Domain Sockets on Steroids

Bypassing the Kernel using Shared Memory

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Alexander van Renen
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Motivation

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Everyone is using domain sockets

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PostGres MySQL

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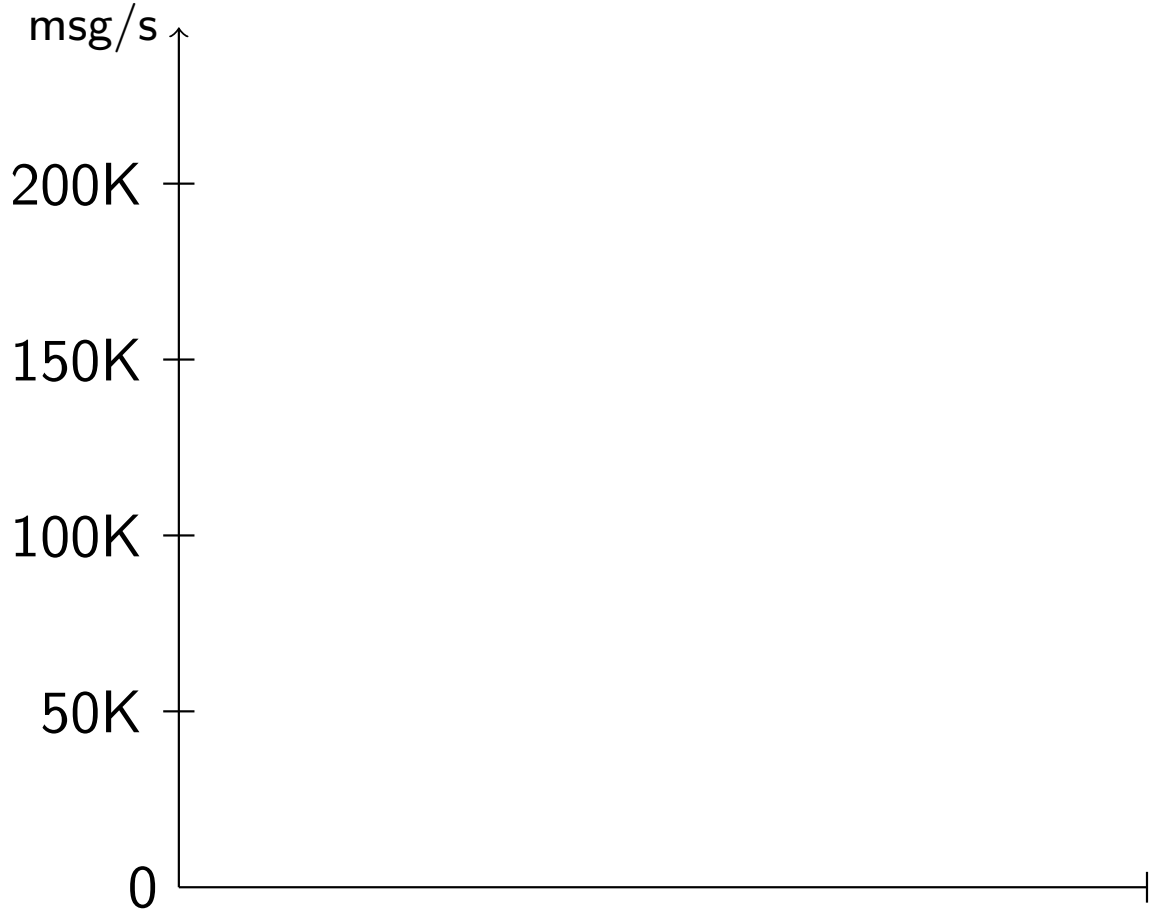
PostGres MySQL HyPer

So, obviously, domain sockets are the best?

Comparing IPC Methods



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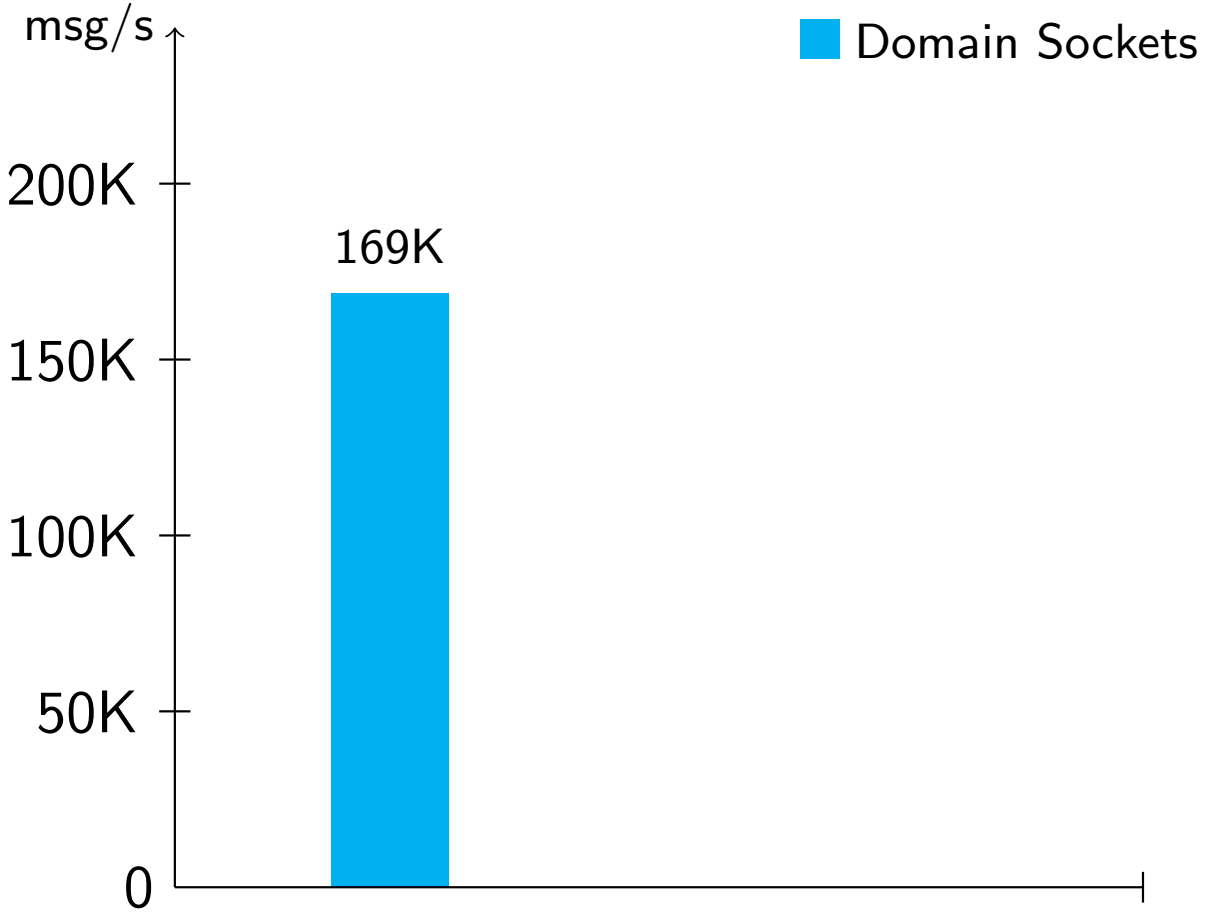

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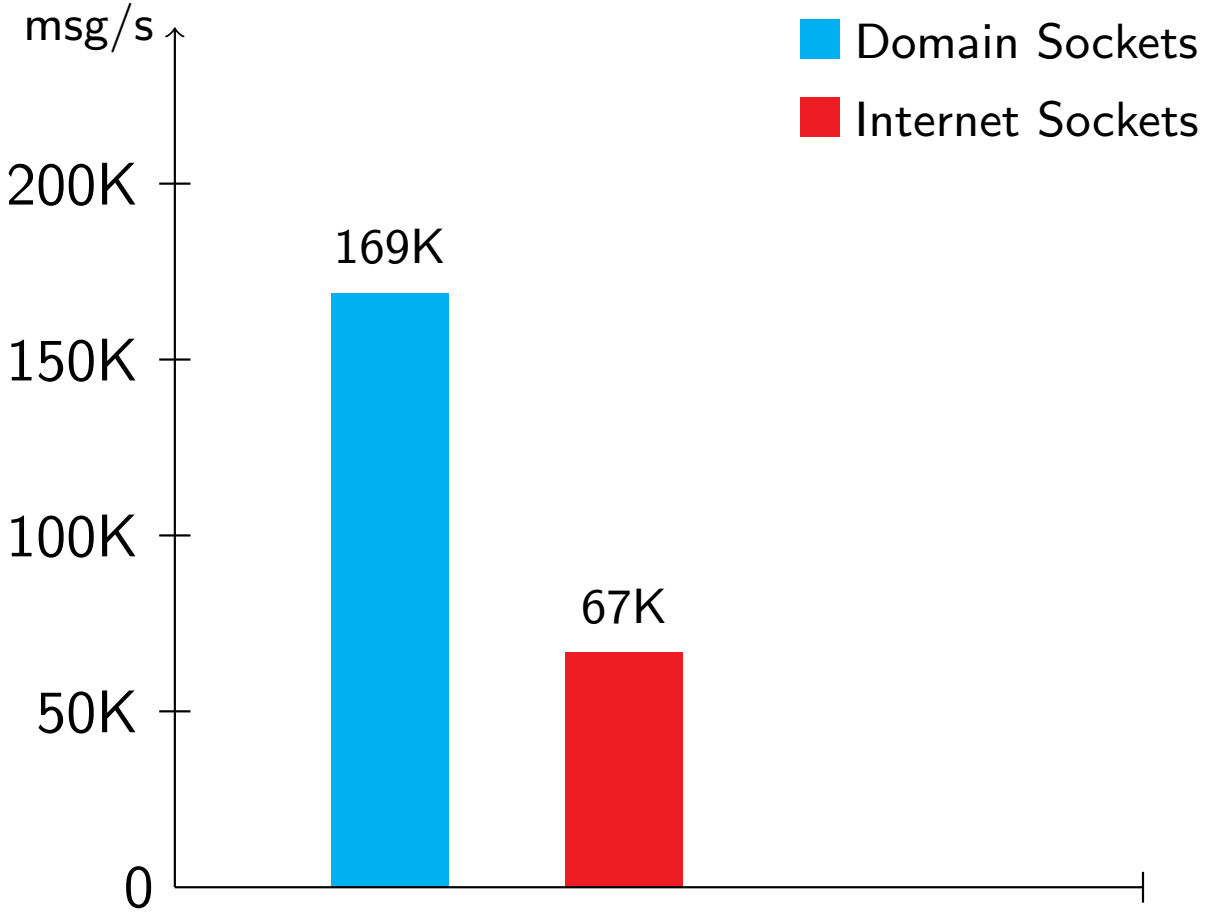

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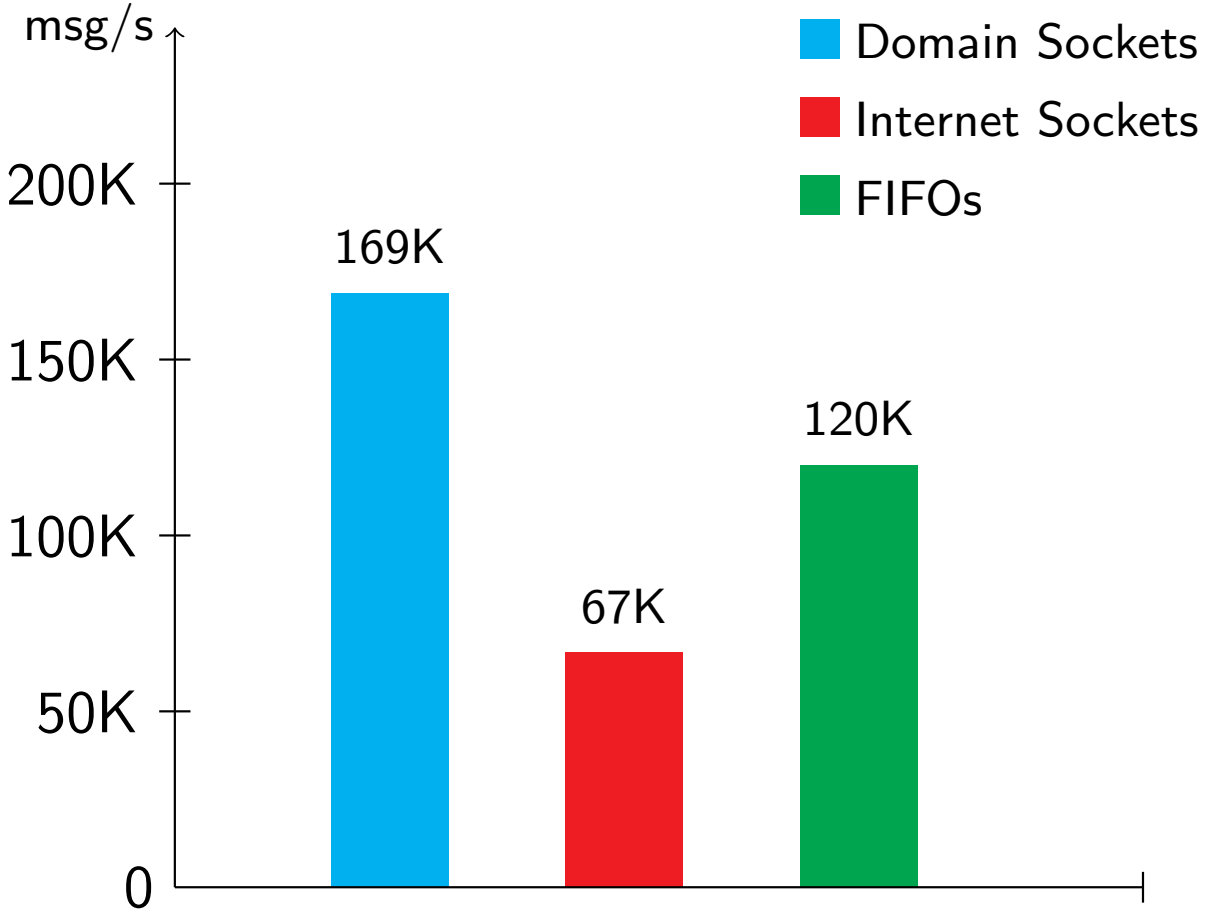

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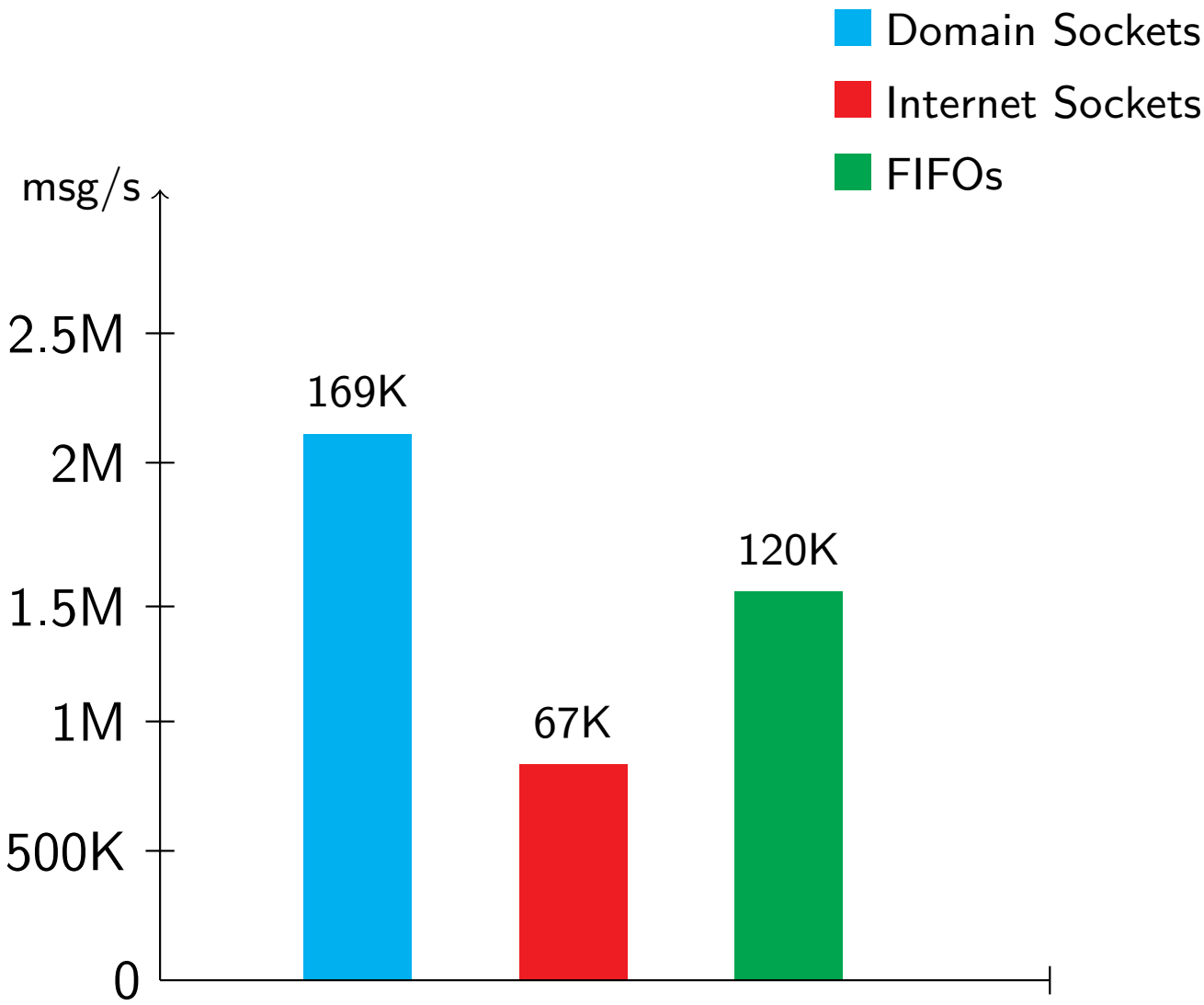

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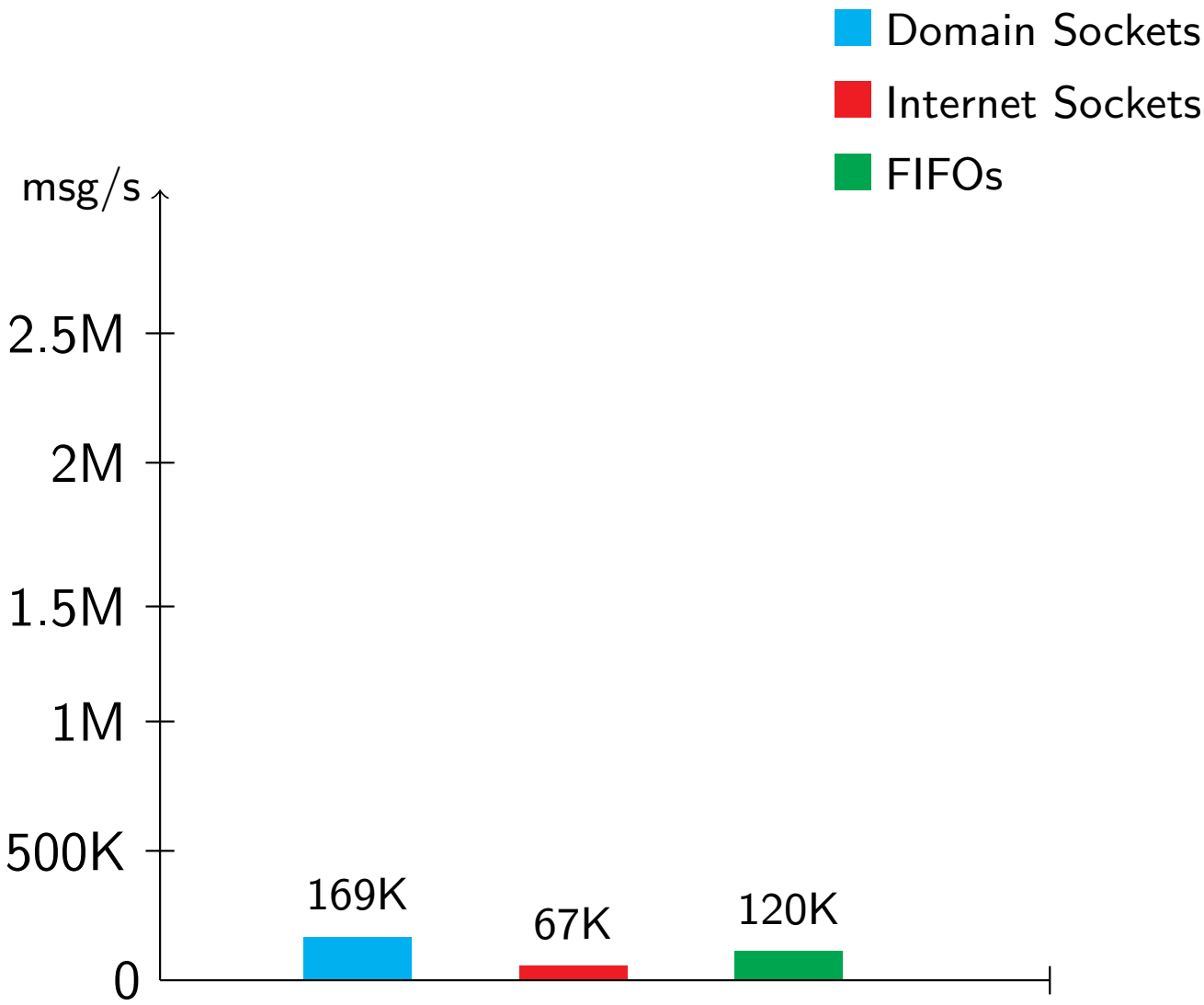

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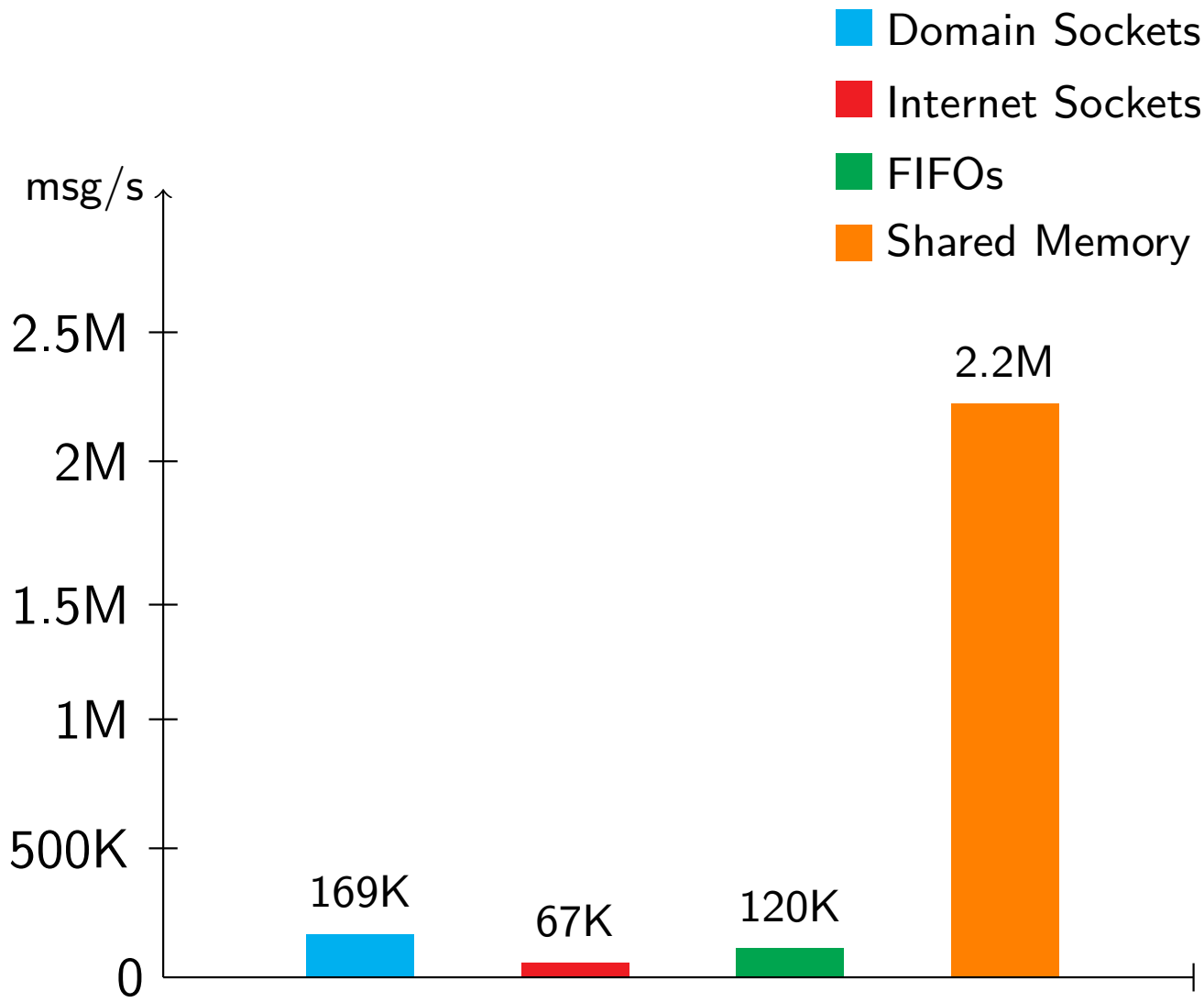

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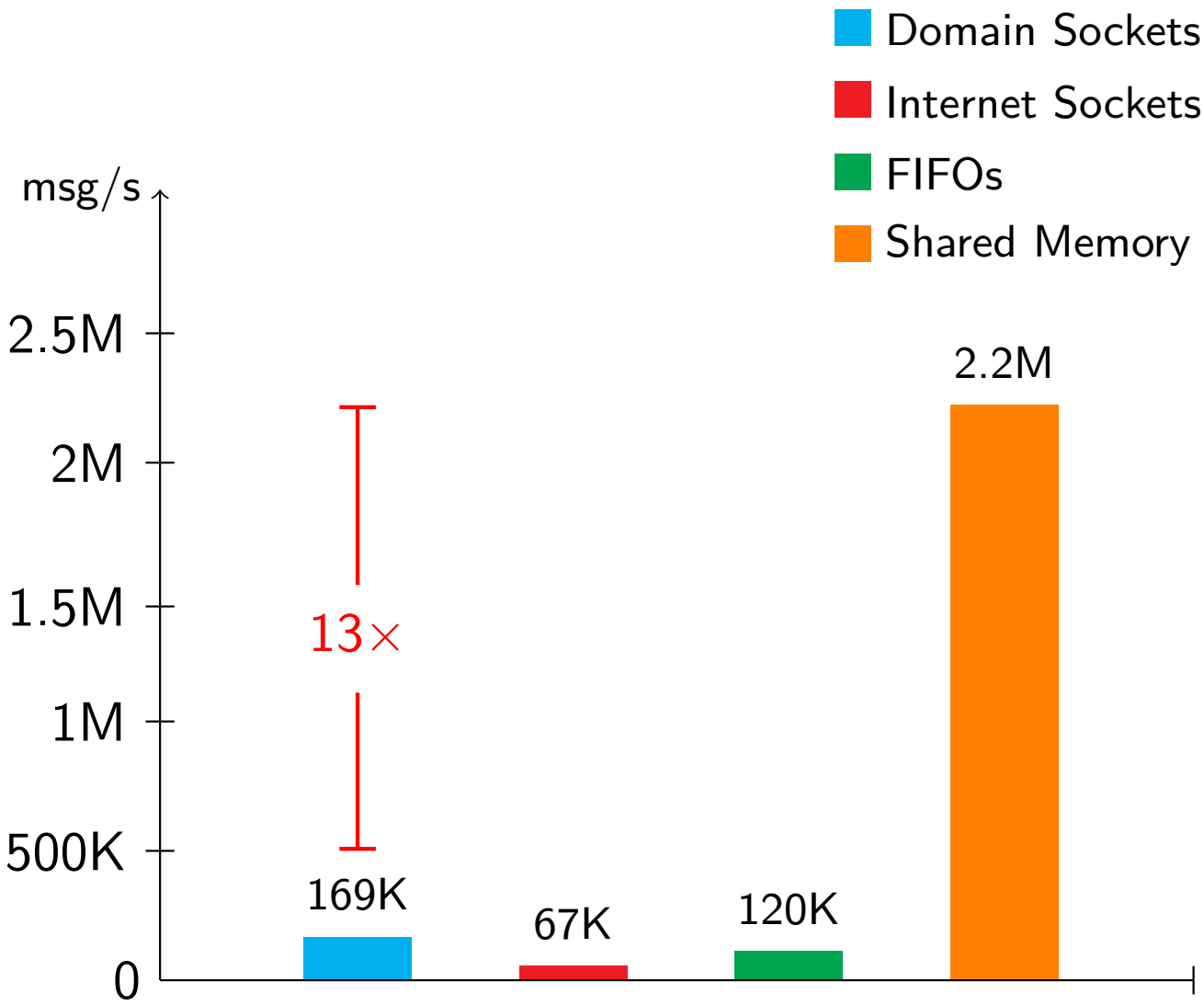

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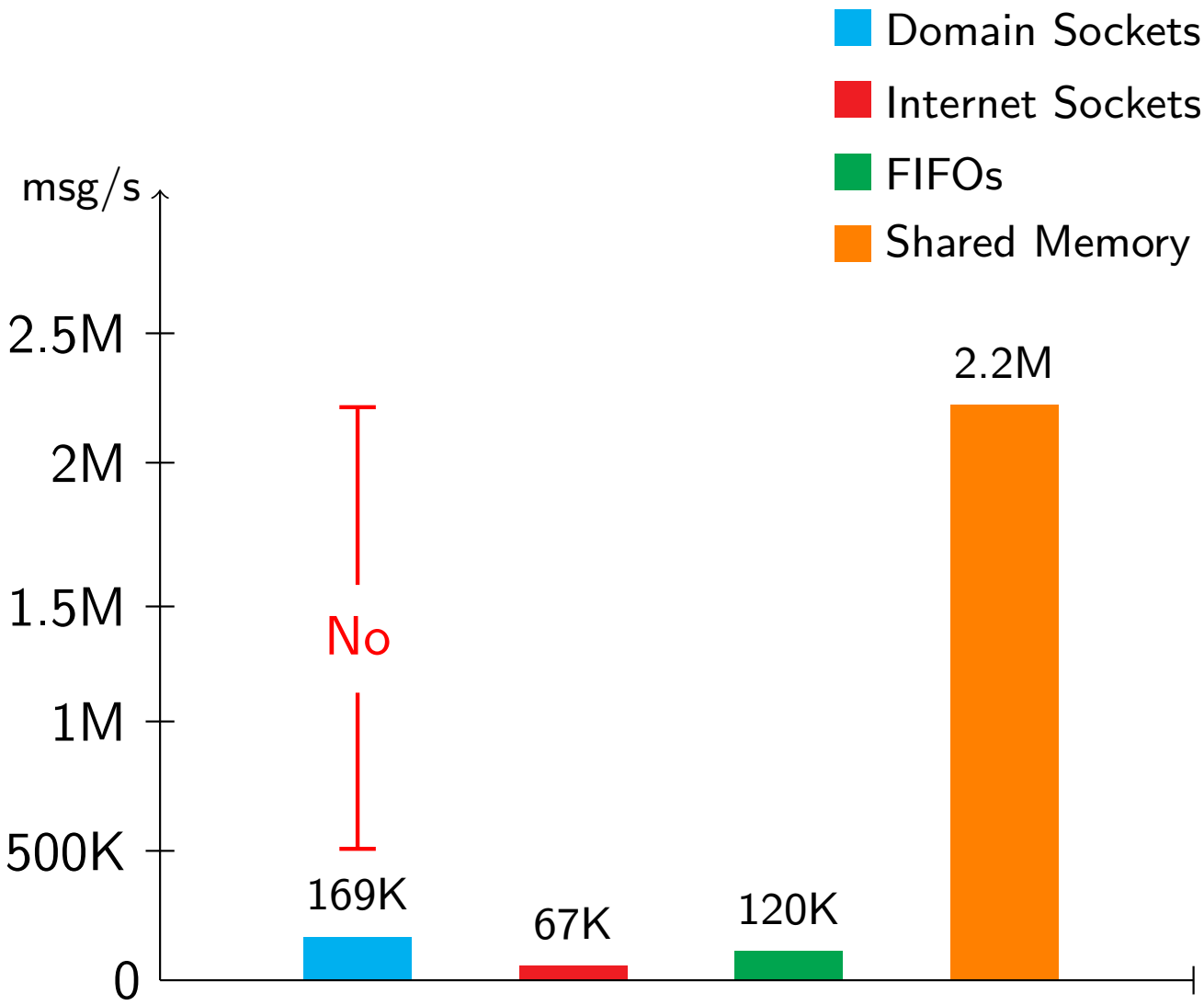

Basic Idea

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2. Overwrite syscalls

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socket()
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connect()
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1. Put on mad scientist hat
2. Overwrite syscalls

```
socket()
accept()
connect()
```

3. Create shared memory channel in the background
4. Don't recompile a single file

```
LD_PRELOAD=/path/to/our/library ./hyper
```

Implementation

(1) `connect()` $\longleftrightarrow$ `accept()`

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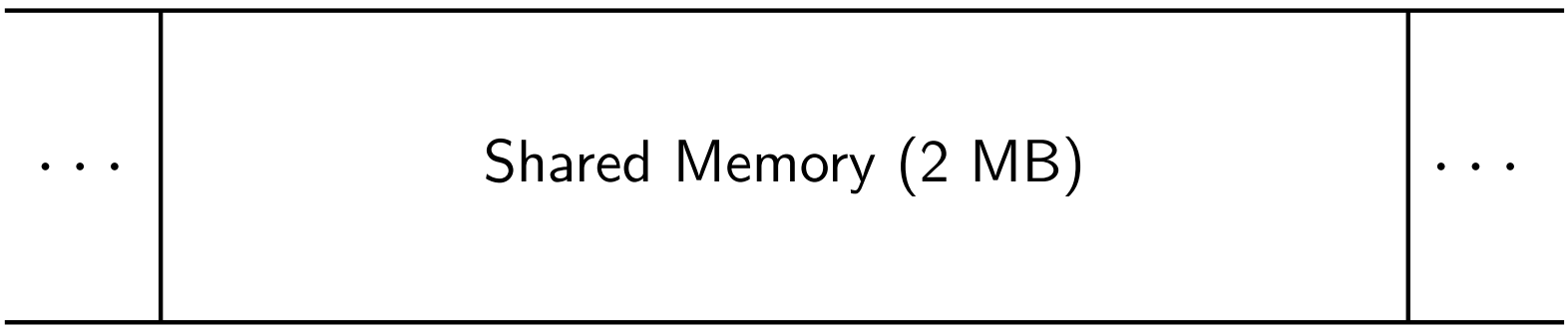

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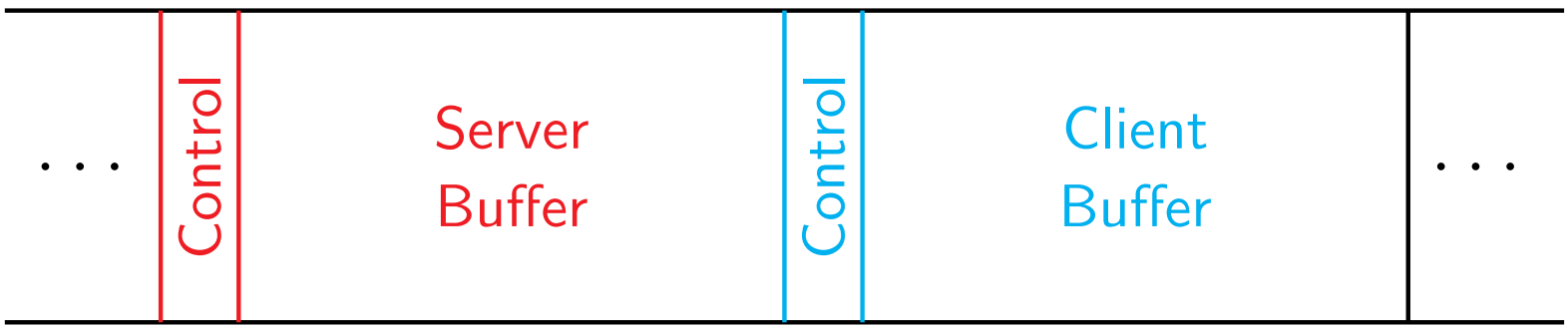
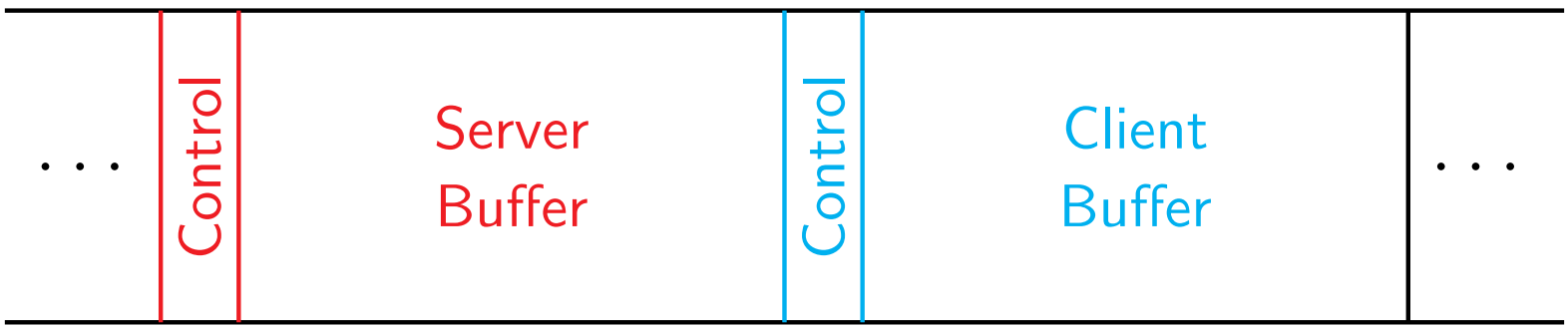


Implementation

(2) Client `write(500 KB)`



Implementation

(2) Client `write(500 KB)`

```
int write(int fd, void* buffer, int length) {
  if (using_our_library(fd)) {
    connection = lookup(fd);
    return buffer_write(connection, buffer, length);
  } else {
    return real_write(fd, buffer, length);
  }
}
```

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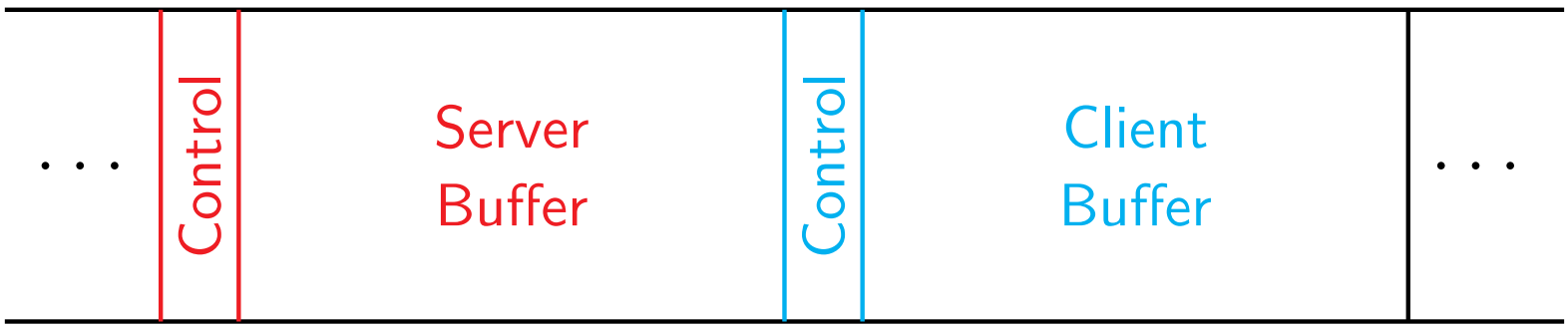

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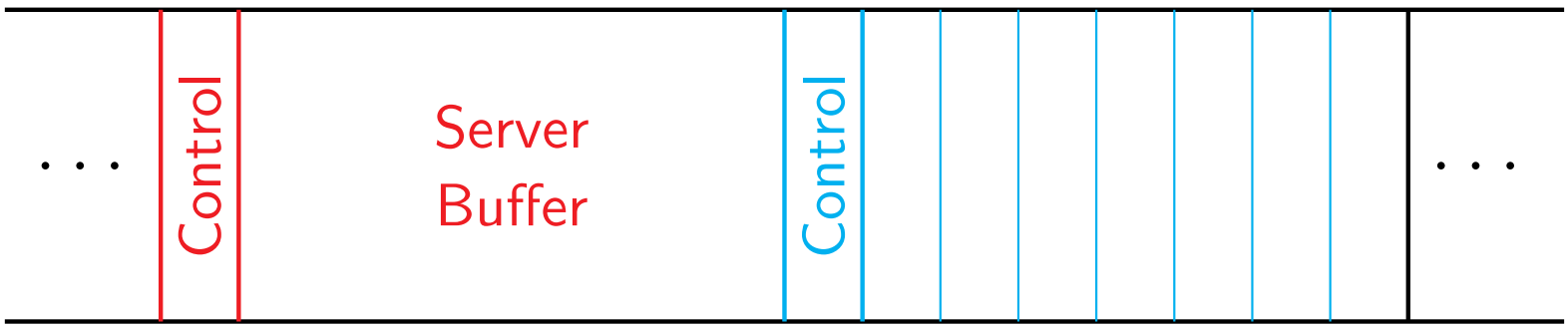

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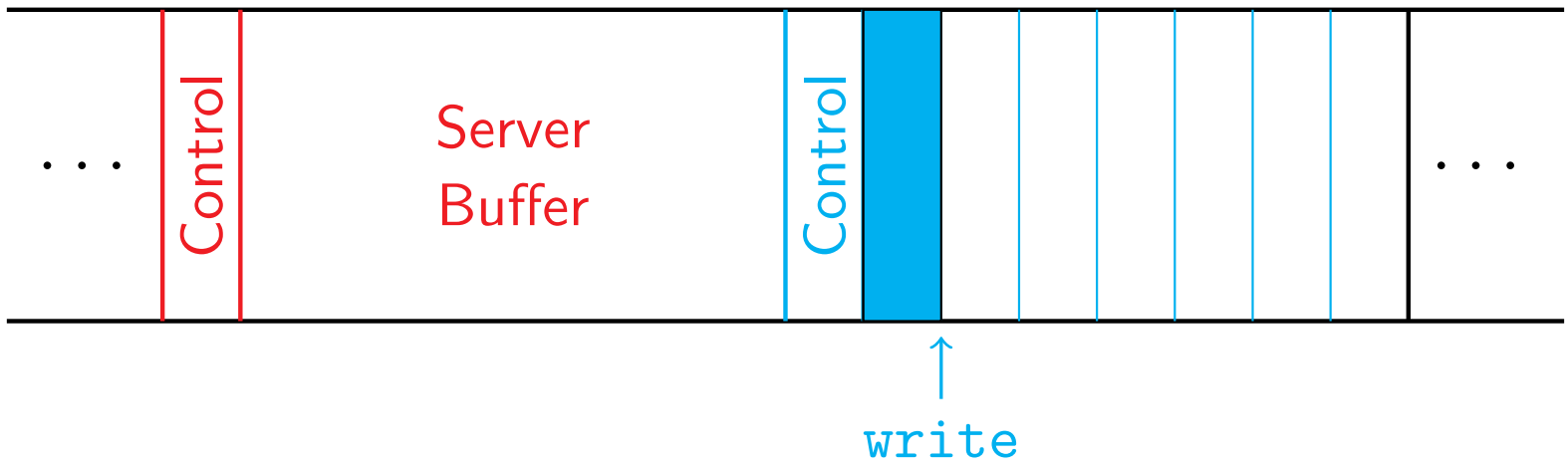

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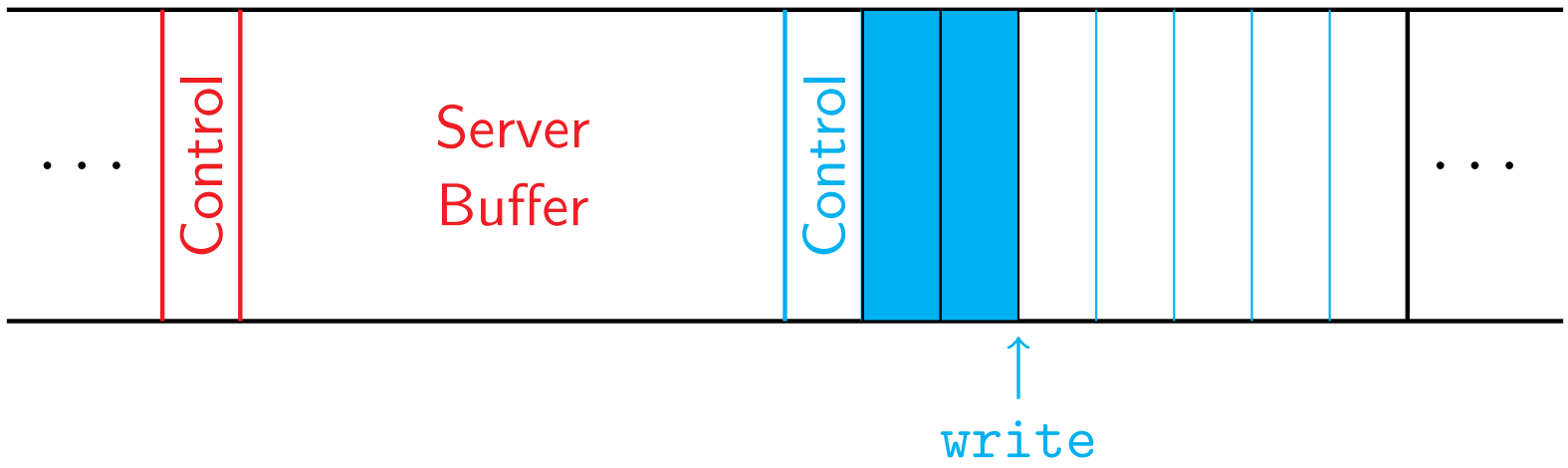

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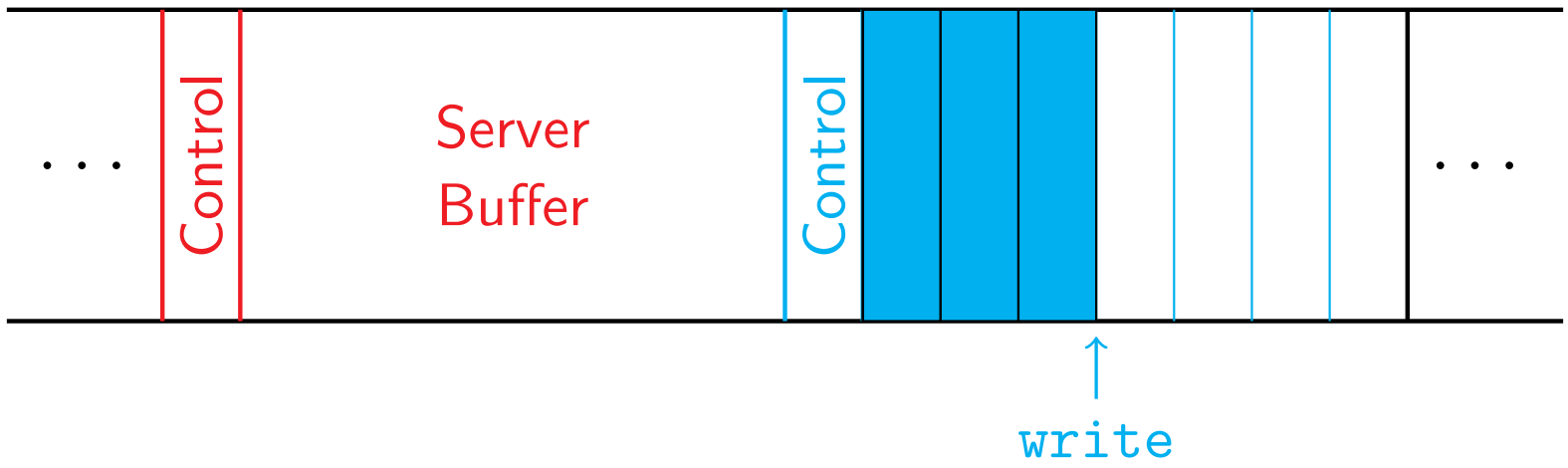

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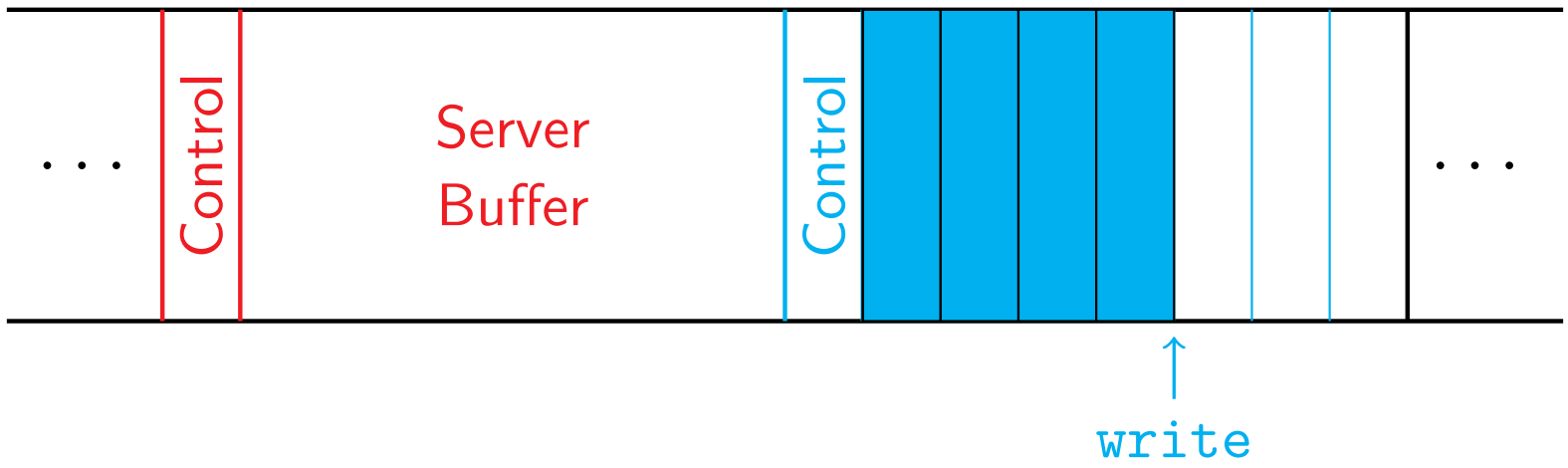

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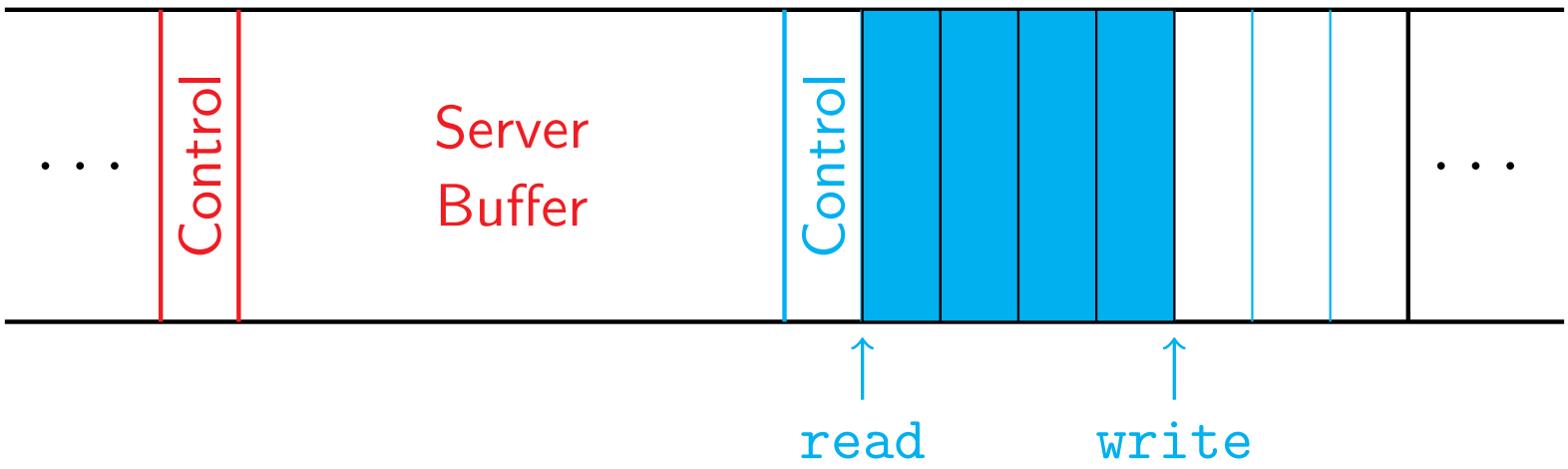
(2) Server `read(250 KB)`



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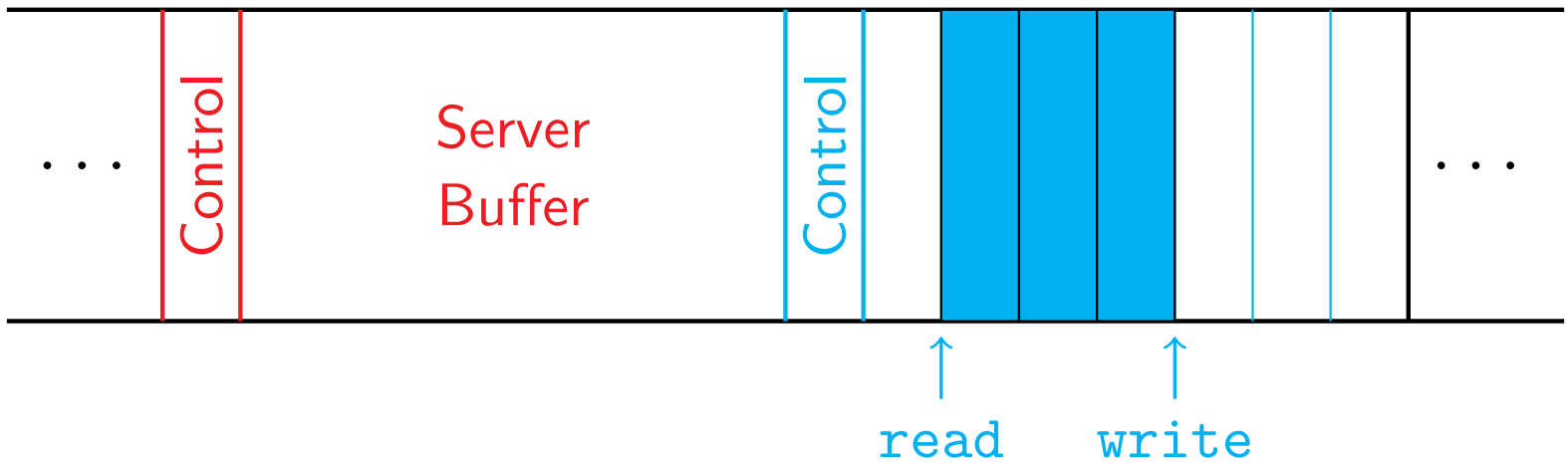

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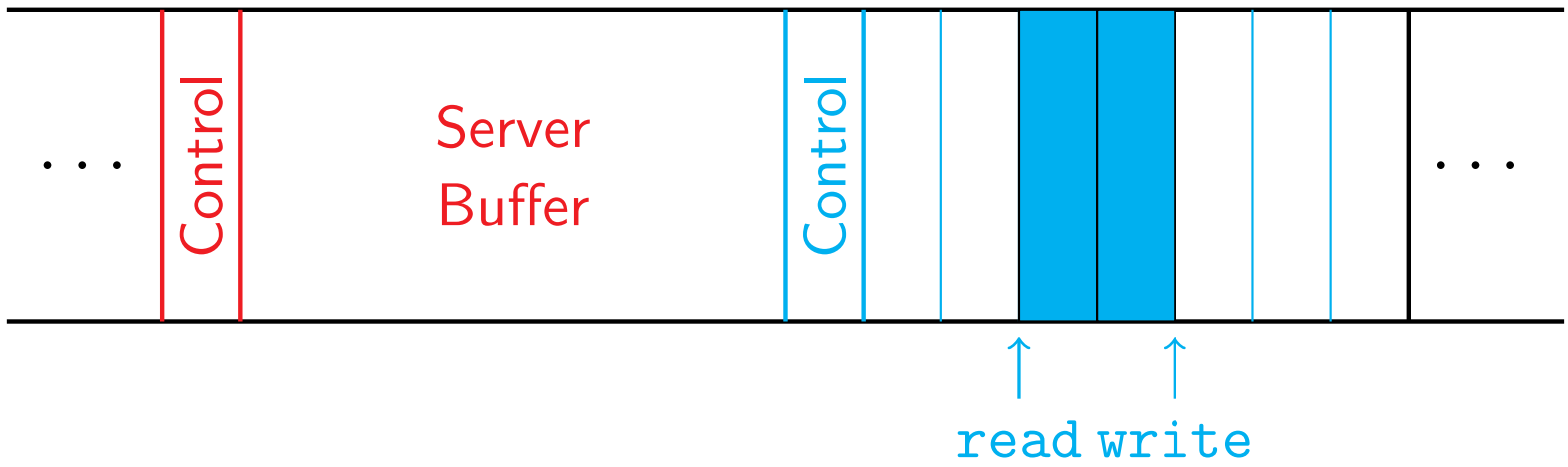
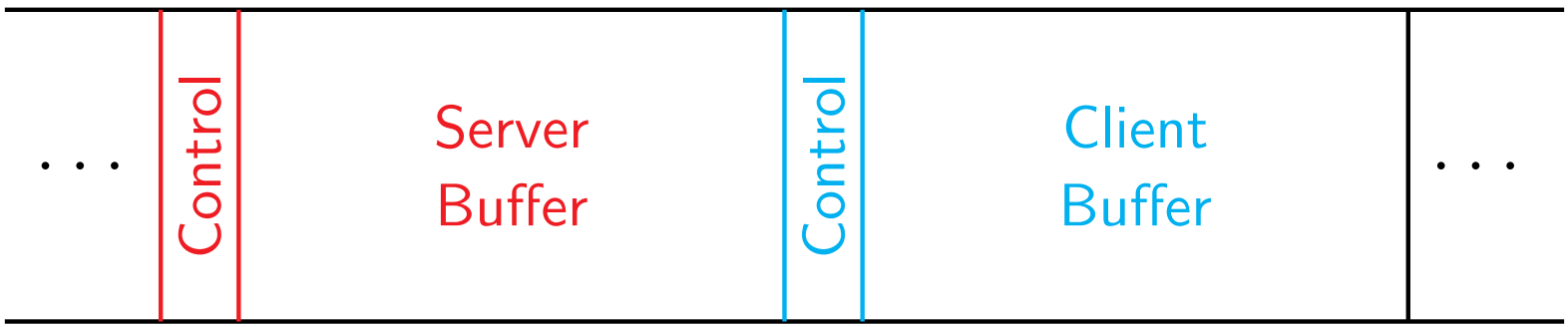


Implementation

(4) Server `write(1.2 MB)`



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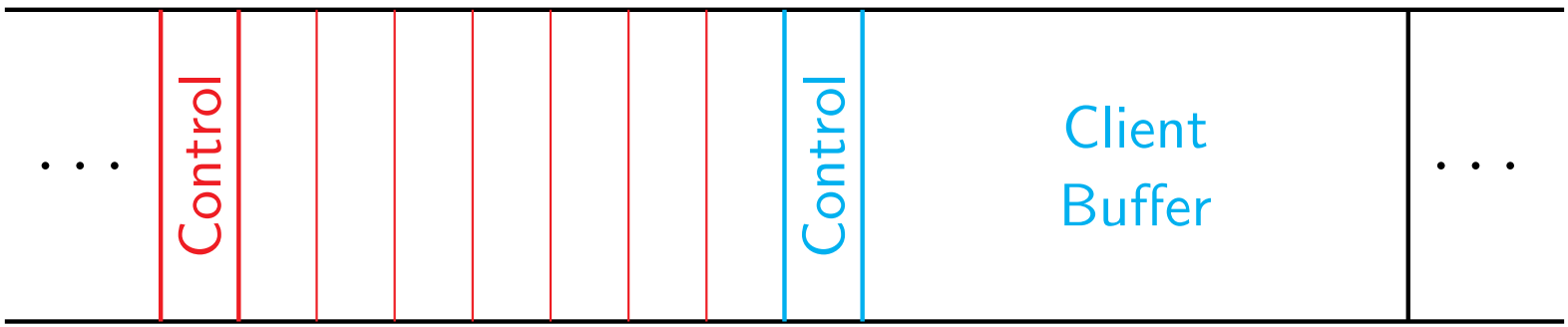

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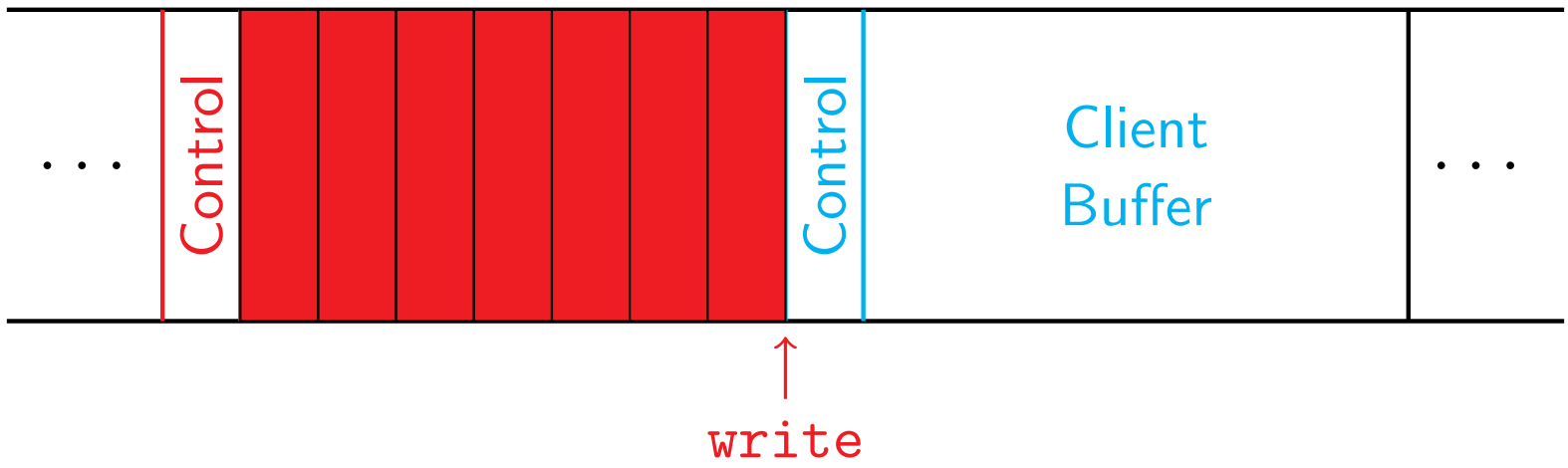


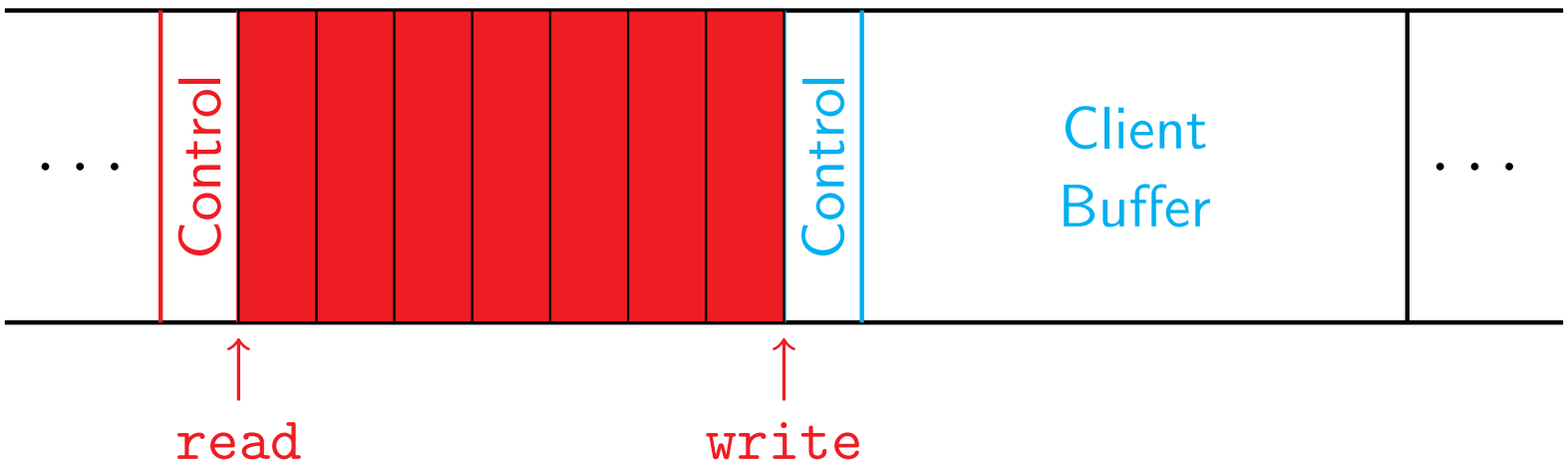
Implementation

(4) Server `write(1.2 MB)`

```
start = now(); // asm("rdtsc")
while(not enough space) {
  switch(now() - start) {
    case elapsed_time < LEVEL_ONE: asm("pause"); break;
    case elapsed_time < LEVEL_TWO: sched_yield(); break;
    case elapsed_time < TIMEOUT: usleep(1); break;
    default: return TIMEOUT_ERROR;
  }
}
```

Implementation

(5) Client `read(200 KB)`



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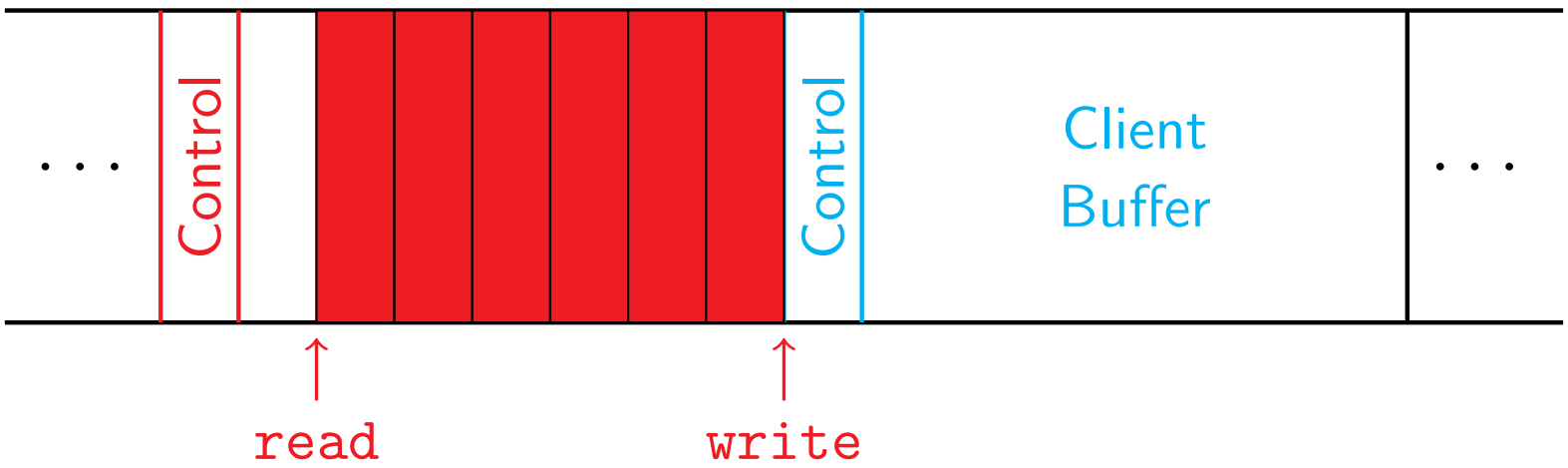

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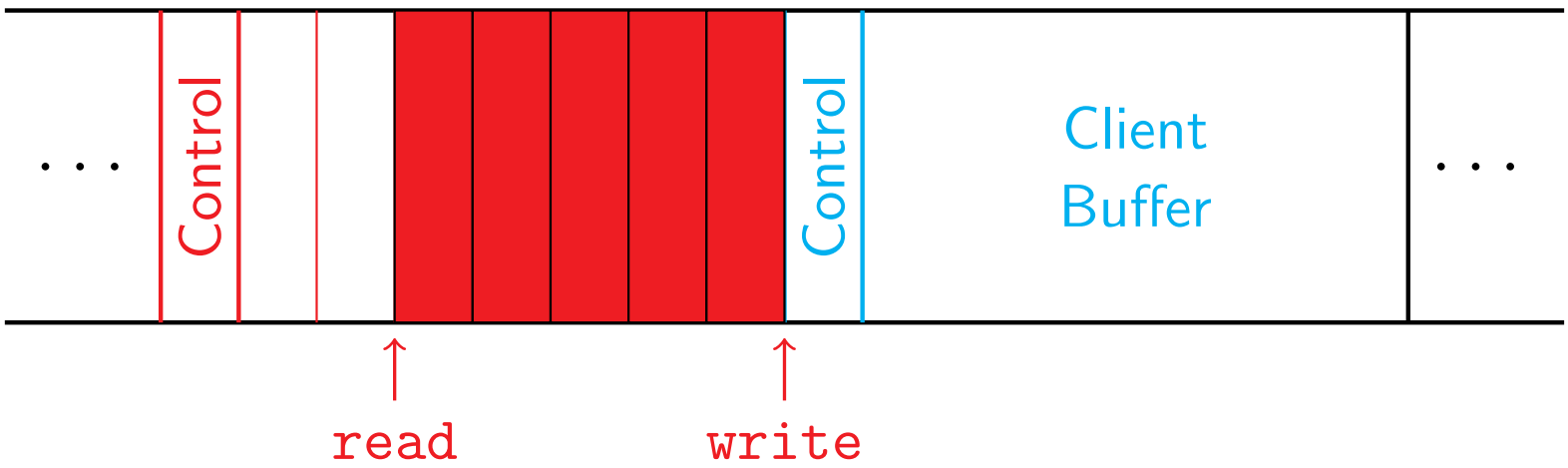

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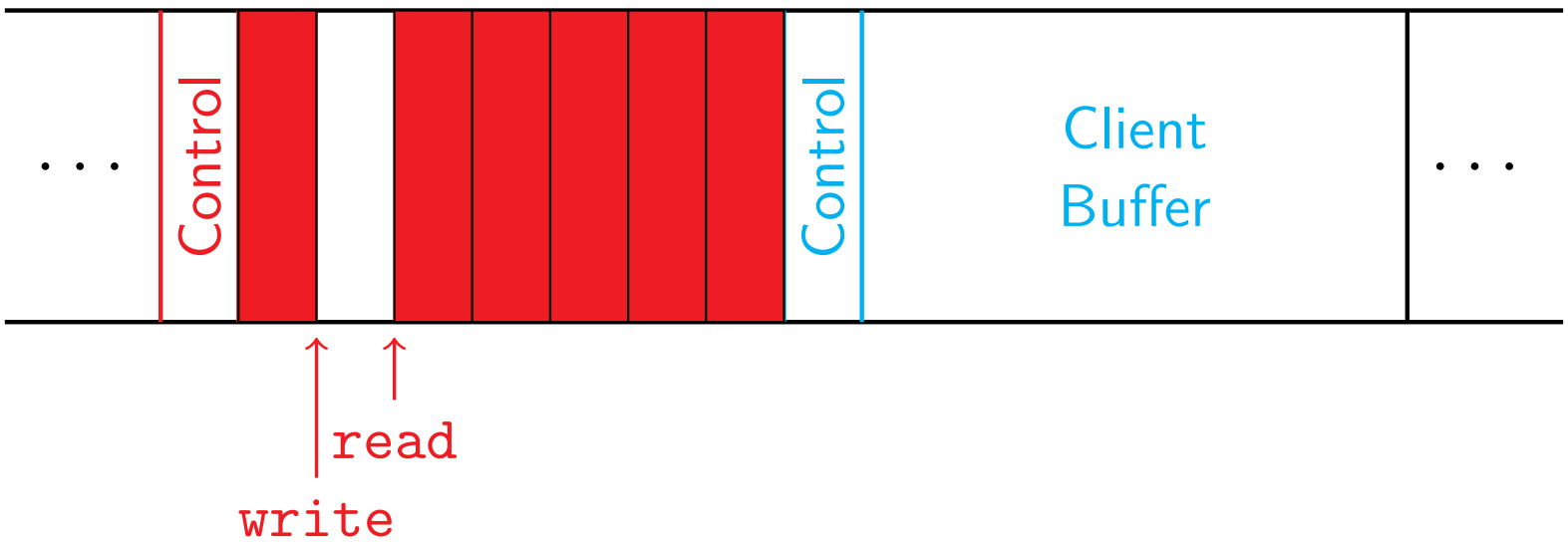

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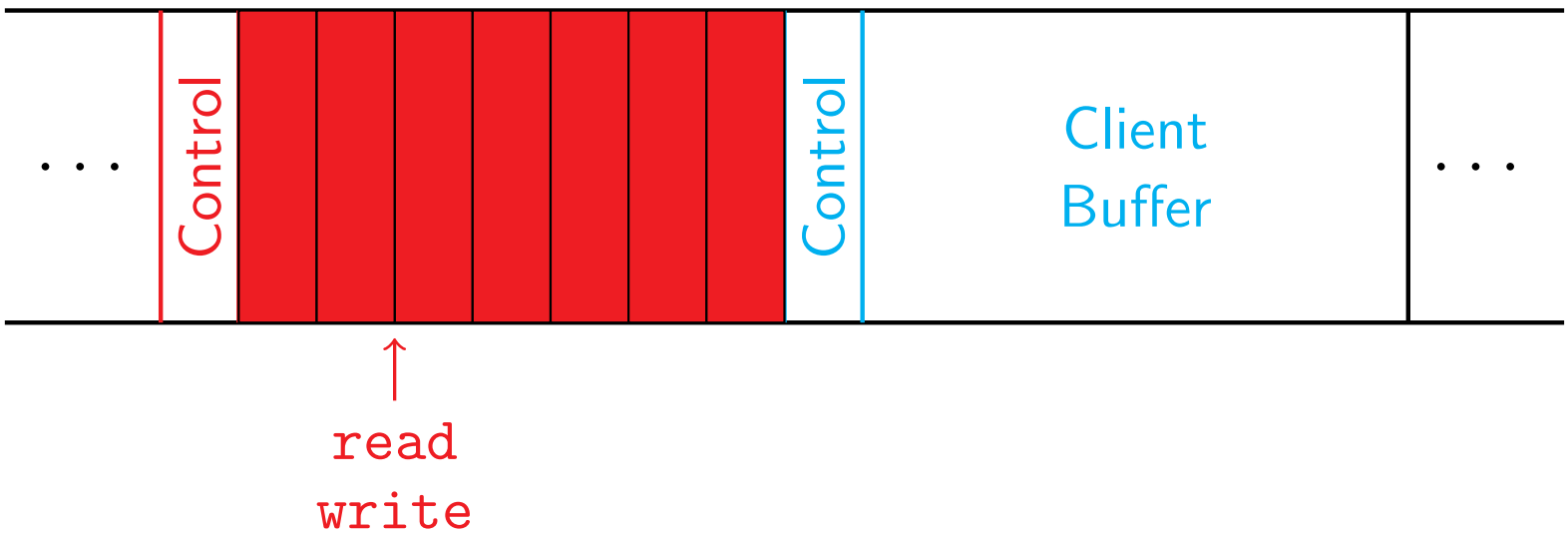


Problems

File Descriptors or Keys?

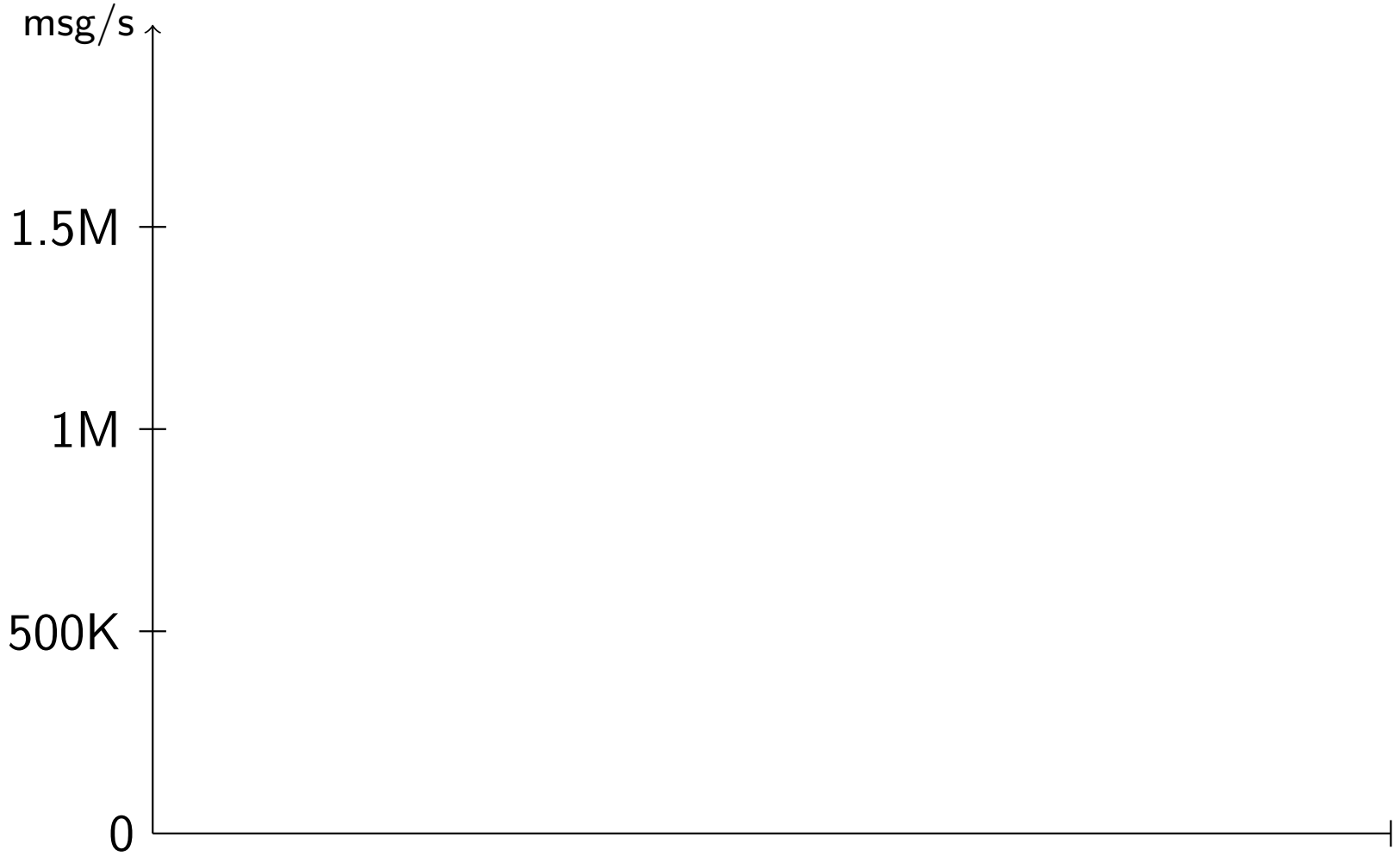
Problems

`select()` and `poll()`

Problems

`fork()` and `kill()`

Results



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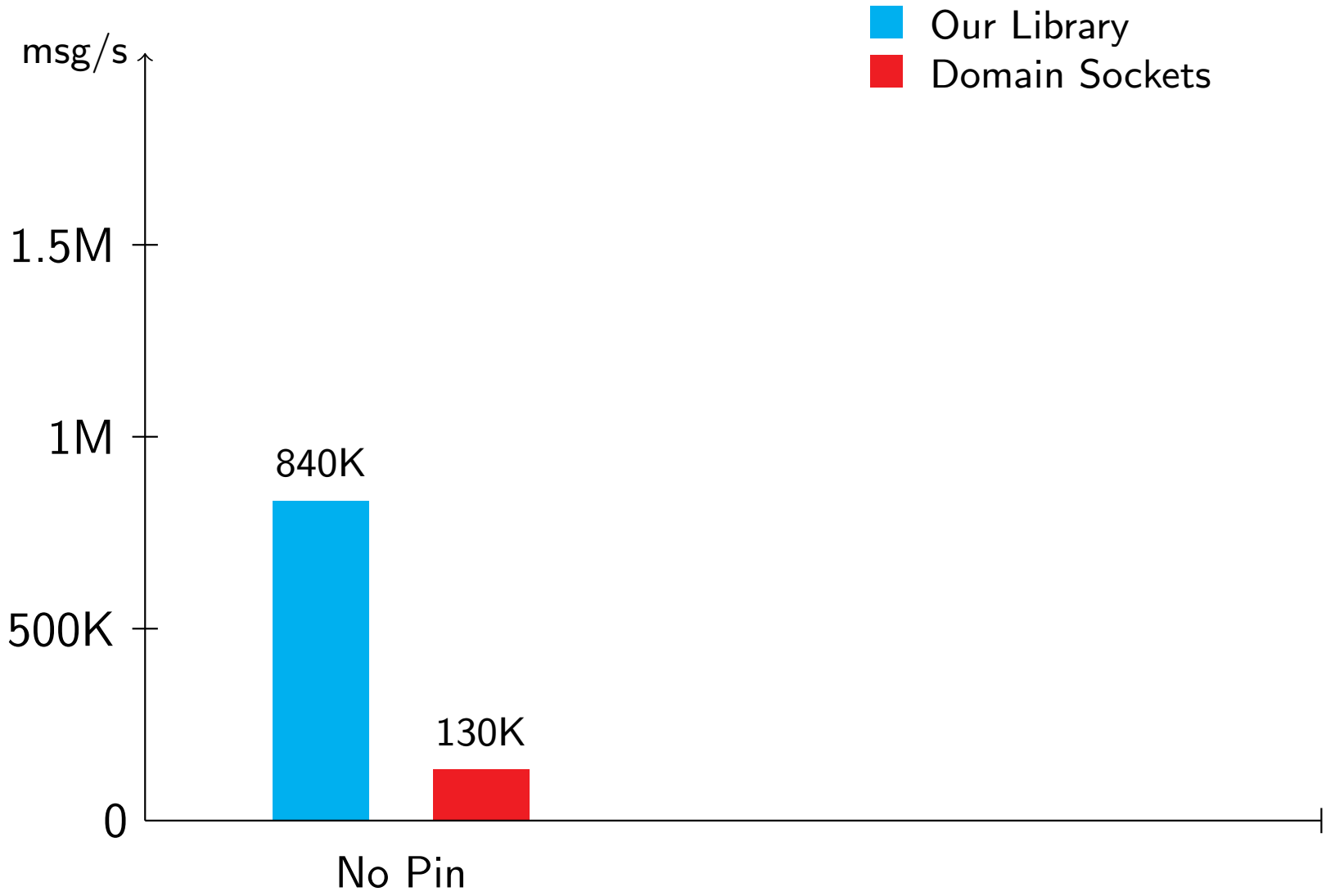
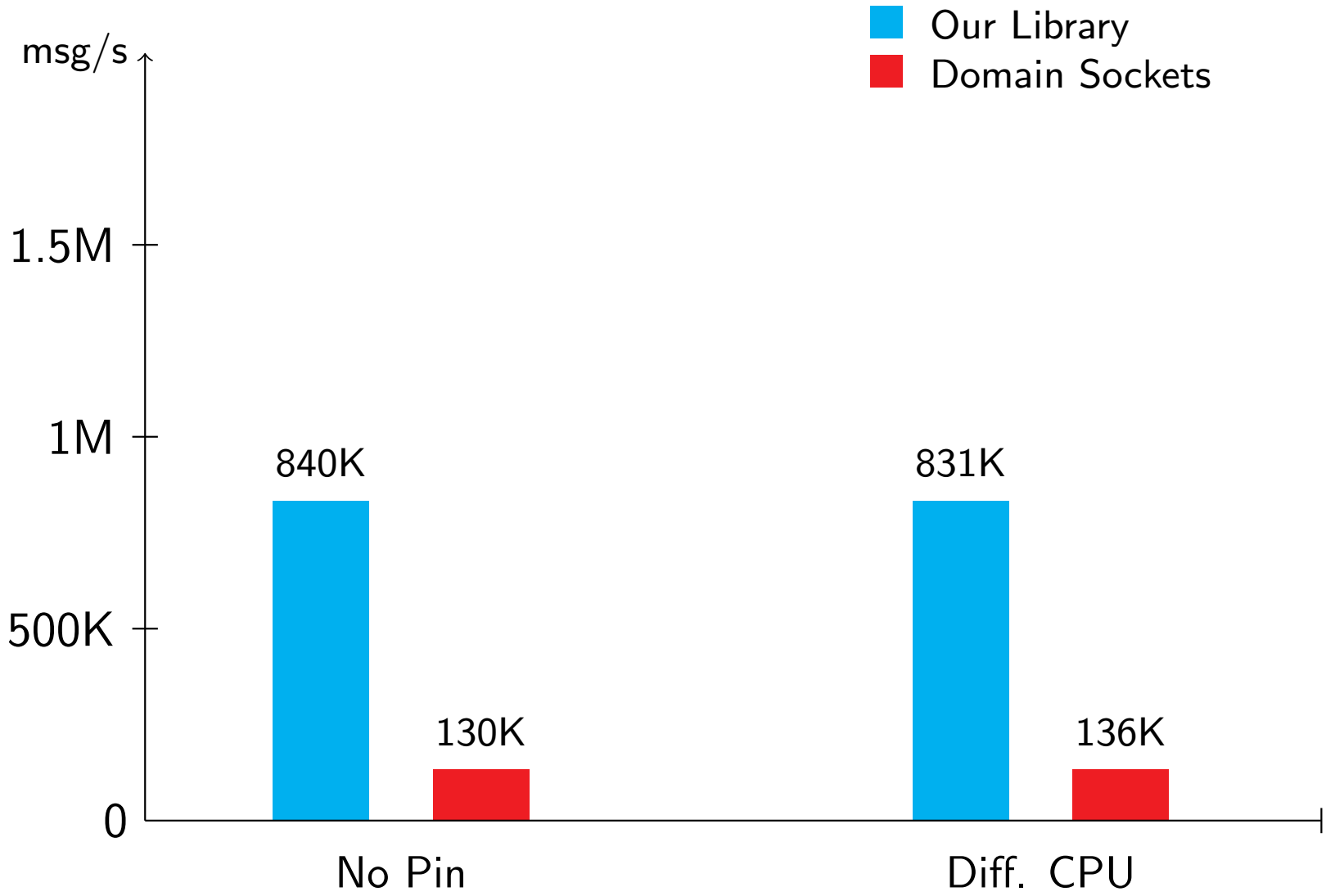

Our Library
Domain Sockets
msg/s
1.5M
1M
500K
0
840K
130K
No Pin

Results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Diff. CPU

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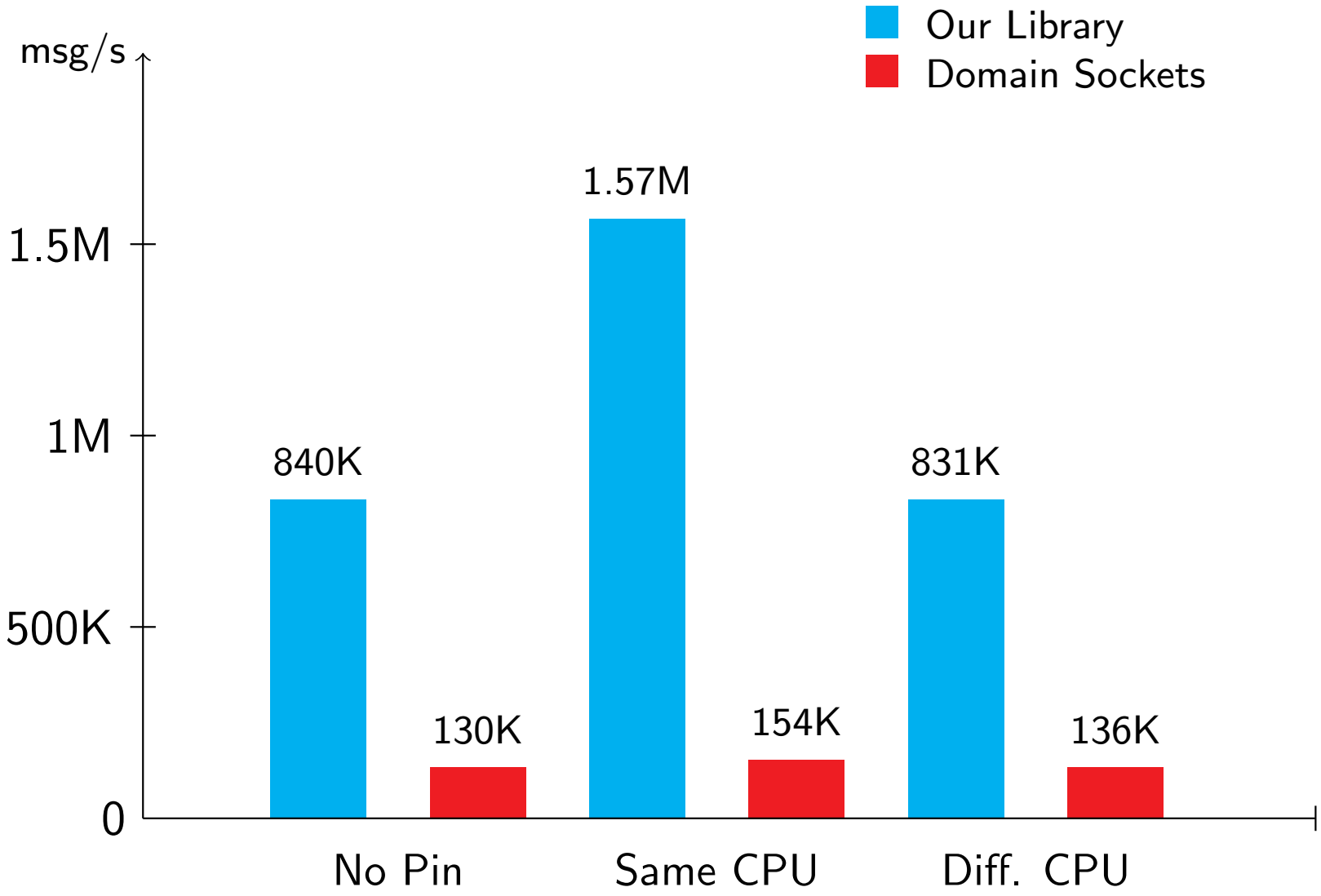
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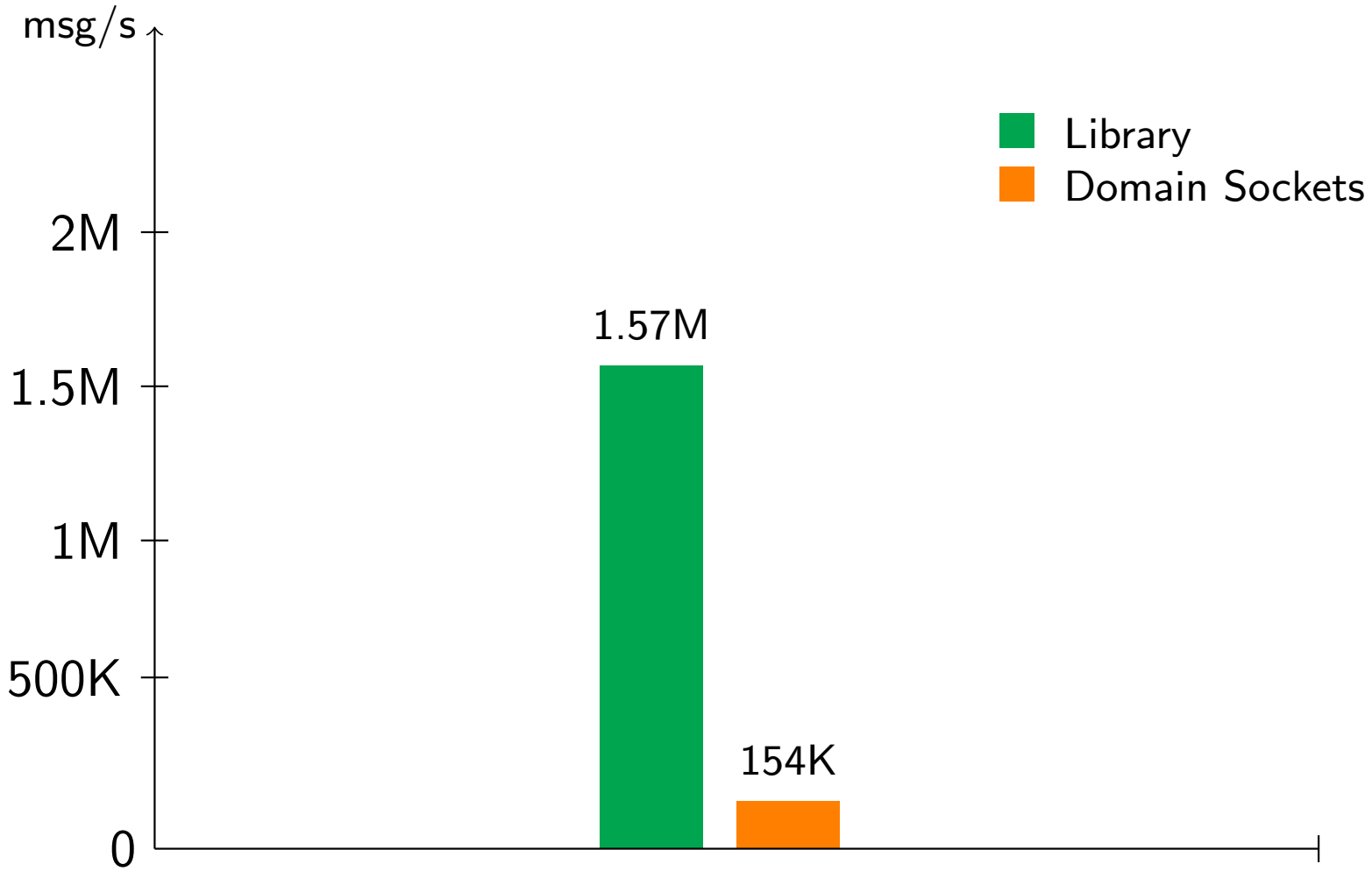
Where does this leave us?



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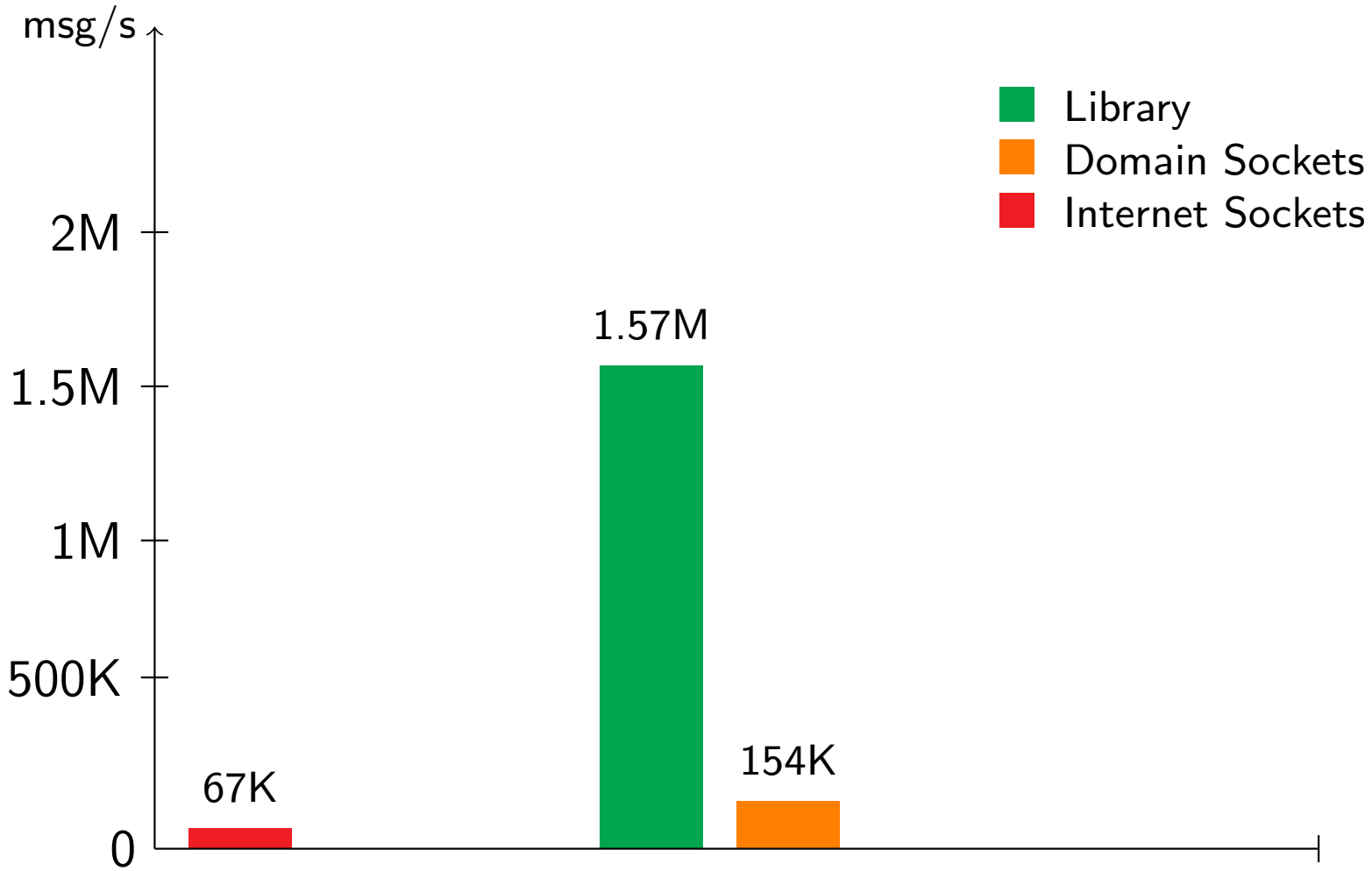

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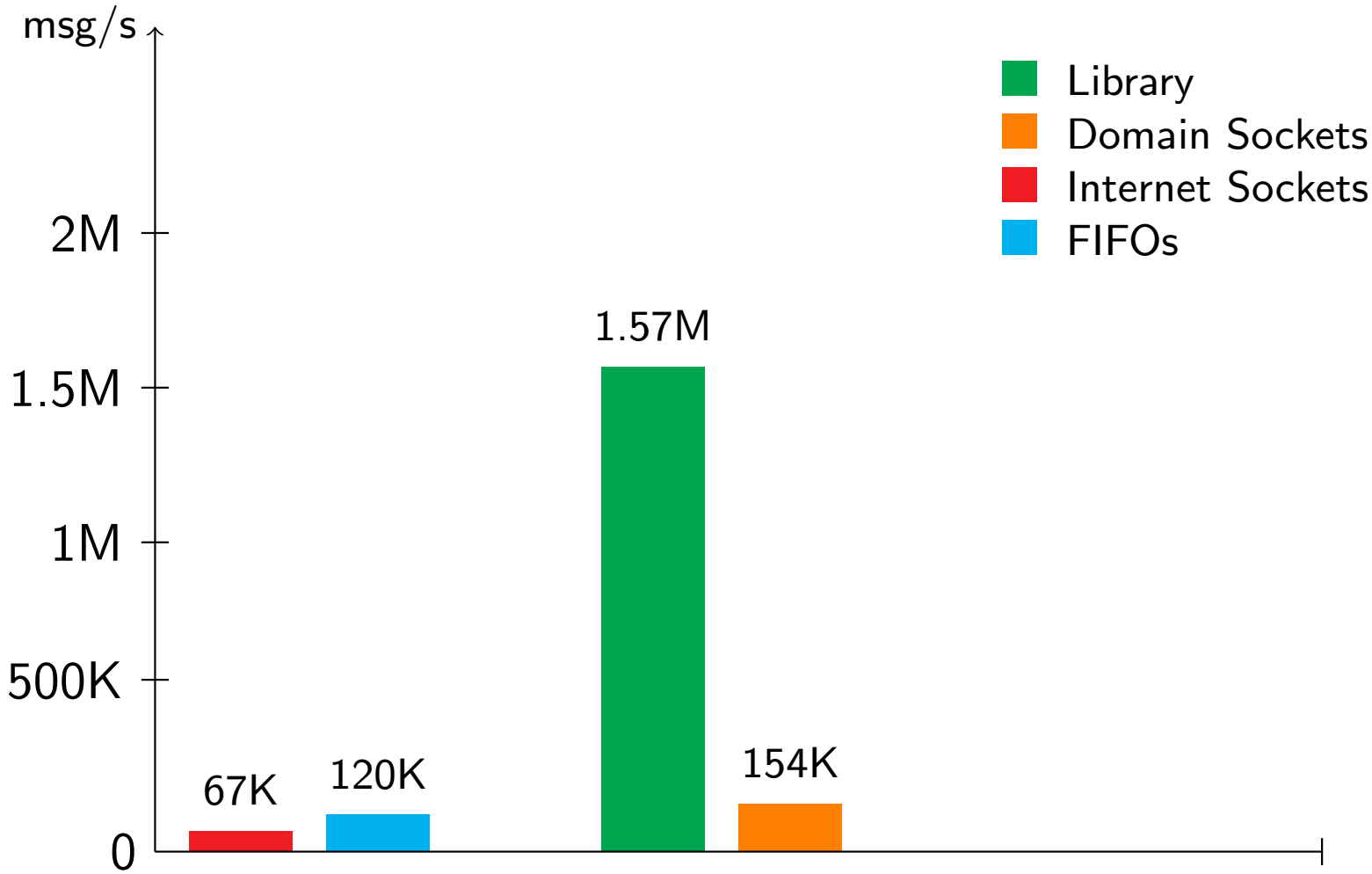

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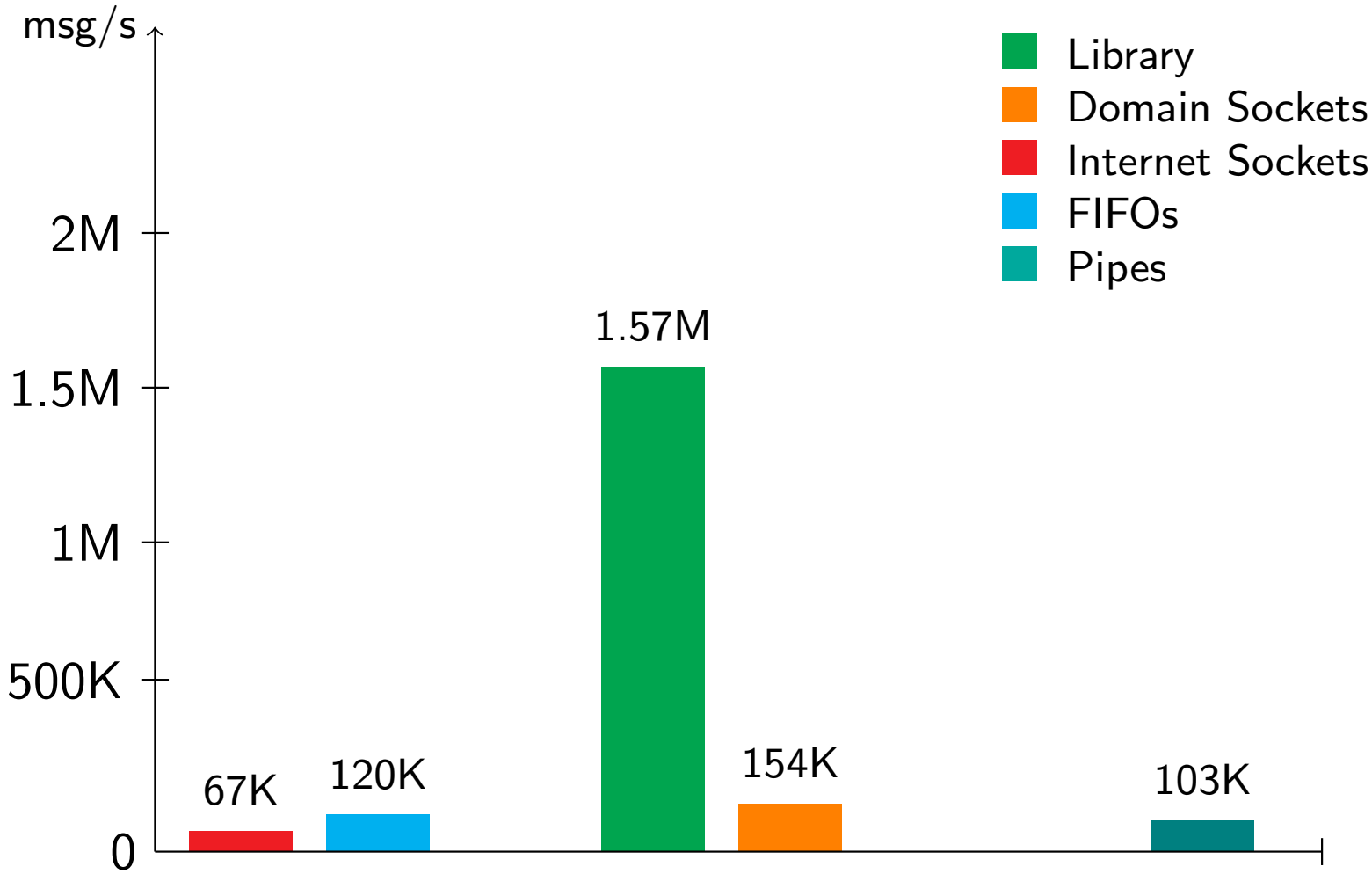

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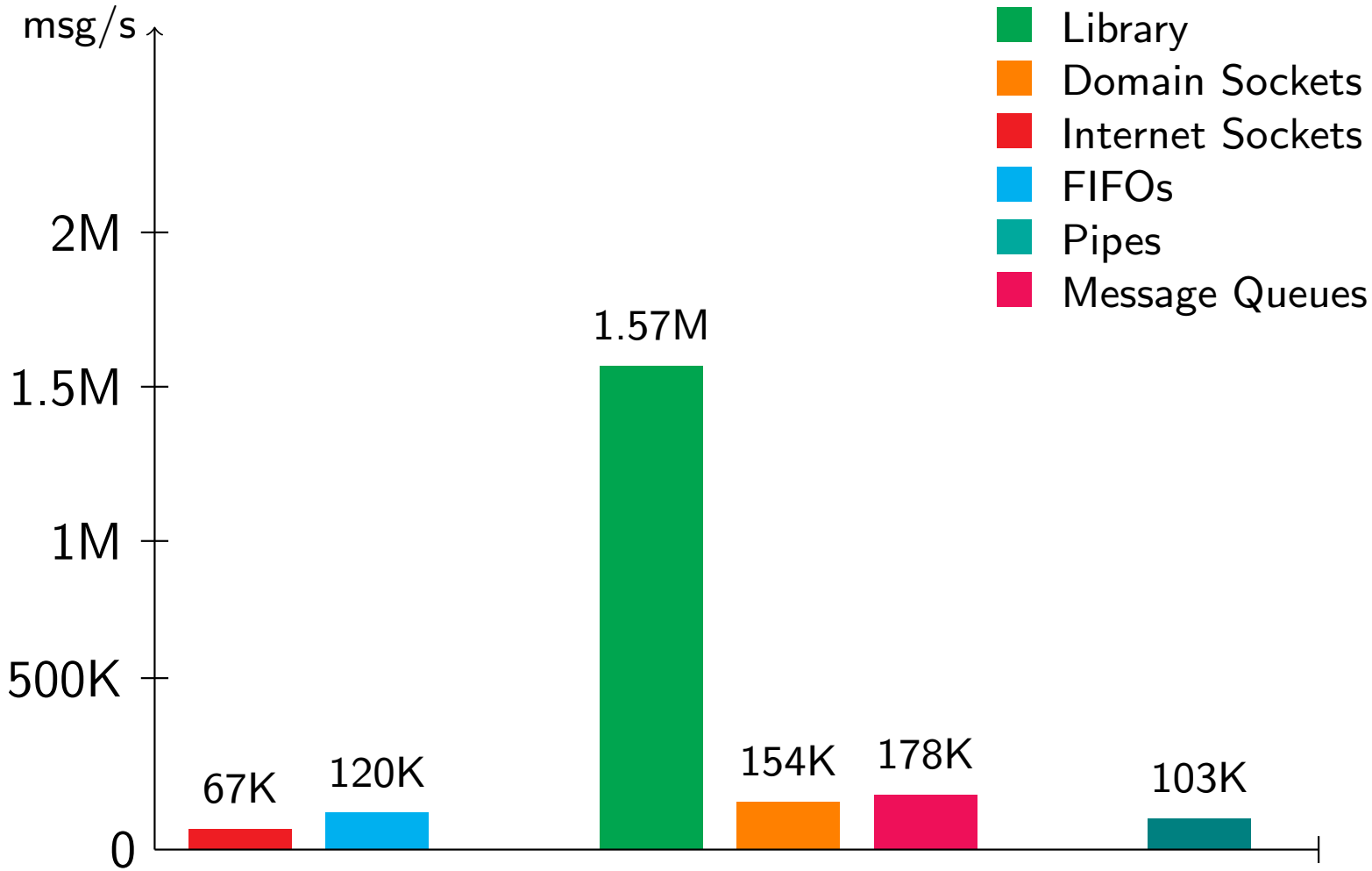

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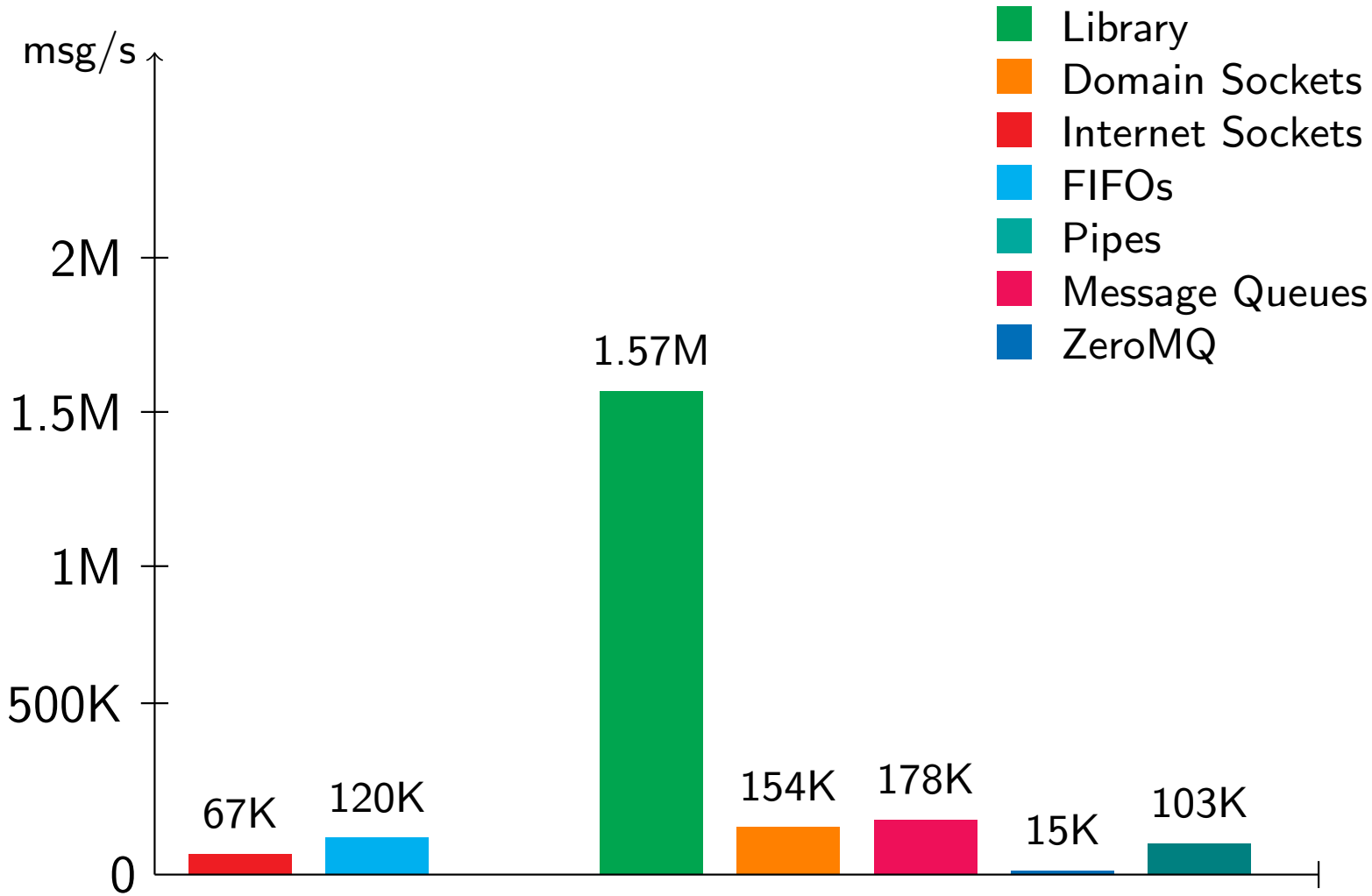

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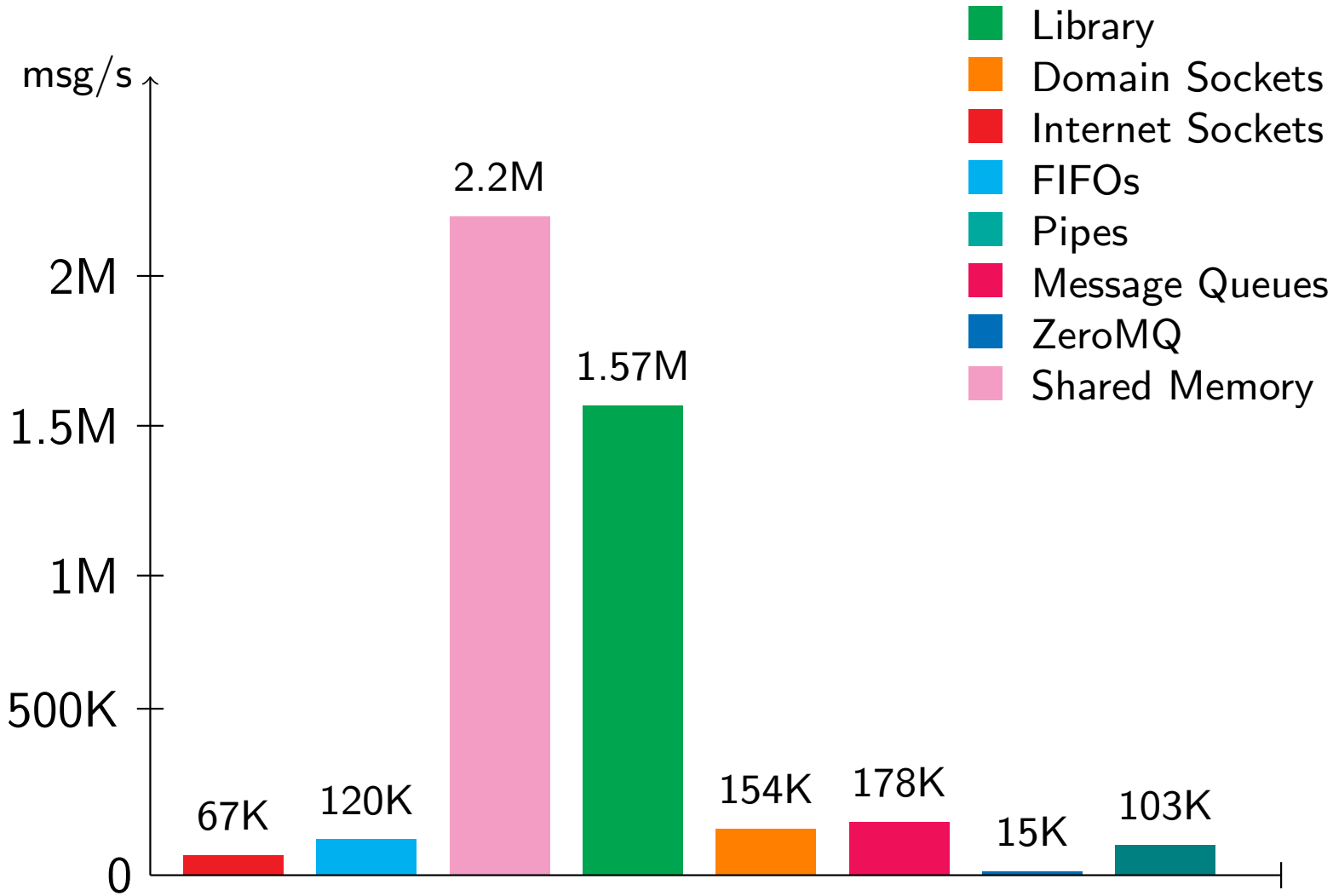
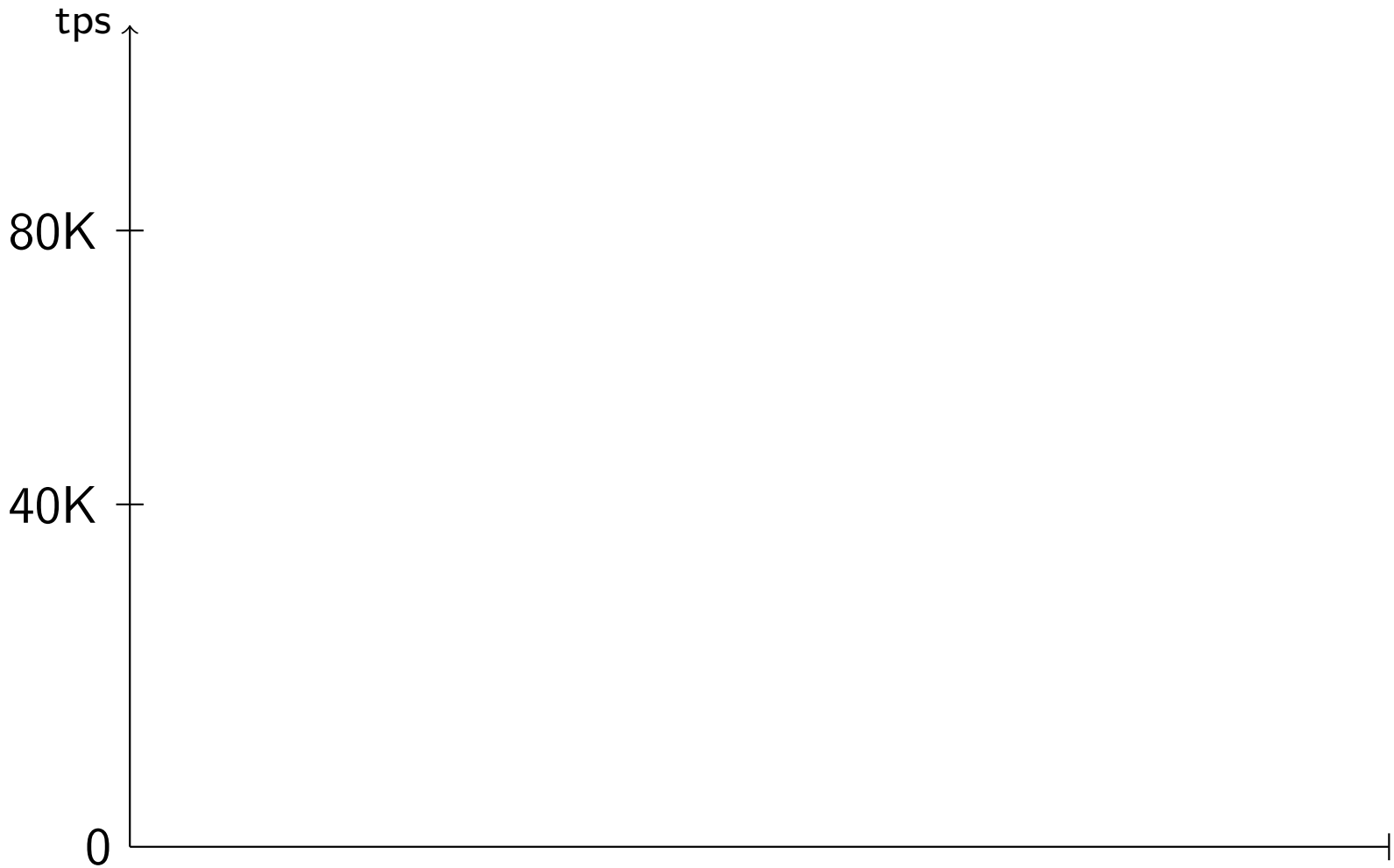


TPC-B Benchmarks



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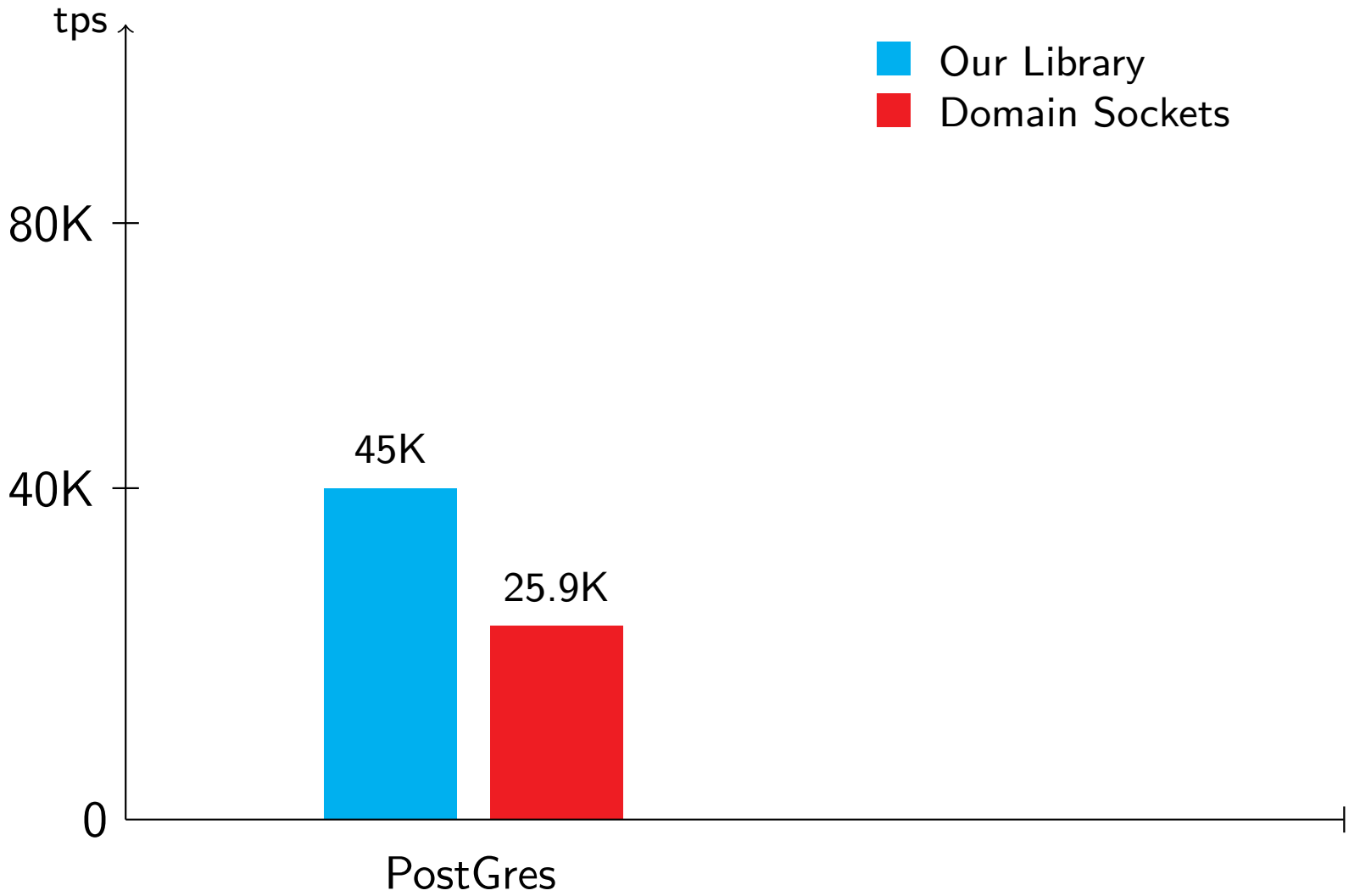

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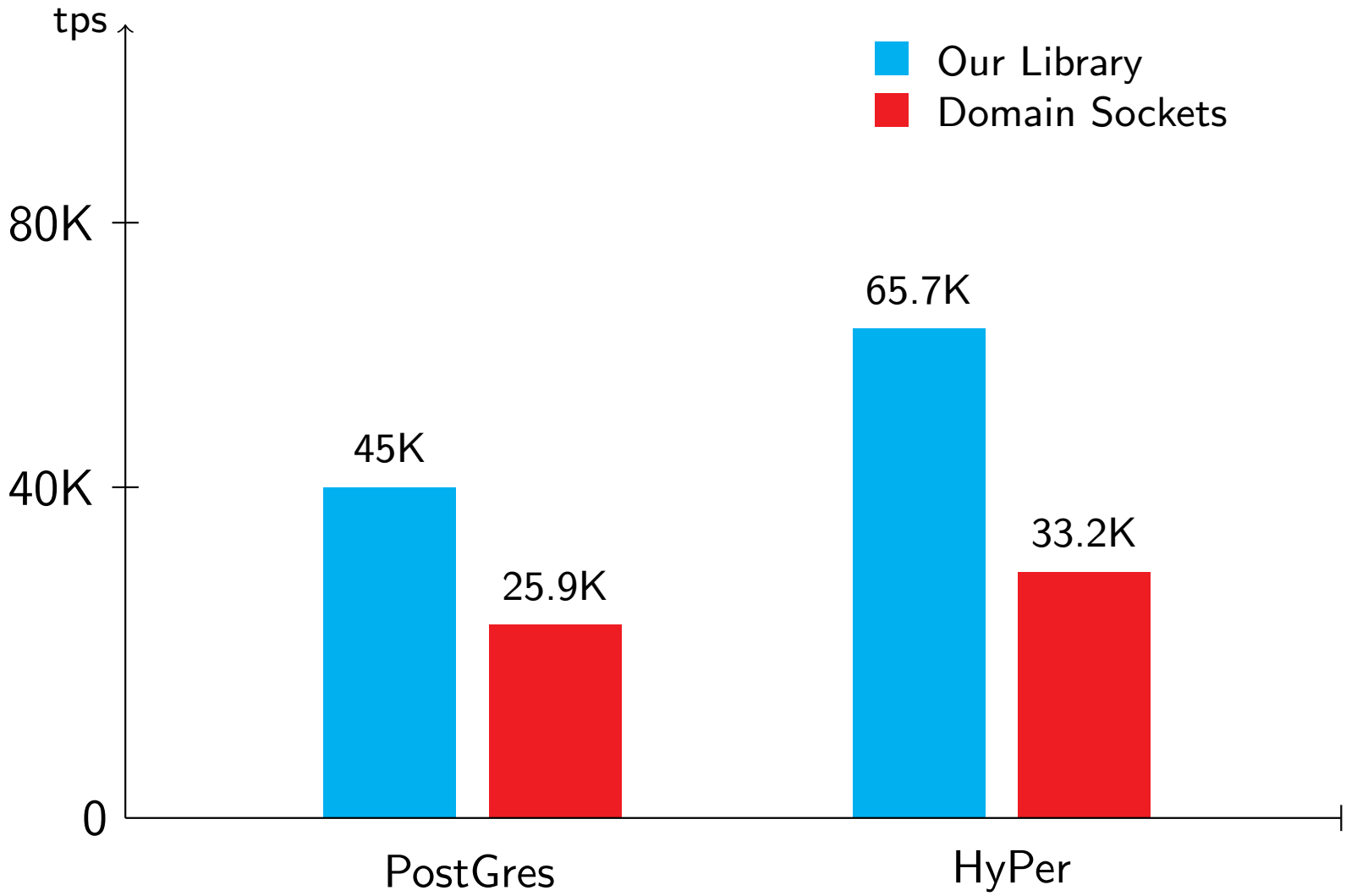
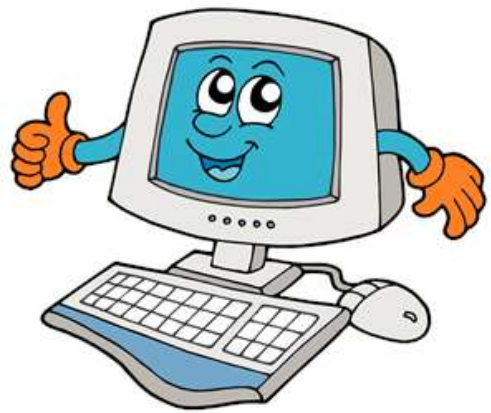


Outlook

Outlook



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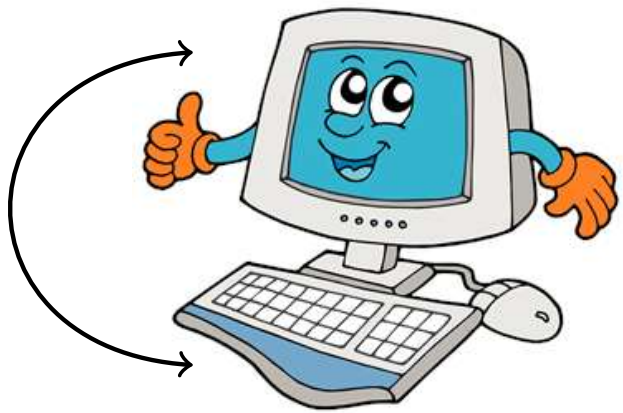

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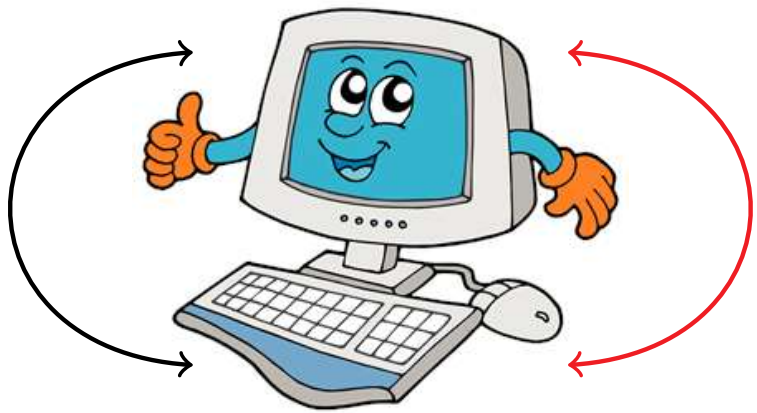
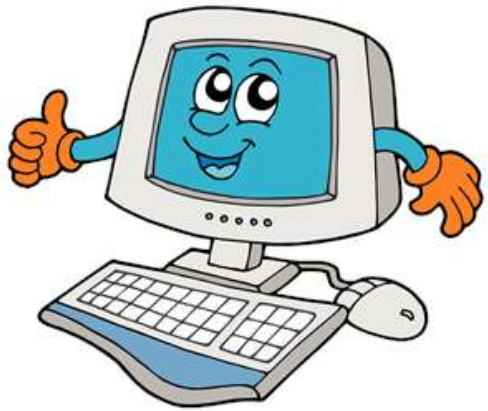
Domain Sockets



Shared Memory

Outlook



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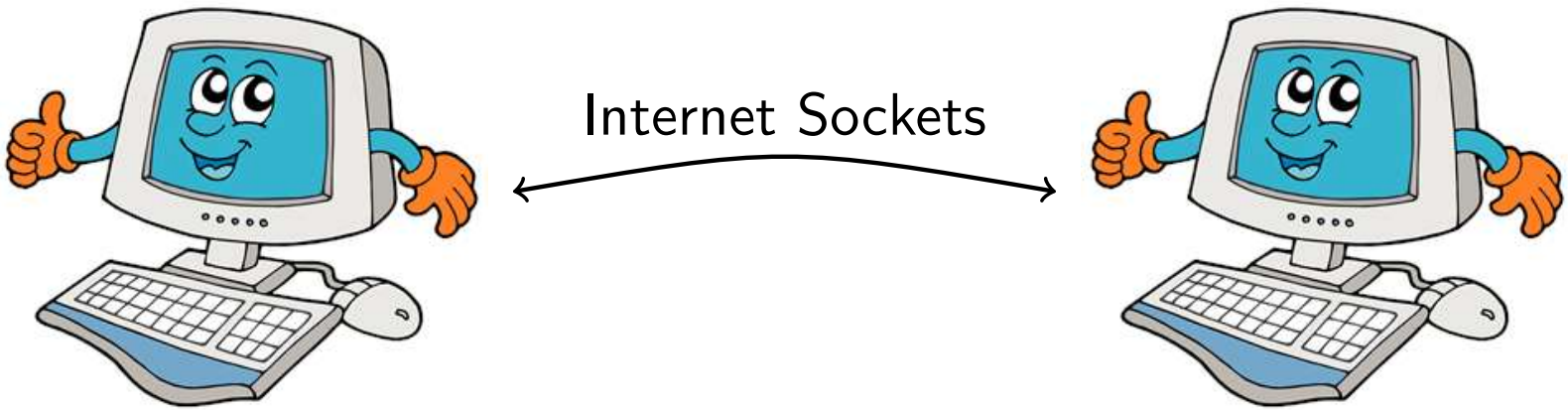

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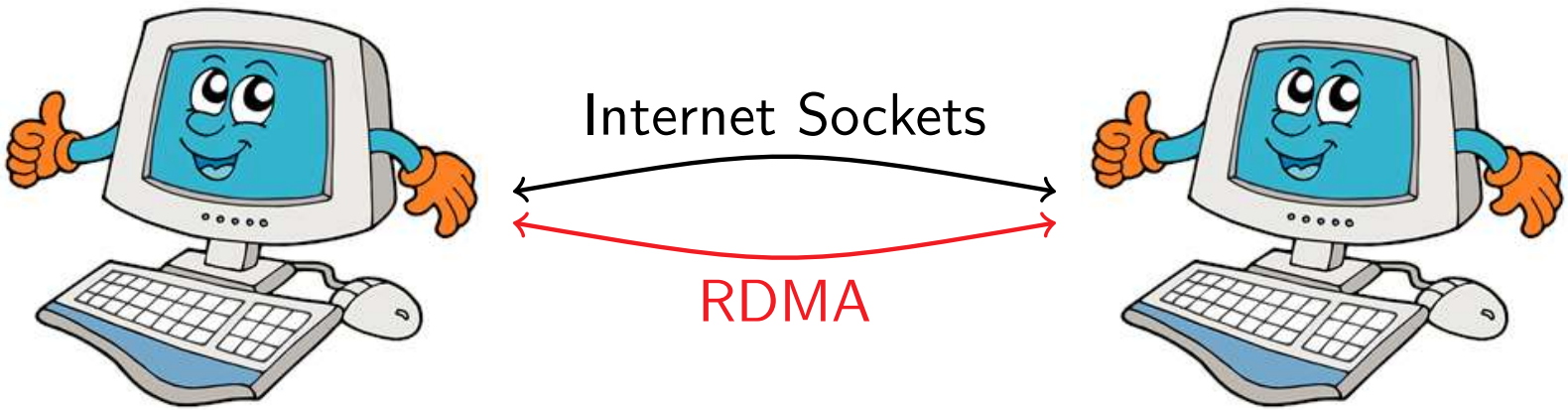

Outlook

- Inter-server communication via RDMA
- Tune database frontend

Q & A