed, 04 Apr 2018 01:34:15 GMT
etag: "aee48fd78f586b1f742daf735f9e2936"
Server: meinheld/0.6.1
Set-Cookie: dwf_sg_task_completion=False; expires=Fri, 04-May-2018 01:34:15 GMT; Max-Age=2592000; Path=/; secure
Set-Cookie: csrftoken=jvwE065DIrGTWwVq8MMuULDZRTAPnQg; expires=Wed, 03-Apr-2019 01:34:15 GMT; Max-Age=31449600; Path=/; secure
strict-transport-security: max-age=63072000
Vary: Cookie, Accept-Encoding
```

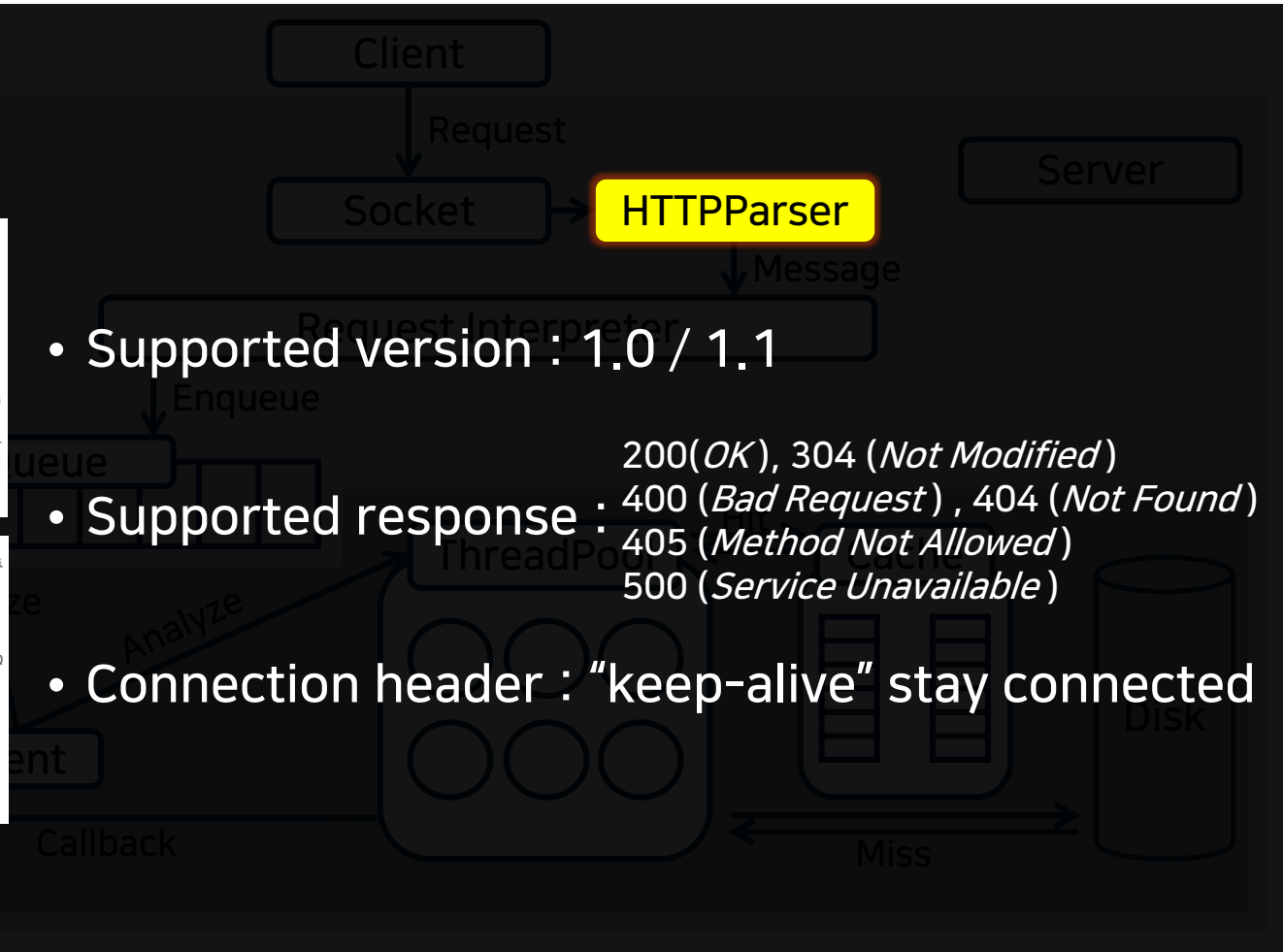
▼ Request Headers view source

```
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,image/apng,*/*;q=0.8
Accept-Encoding: gzip, deflate, br
Accept-Language: ko,en-US;q=0.9,en;q=0.8,ja;q=0.7
Connection: keep-alive
Cookie: csrftoken=jvwE065DIrGTWwVq8MMuULDZRTAPnQg; dwf_sg_task_completion=False; _ga=GA1.2.620021487.1522805172; _gid=GA1.2.658904446.1522805172
Host: developer.mozilla.org
Referer: https://developer.mozilla.org/en-US/docs/Web/HTTP/Status/412
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_13_3) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/65.0.3325.181 Safari/537.36
```

• Supported version : 1.0 / 1.1

• Supported response : 200(OK), 304 (Not Modified)  
400 (Bad Request) , 404 (Not Found)  
405 (Method Not Allowed)  
500 (Service Unavailable)

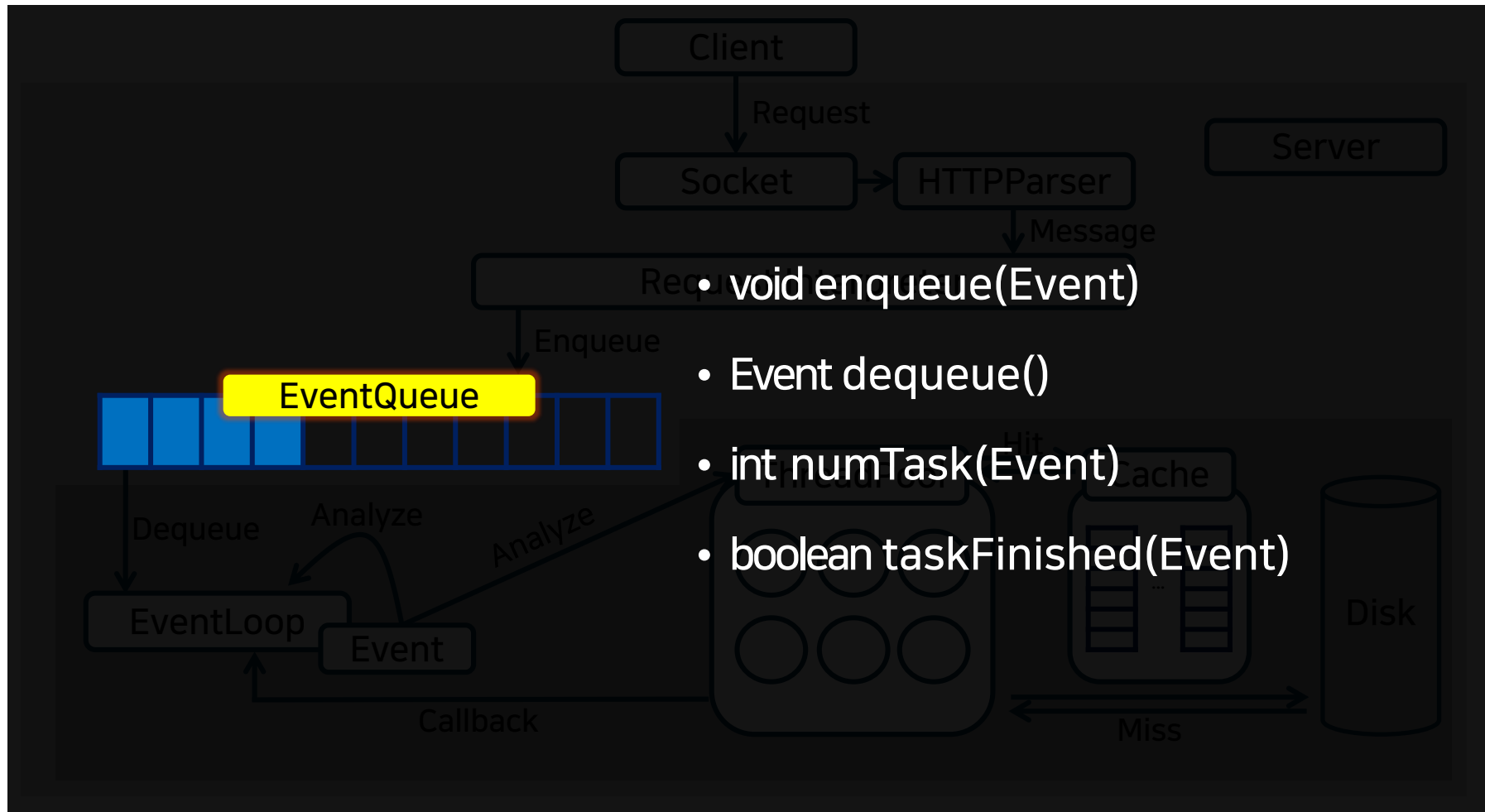
• Connection header : "keep-alive" stay connected





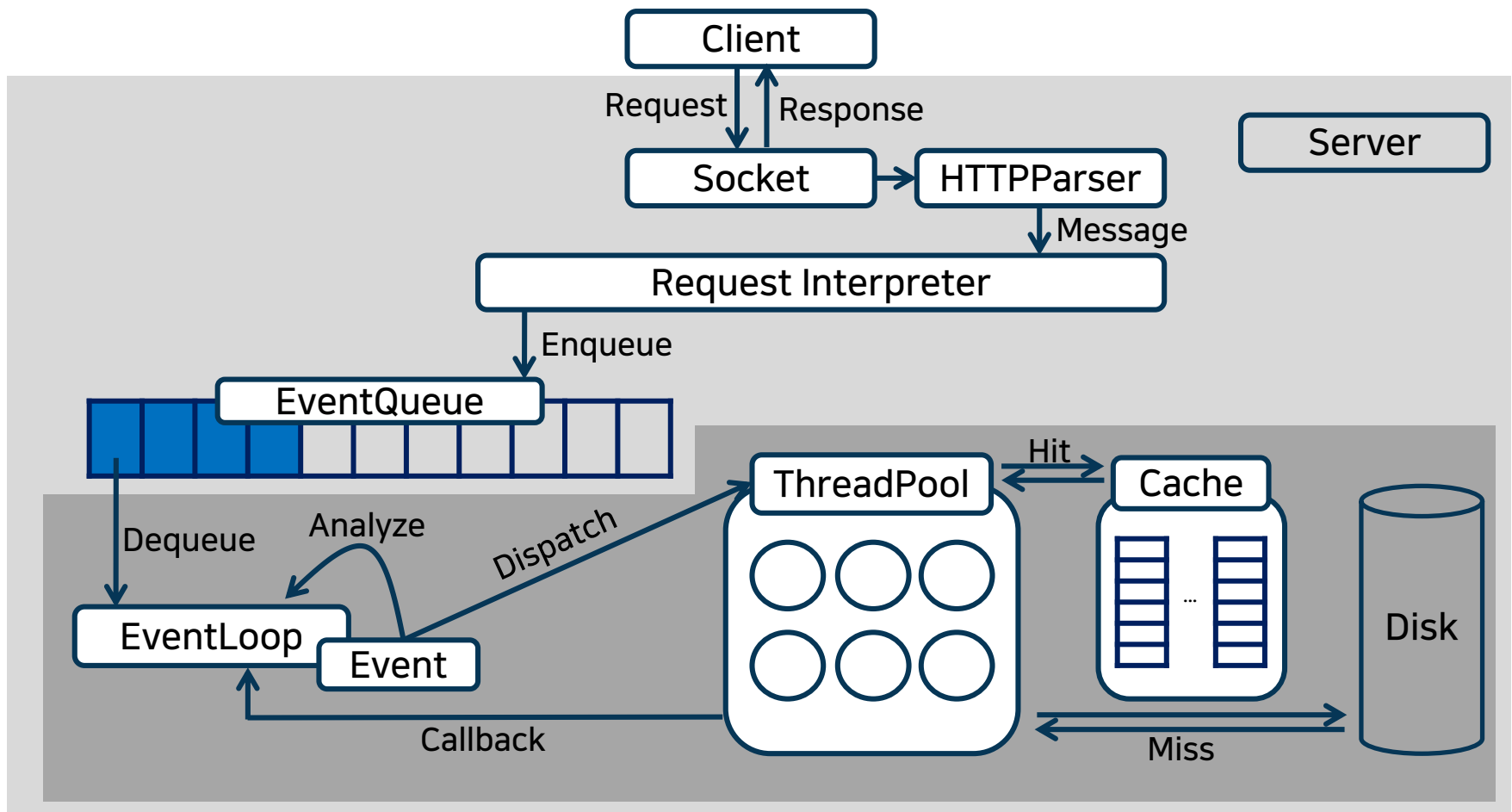
# Current Status(6)

## ✓ EventQueue



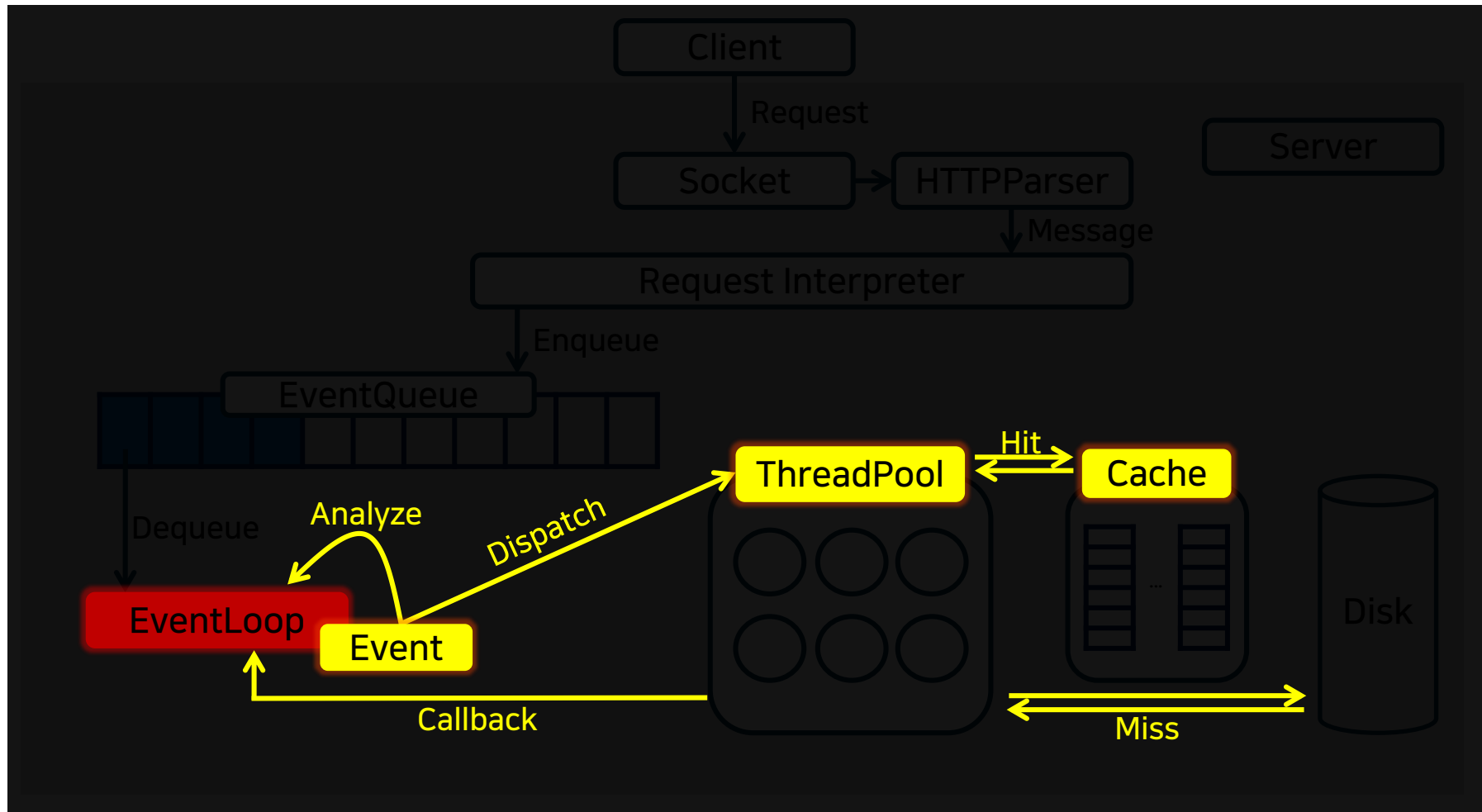
# Further Plan(1)

## ✓ Additional Implementation




# Further Plan(2)

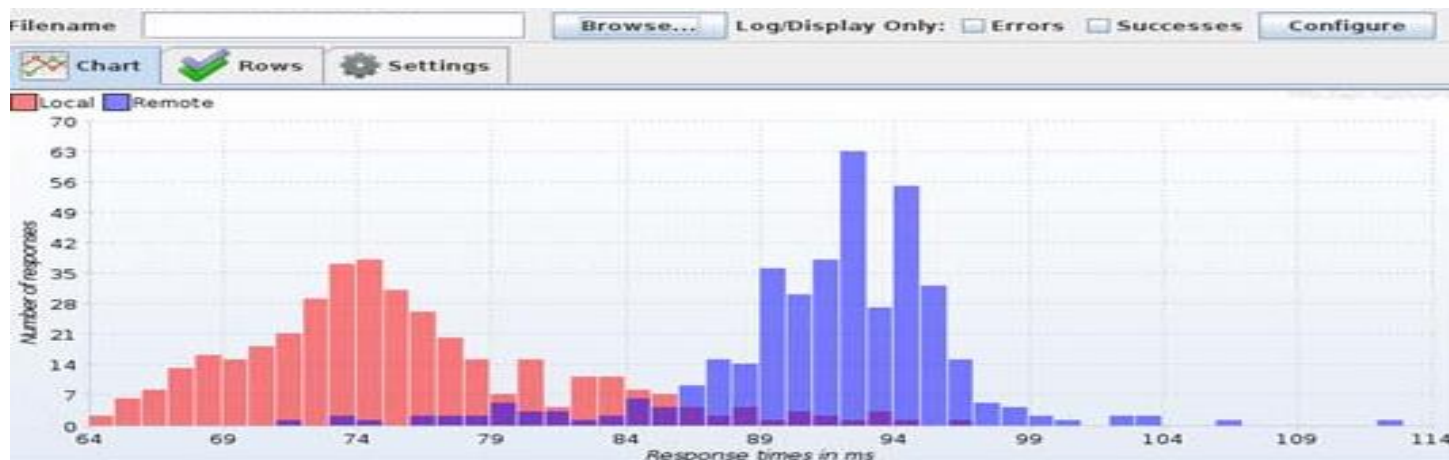
## ✓ Additional Implementation



# Further Plan(3)

## ✓ Demo Plan(1)

- On browser test (Chrome) / using Apache Jmeter
- With famous asynchronous web server **node** 
- Static file system access
- Cache policy : LRU / FIFO



# Further Plan(4)

## ✓ Demo Plan(2)

- Above 1MB file access : using DMA (transfer directly from disk)
- Below 1MB file access : using cache
- Load generation : number of clients
- Client Numbers : 1K, 5K, 10K, 50K, 100K, 500K
- Comparative index : average response time
- Target compare value : at least 80%

# Division of Work



이승현

- 전반적인 프로젝트 관리와 일정 조율
- EventQueue 구현
- Connection header 이슈 처리



박성우

- 전반적인 프로젝트 관리와 일정 조율
- 소켓 프로그래밍 관련 이슈 담당
- HTTP Parser, Interpreter 구현



David

- 테스트 구성 및 오픈소스 코드 스크랩
- 소켓 프로토콜, 초기 개발환경 구축
- Job Classification 및 Type, 코드 리뷰

감사합니다

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