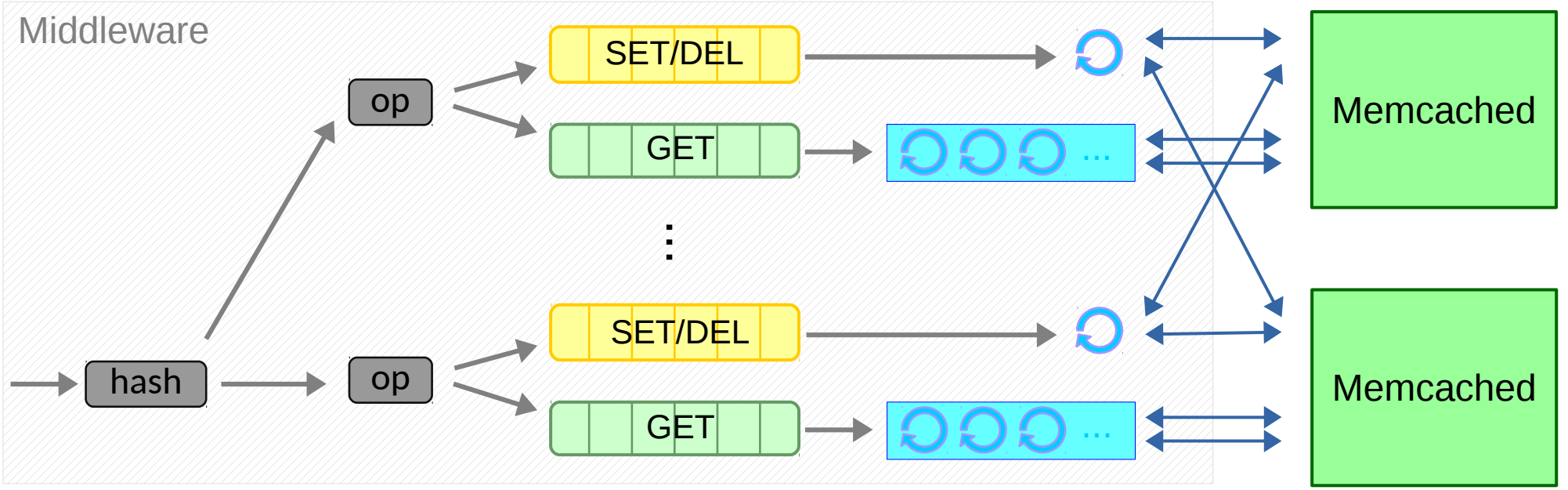
Java Development: Do’s and Don’ts

Overview

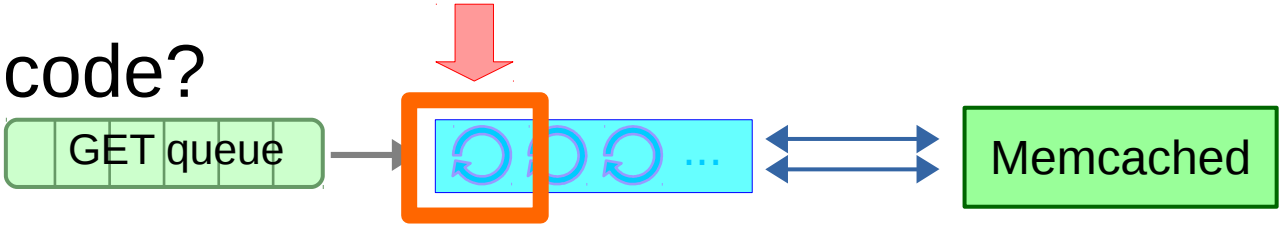
- **Asynchronous networking**
- **Data copies**
- Connection management
- Logging

ASL Project 2016: Middleware for different replication modes



- Middleware provides multiple replication schemes
- `Sets` and `Deletes` are handled by an asynchronous thread (one for each server)
- `Gets` are handled by a synchronous reader thread pool

What is wrong with this code?



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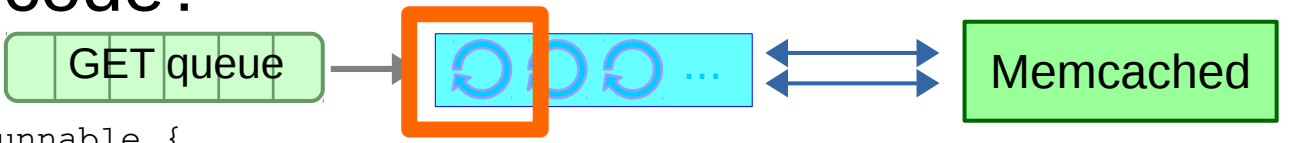


```
public class ReadHandler implements Runnable {
     [...]
     public ReadHandler(BlockingQueue<Request> queue, InetSocketAddress serverAddr){
          this.queue = queue;
          server = SocketChannel.open();
          server.connect(serverAddr);
          server.configureBlocking(false);
     }

     public void run(){
          while(true){
               Request request = queue.take();
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               ByteBuffer buf_header = ByteBuffer.allocate(message_size);
               int bytesRead = 0;
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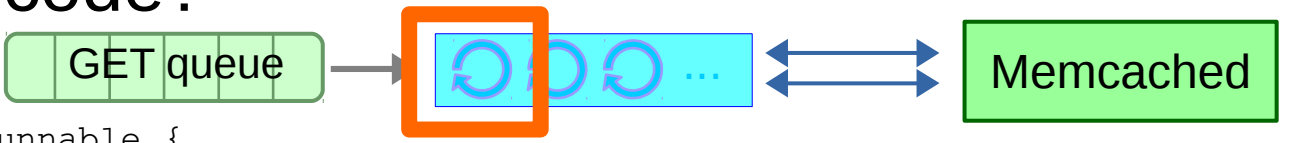


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Socket is non-blocking.
What are the implications?

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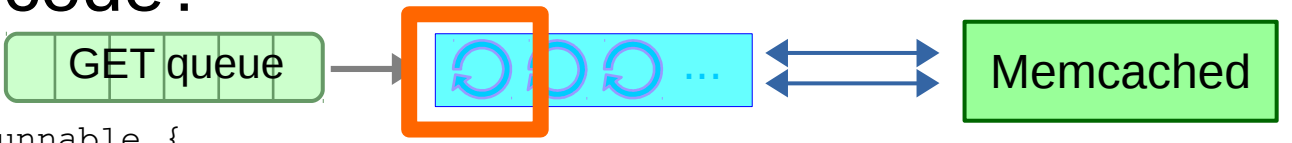


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Hot loop!
Consumes CPU!

Read will return instantly

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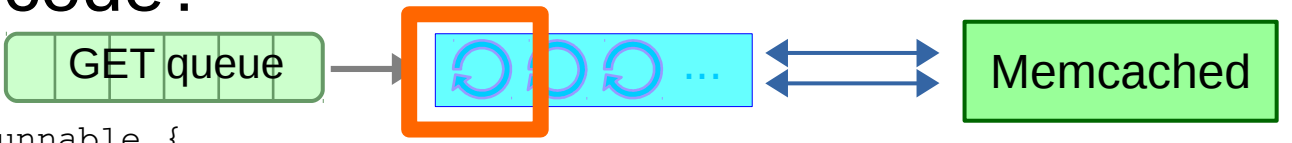


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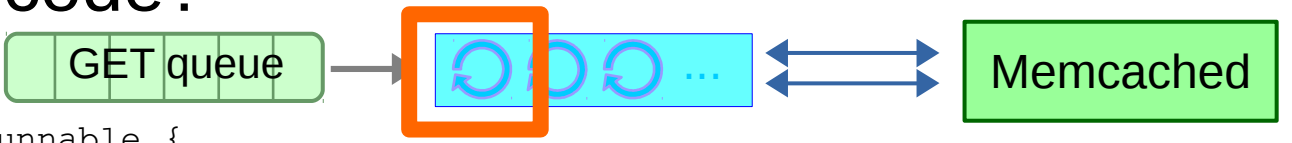


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What are the implications?

How about a read with timeout?
Can lead to increasing and unpredictable response time.

Hot loop!
Consumes CPU!

Read will return instantly

How much difference can this change make?

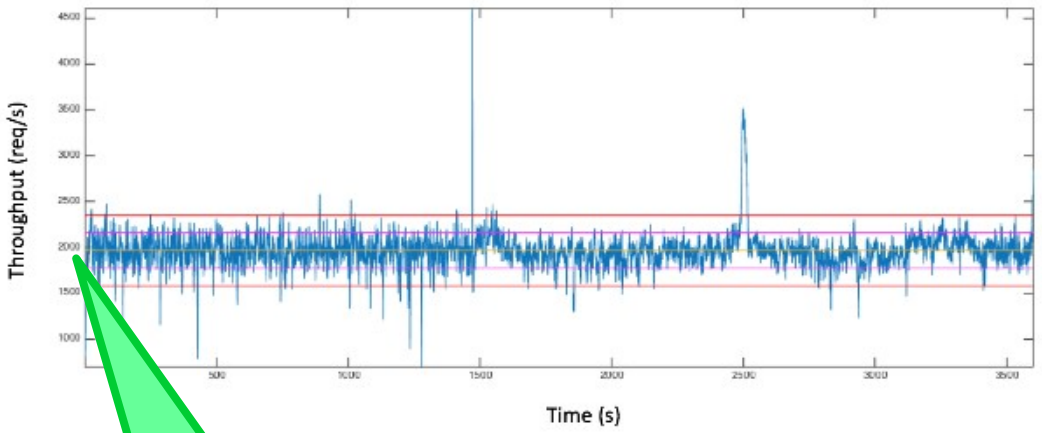

Figure 4: The ut during the one-hour experiment. The mean is 1966.6 and the standard deviation is 19

2.000 req/sec

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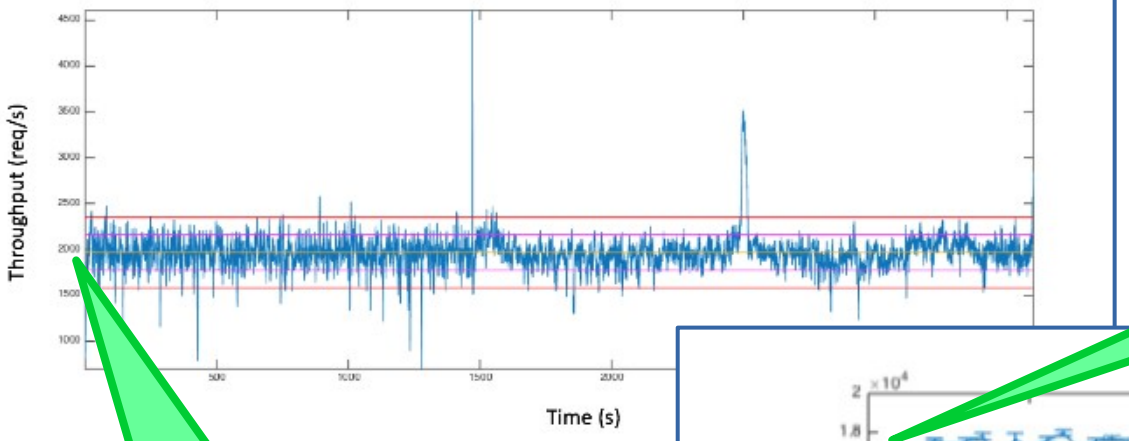

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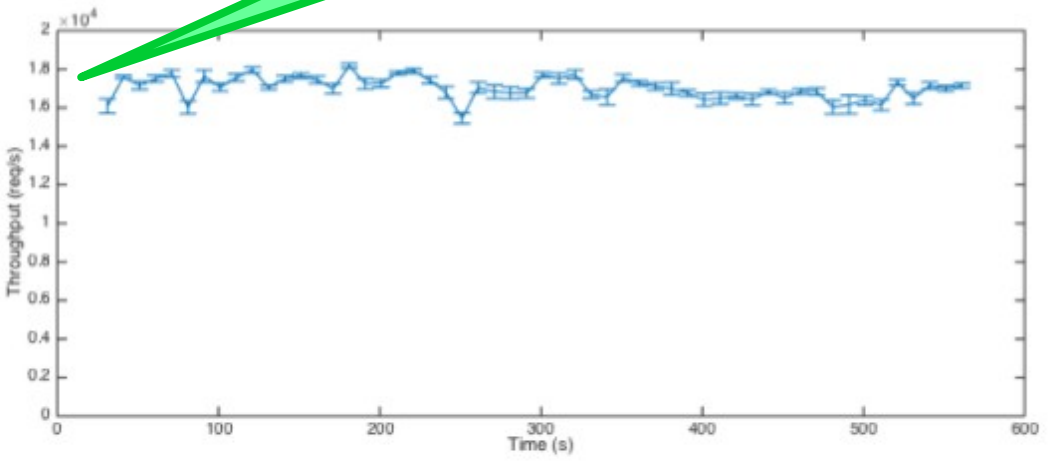
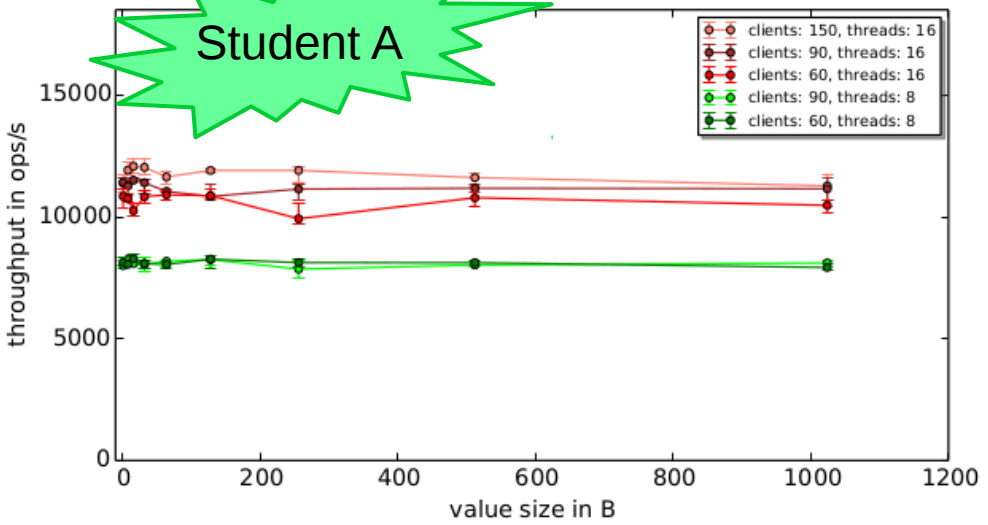


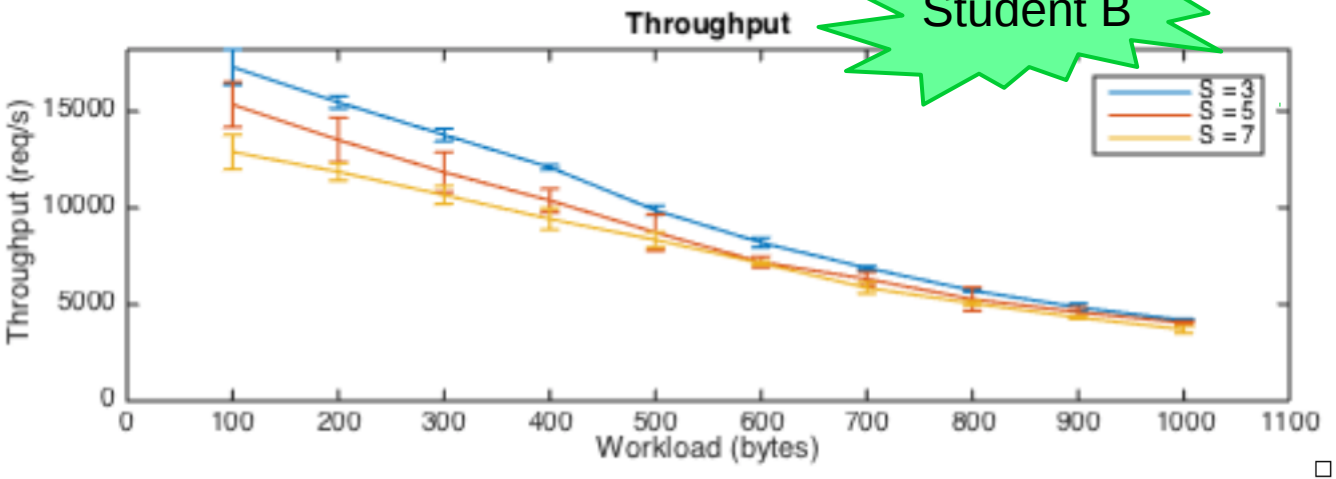
Figure 3: The throughput during the 10-minute trace. The error bars represent the 95% confidence intervals.

How about different message sizes?

Student A



Student B



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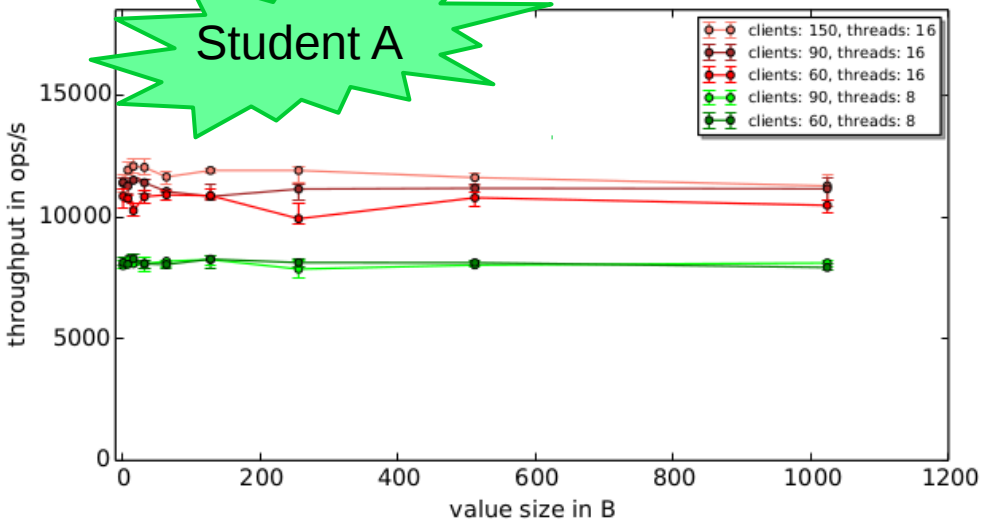
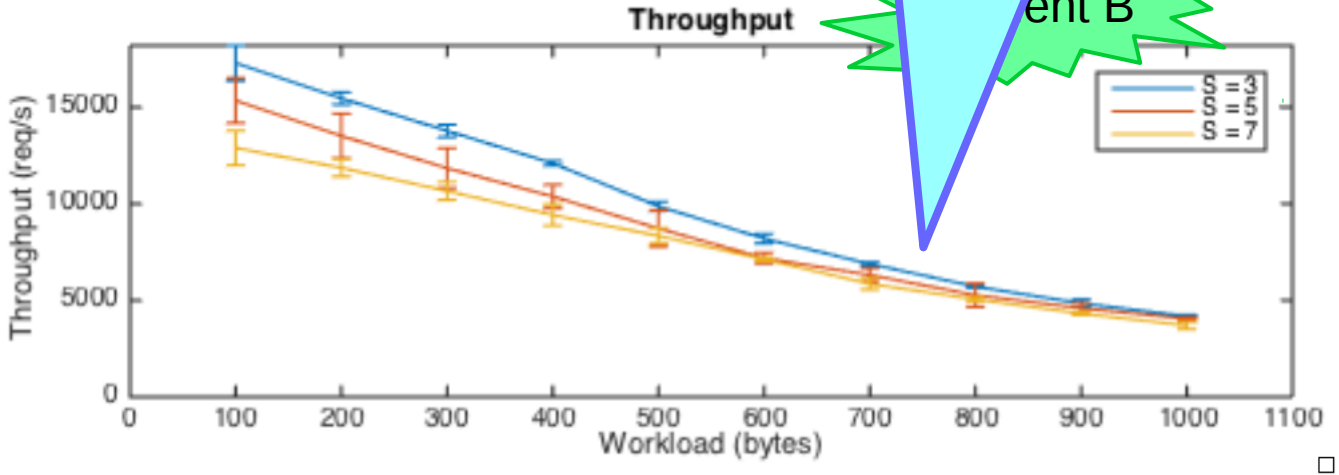


Is this network bound?

ent B



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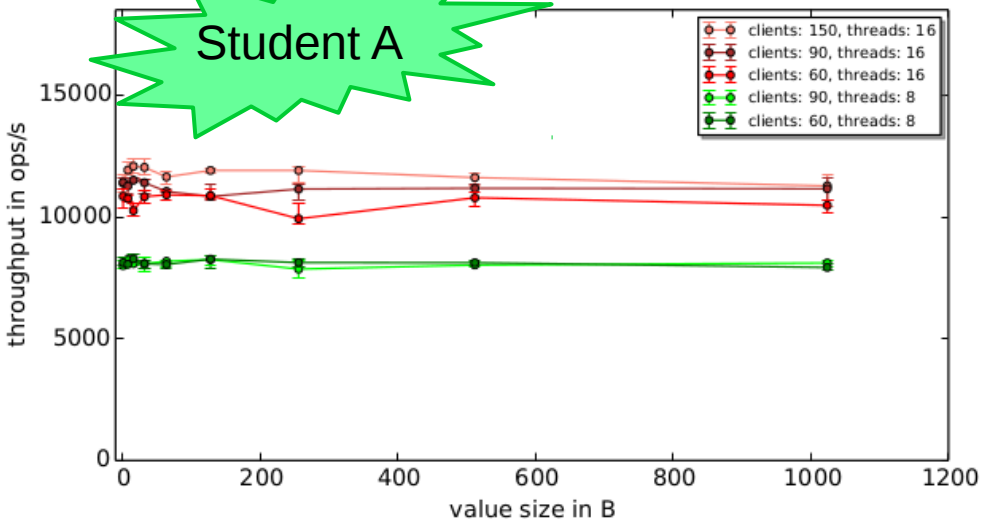

Is this network bound?
No. Sending data to 7 servers is not 2x slower than 3 servers.
Required bandwidth << network bw.

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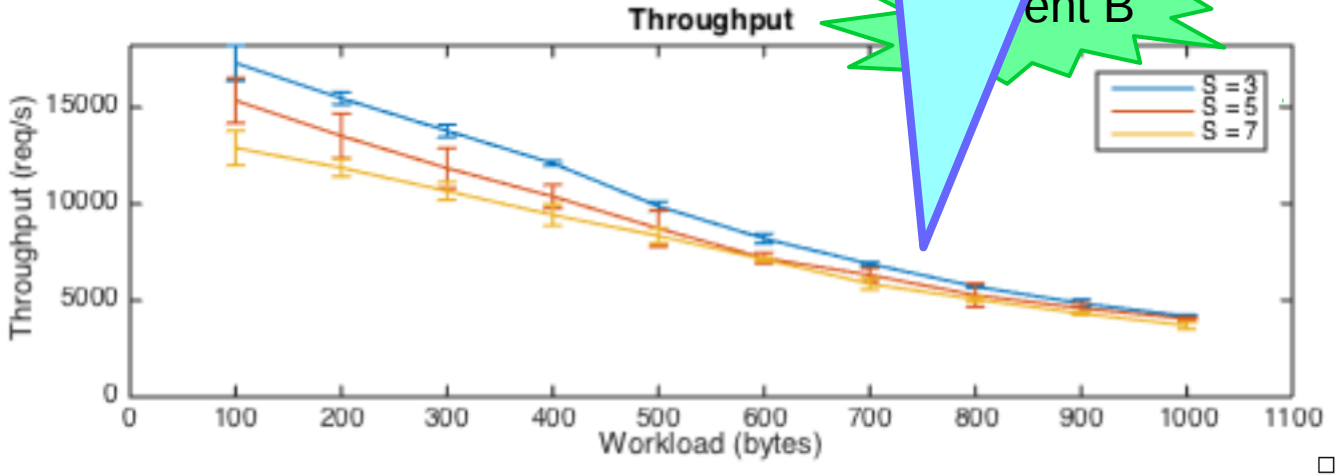

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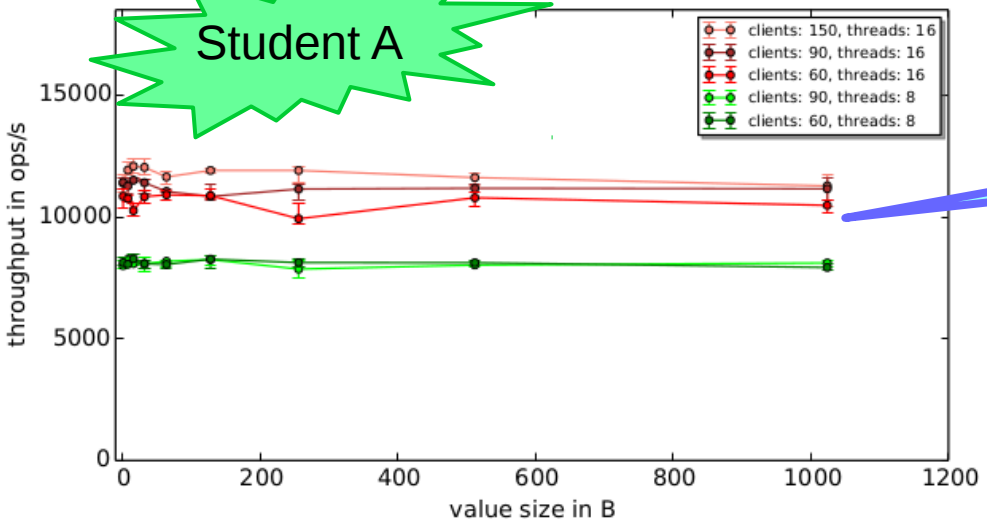

Large messages should have a higher latency.

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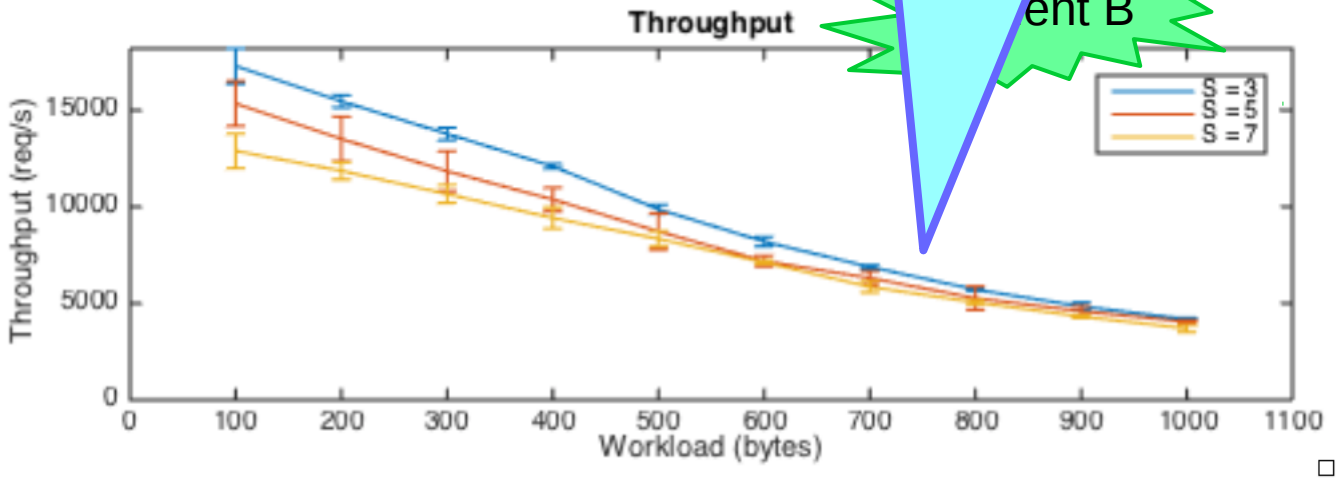

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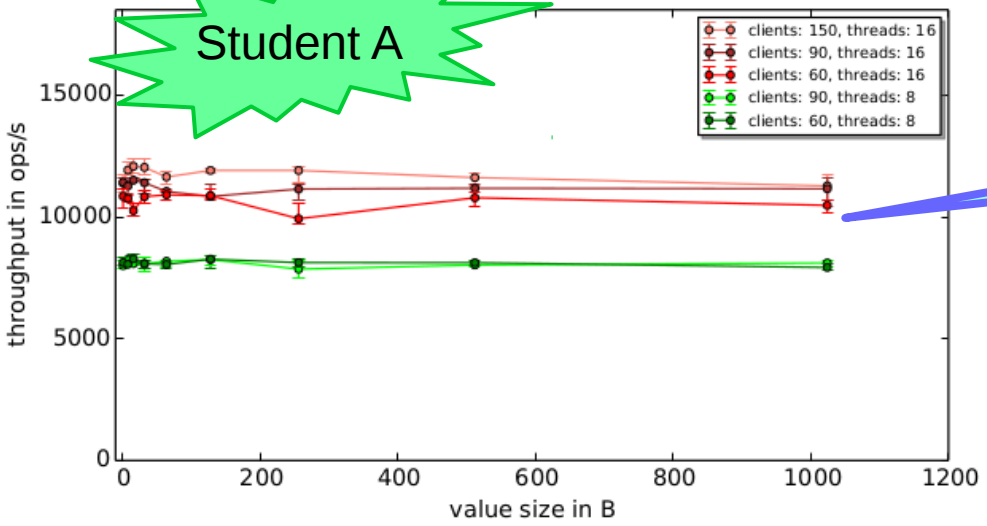

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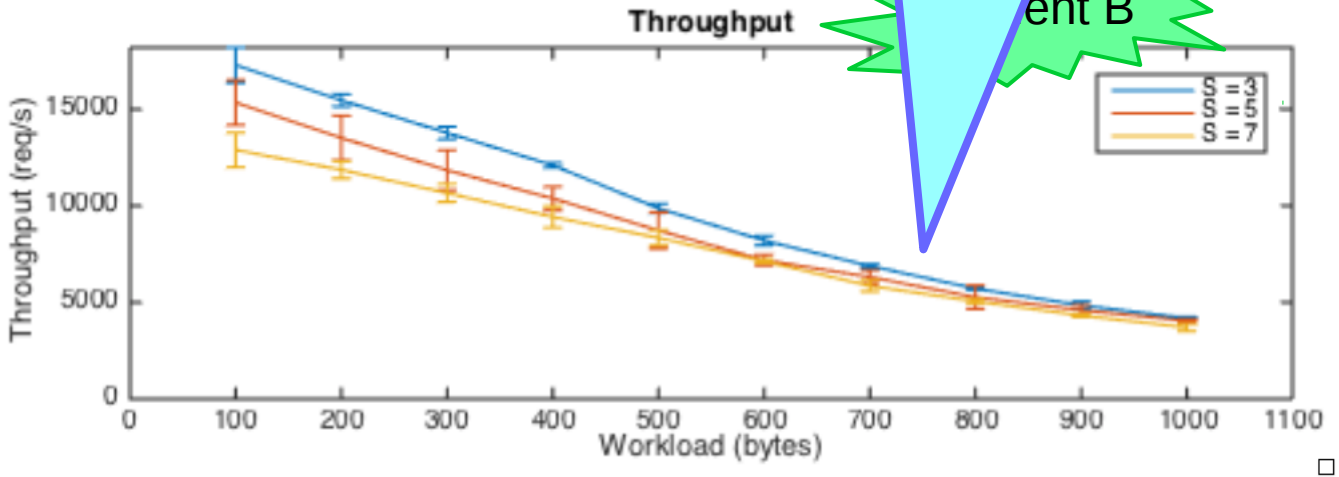

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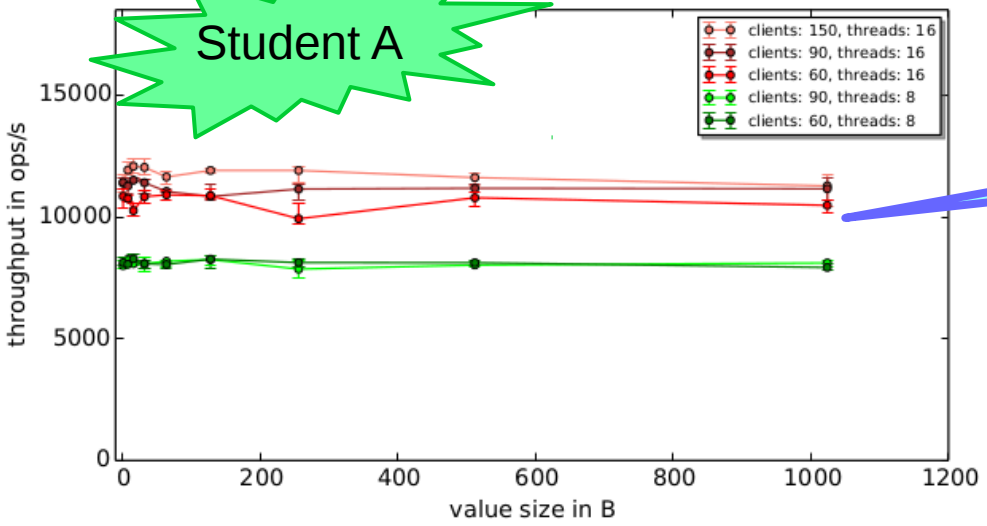

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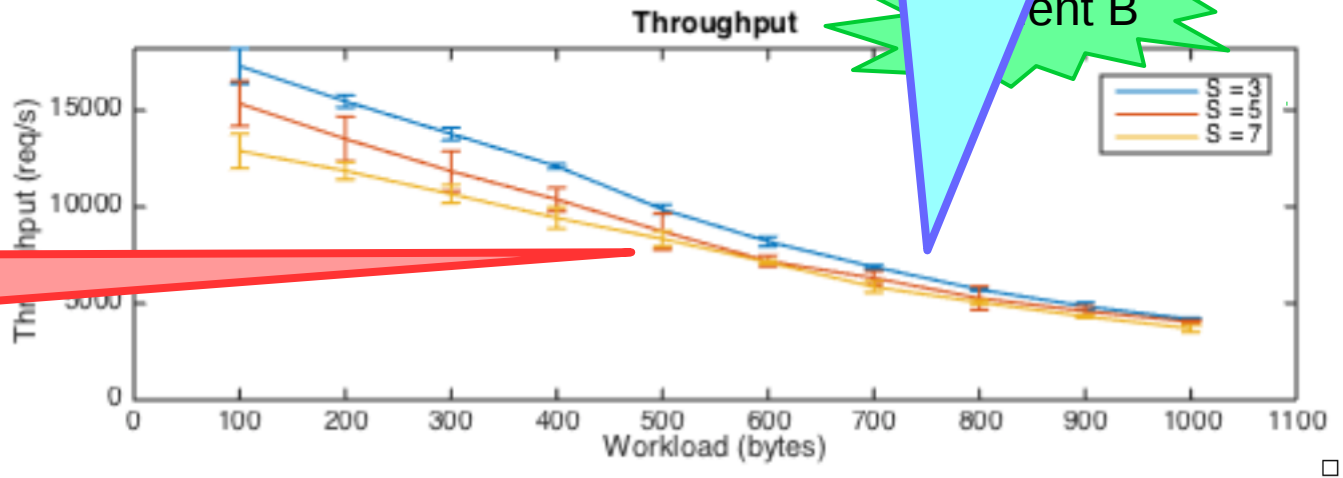


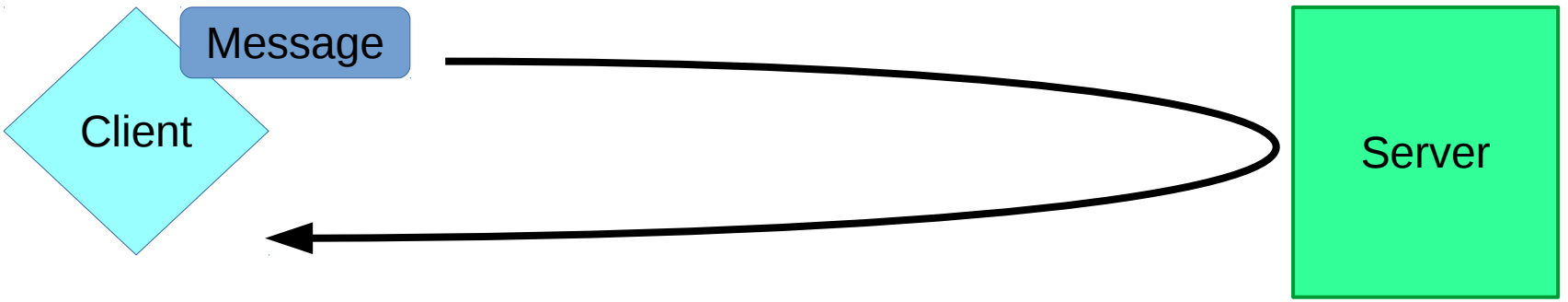
Data is copied across buffers!

```
String s1 = "request";
String s2 = new String(s1);
```

Overview

- Asynchronous networking
- Data copies
- **Connection management**
- Logging

Network Microbenchmark: Echo server



- Client connects to server and sends message
- Server reads message and sends it back
- Client reads message

What is wrong with this code?

Client Code:

```
long startTime = System.nanoTime();

for (int i = 0; i < 100000; ++i) {
      Socket socket = new Socket(hostName, portNumber);
      PrintWriter out = new PrintWriter(socket.getOutputStream());
      BufferedReader in = new BufferedReader(new
                  InputStreamReader(socket.getInputStream()));

      out.println(m);
      out.flush();
      String t = in.readLine();

      out.close();
      in.close();
      socket.close();
}

long stopTime = System.nanoTime();
System.out.println("It took " + (stopTime-startTime) + "ns");
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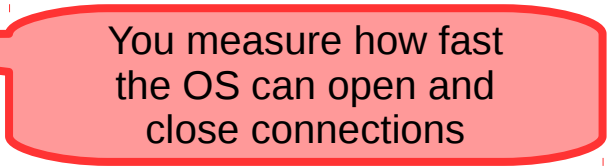

Keep connections open

Client Code:

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Open the connection once and reuse it

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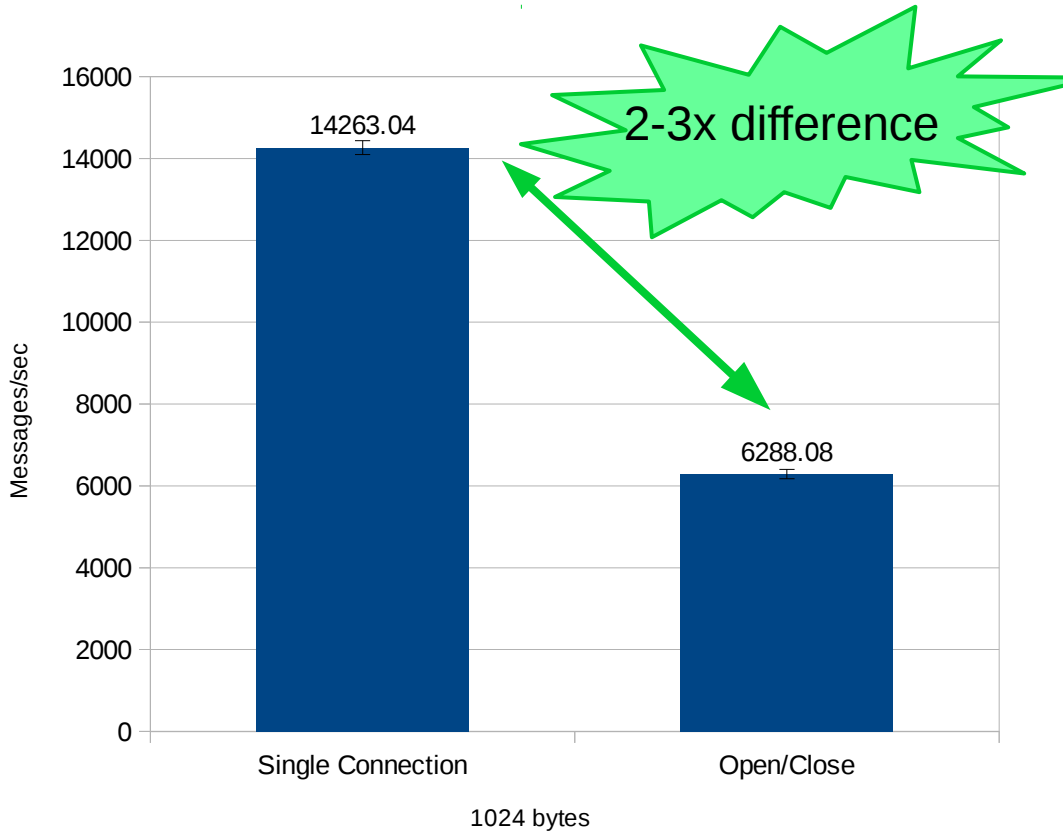
What is the impact?



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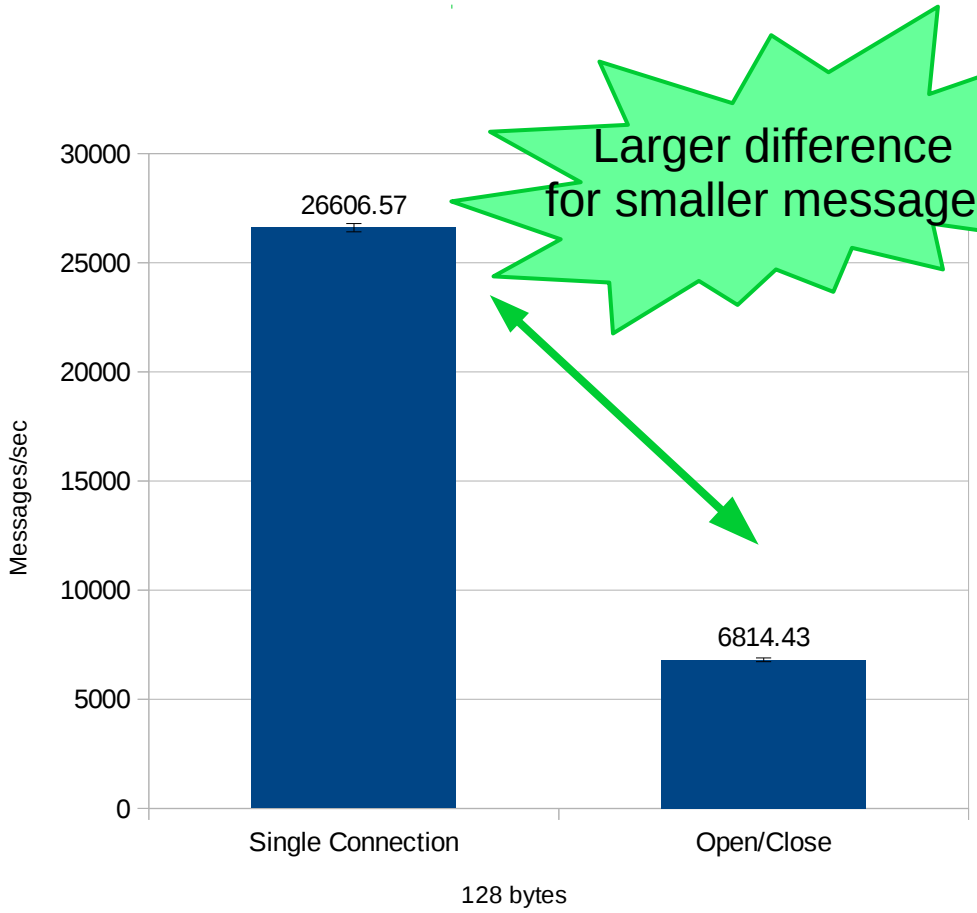

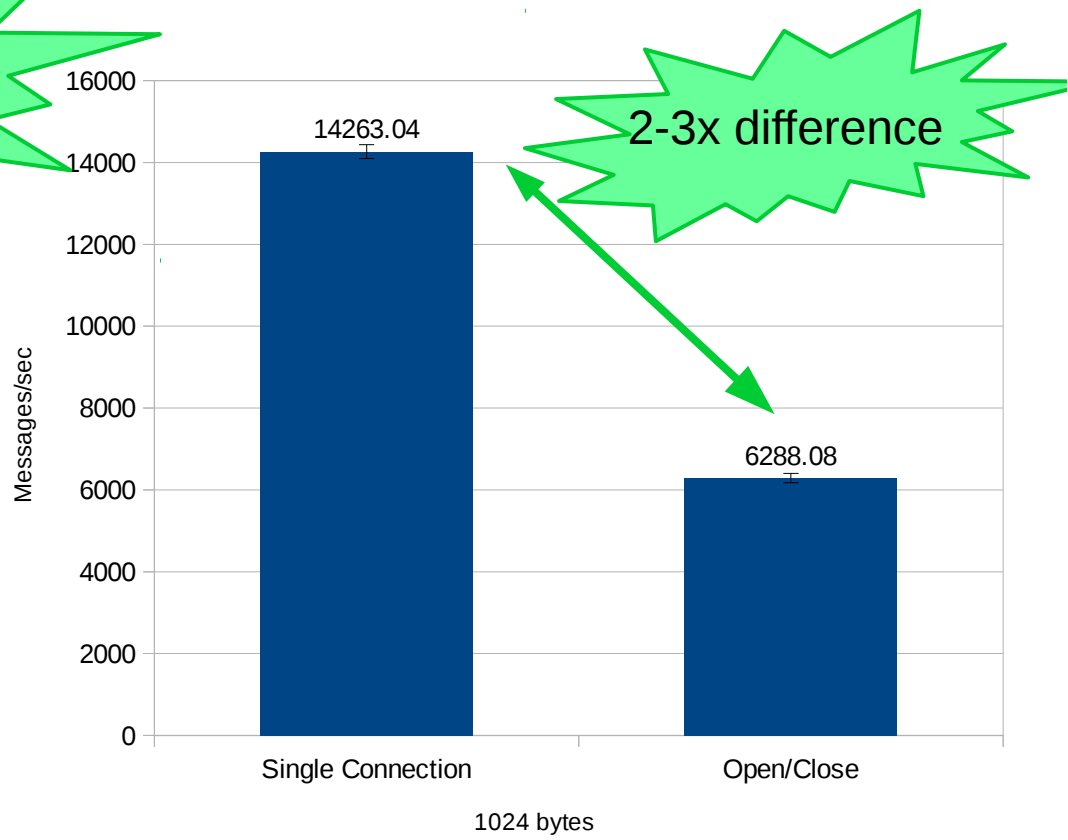

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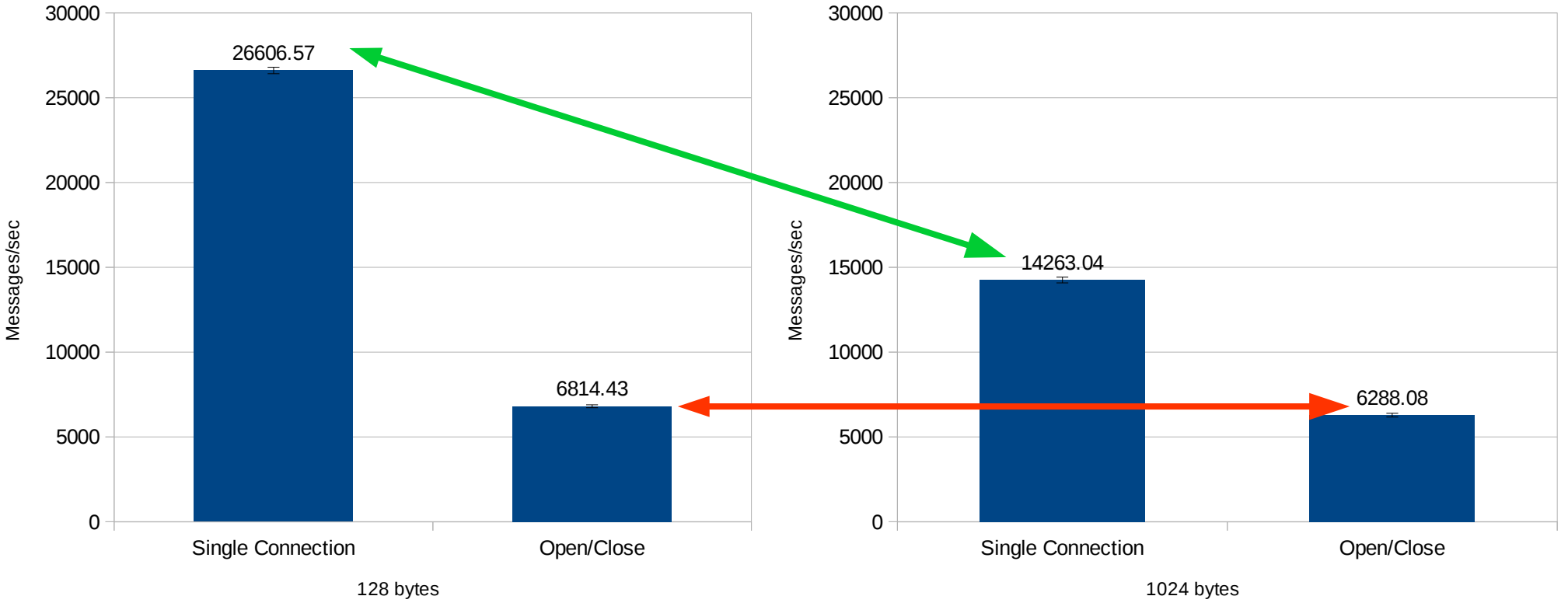

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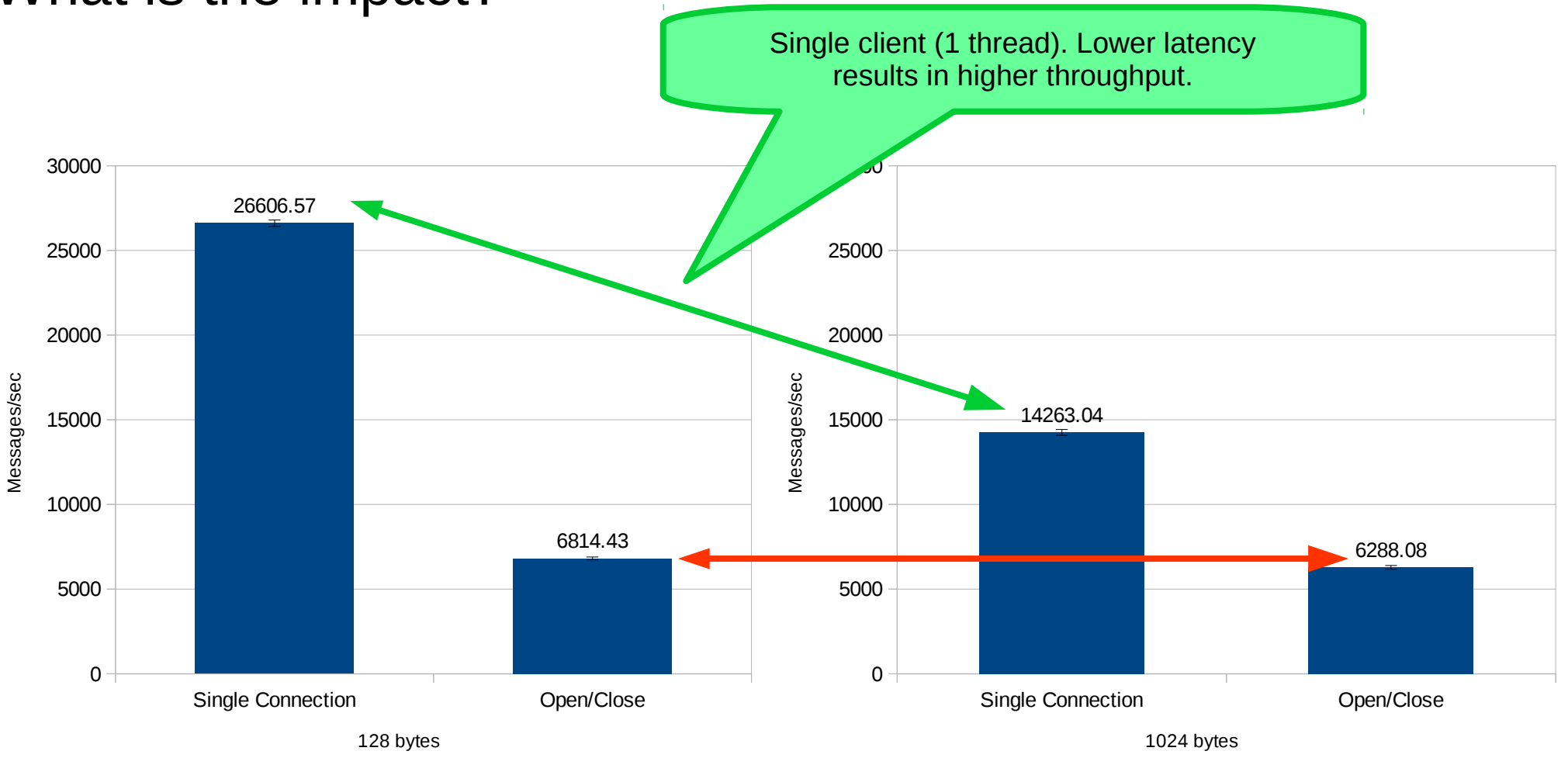

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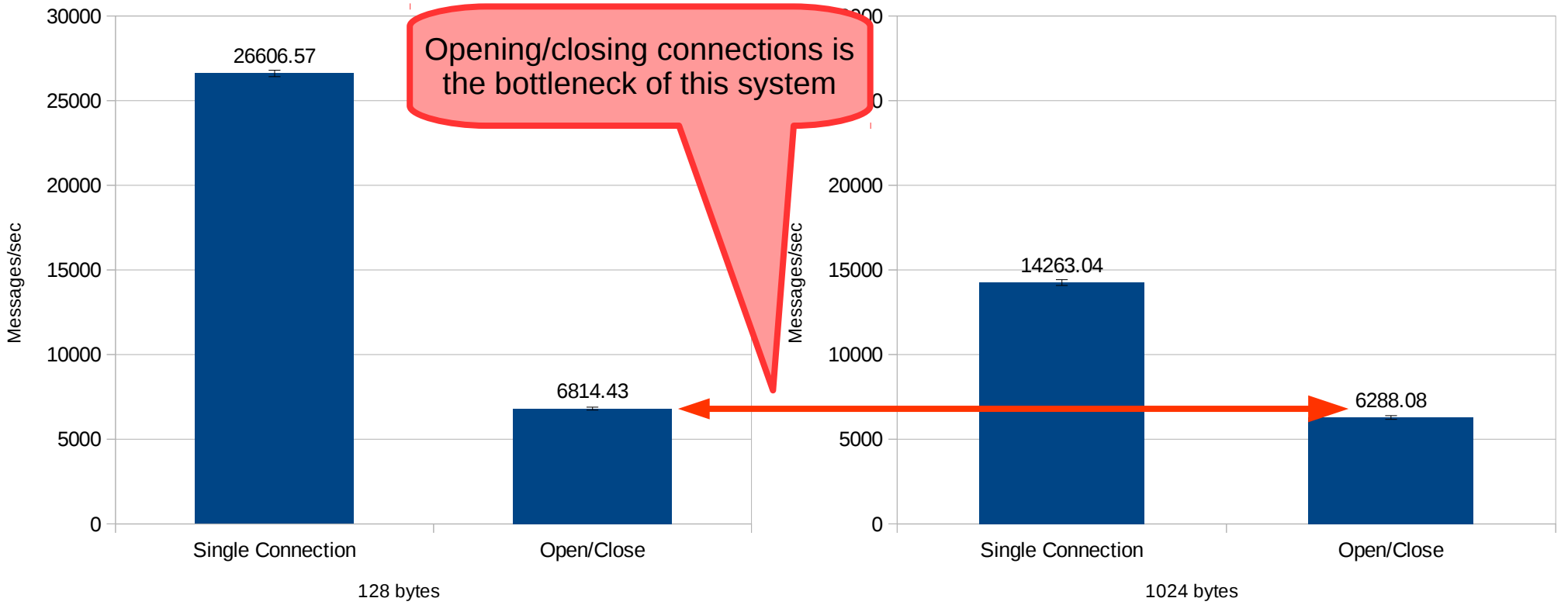

Overview

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Logging to files vs main memory

```
...
for (int i = 0; i < 1000000; ++i) {
   int keyHash = hashFunction(keys[i]);
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Avoid excessive logging/flushing in critical sections

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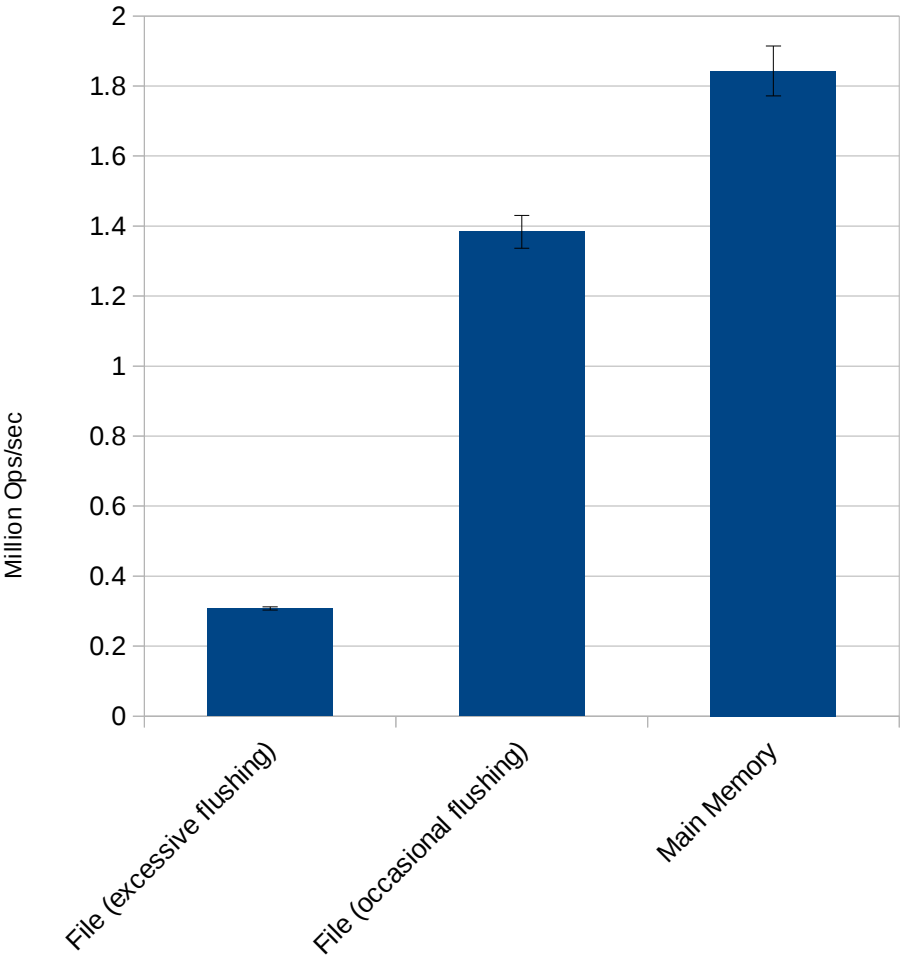

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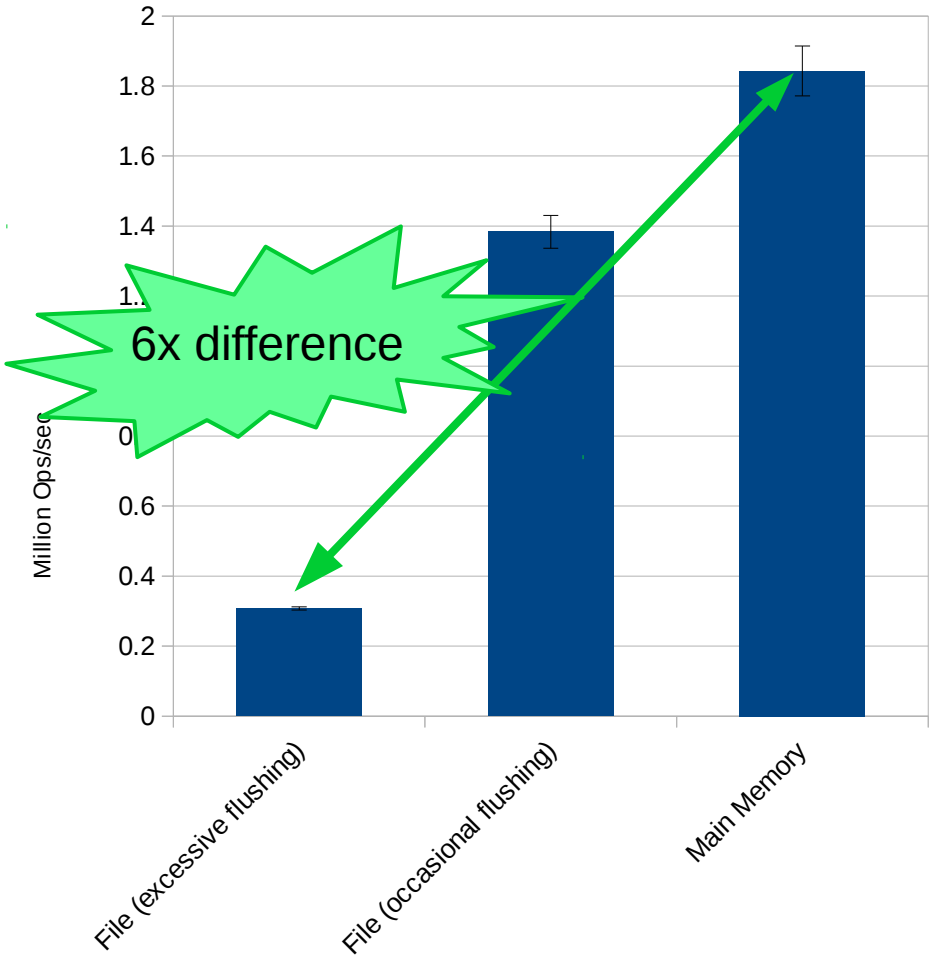

Recurring questions about **threads/queues**

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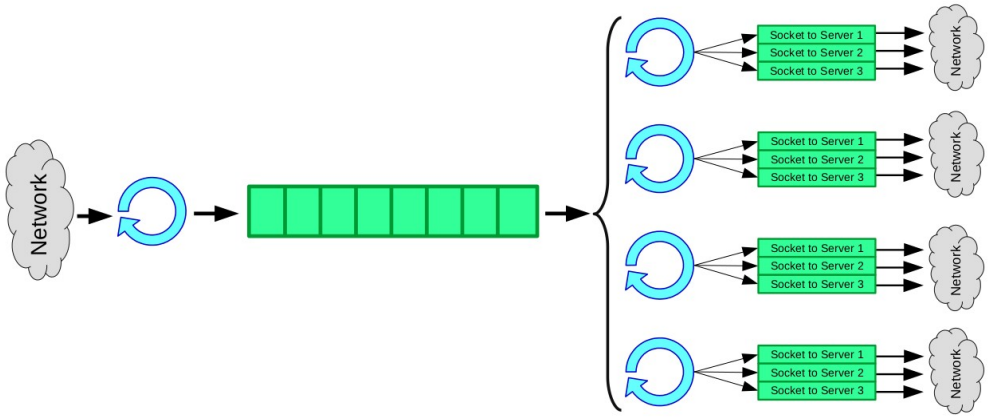
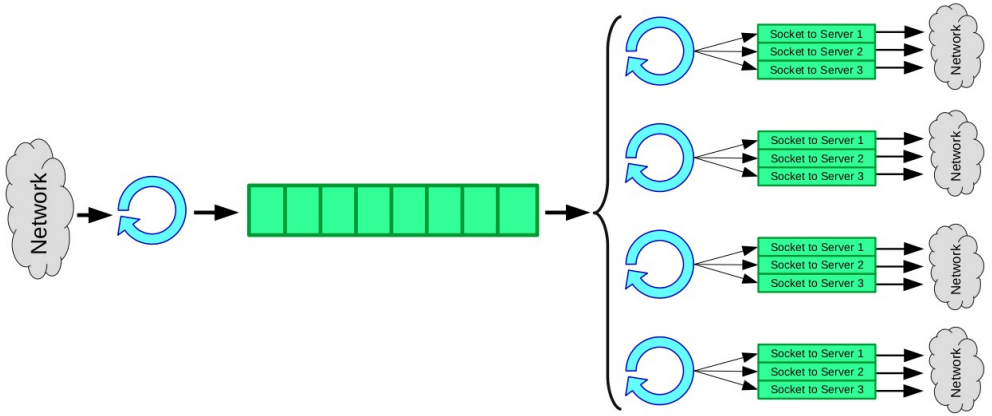


How many net threads are allowed? / Can I use helper threads? / Can I deviate from the thread design in the figure?

It is OK to use helper thread(s), but the fundamental operations (data receiving and sending, request decoding) has to happen as shown in the figure. Points of measurement should be equivalent to the given design also!

Recurring questions about **queues**



What type of objects are enqueued in the queue? / Where should I parse the requests?

Logically, each element in the queue must correspond to a single request. The exact implementation is up to you, but in the report you must explain why the implementation fulfills this condition. Work division between the different types of threads is up to you, but the measurement points must also correspond to the description.

Take-away message: Be careful with ...

- Non-blocking and asynchronous I/O
- Copying of large data buffers
- Opening and closing connections
- Flushing your data to disk in hot loops