Effectively using Amazon Web Services

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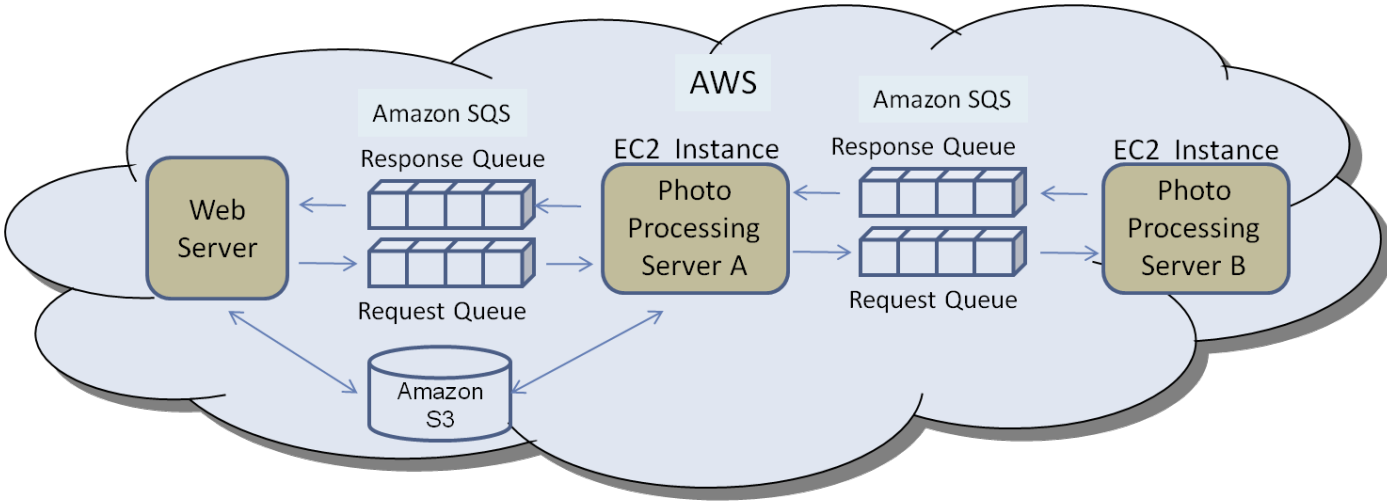
Message latency of SQS (Simple Queue Service)

Optimizing upload performance to S3

Simple Queue Service

- Highly reliable and scalable distributed queue system for web service applications.
- A buffer between the component sending data and the component receiving the data for processing.



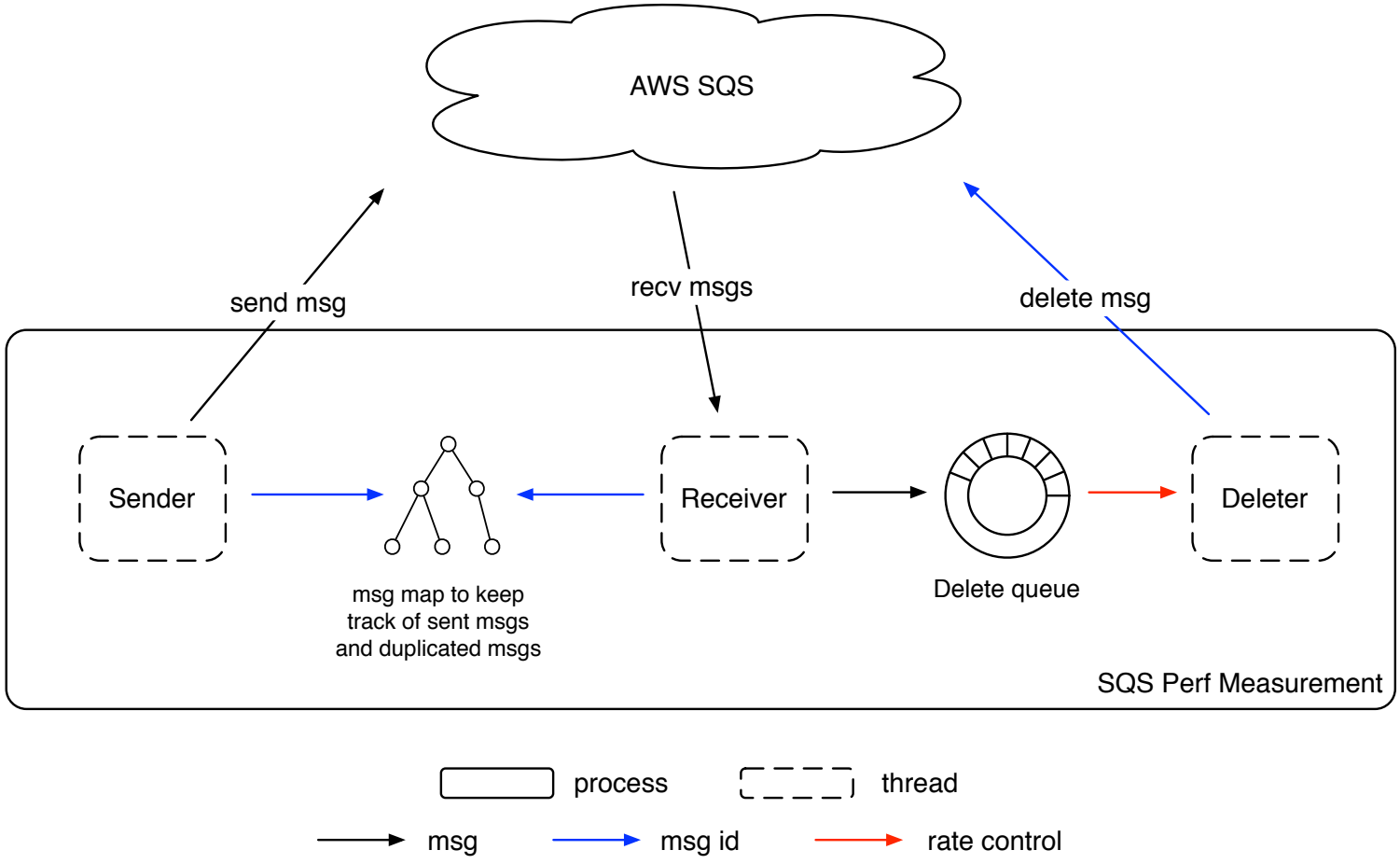
From "Building Scalable, Reliable Amazon EC2 Applications with Amazon SQS."

Good for interactive applications?

- Vague fears about potential very high send-to-receive latency.
  - Many concerns on Amazon SQS forum with latencies more than 60 seconds.
- Let's do some measurement!

First measurement - As Fast As Possible

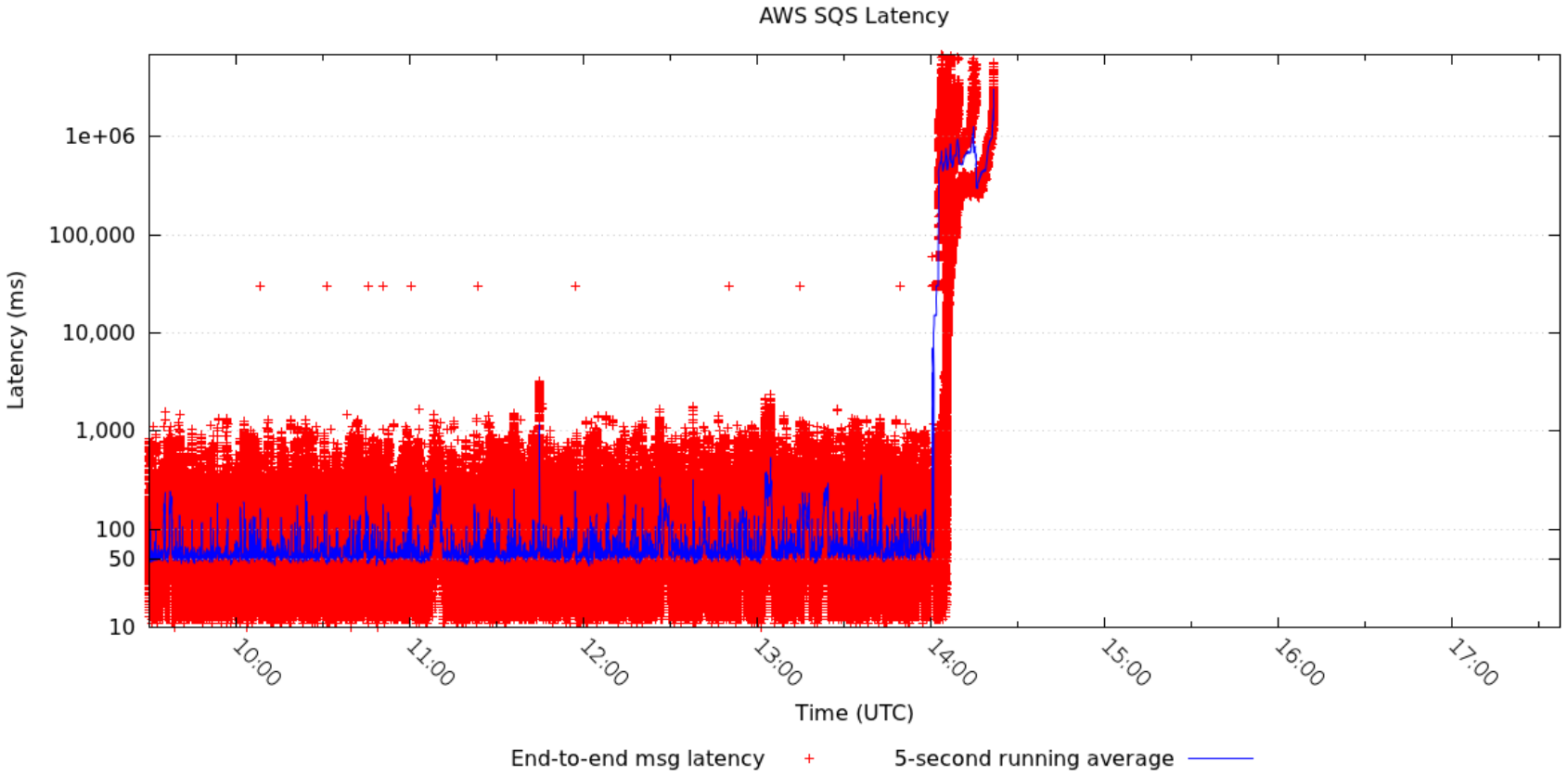
- Send/receive/delete messages as fast as possible.



SQS performance measurement architecture

Huge latencies… really?

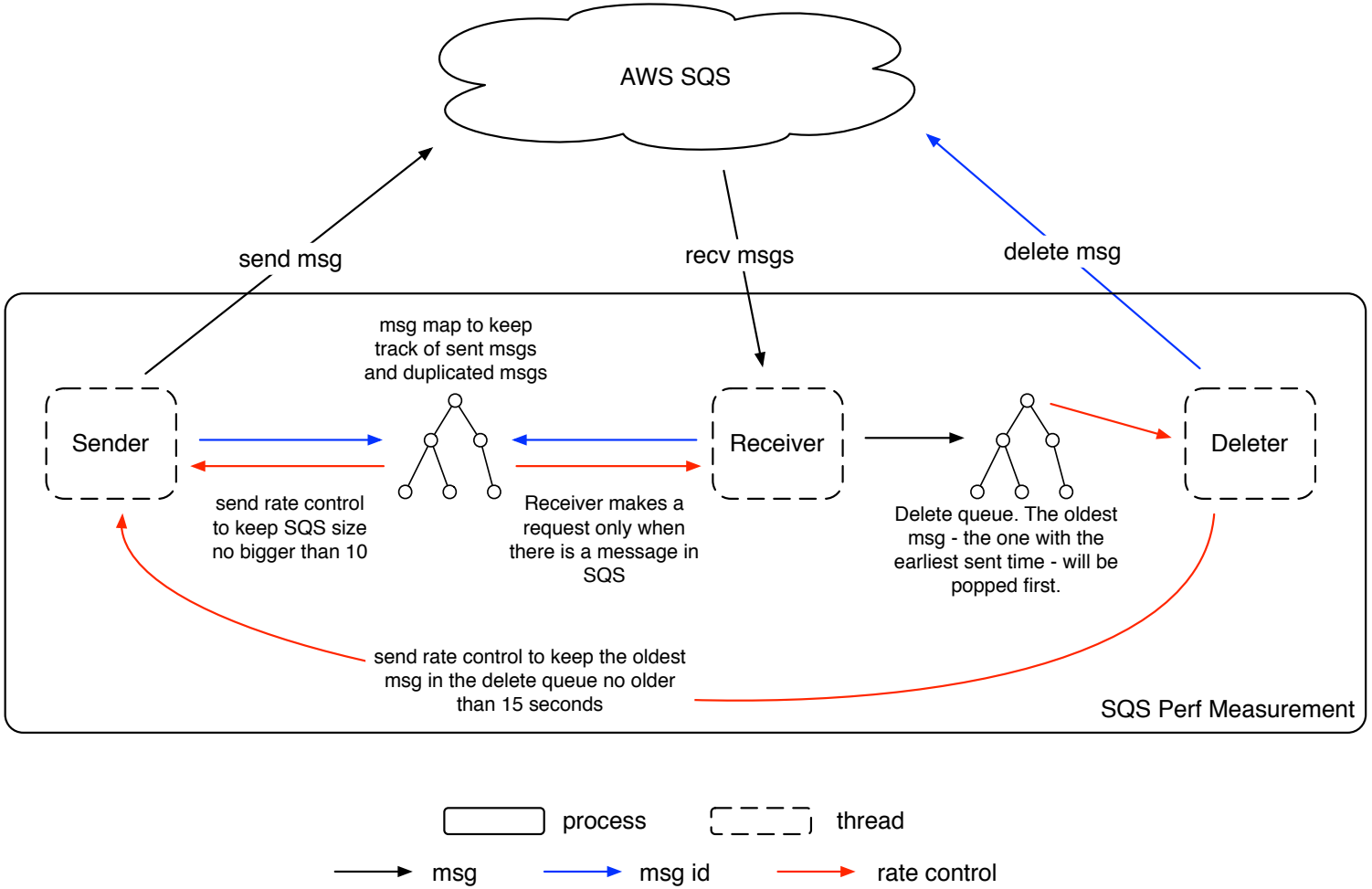
- 30 seconds of sporadic latencies
- After 5 hours, latencies increased sharply and the measurement client became unresponsive…



After inspecting logs, it turned out…

- Lots of duplicated messages.
  - Due to deleter being slower than receiver, messages kept reappearing after the 30-sec invisibility time window.
- Delete queue became too big and consumed all RAM.
- Need Rate control!

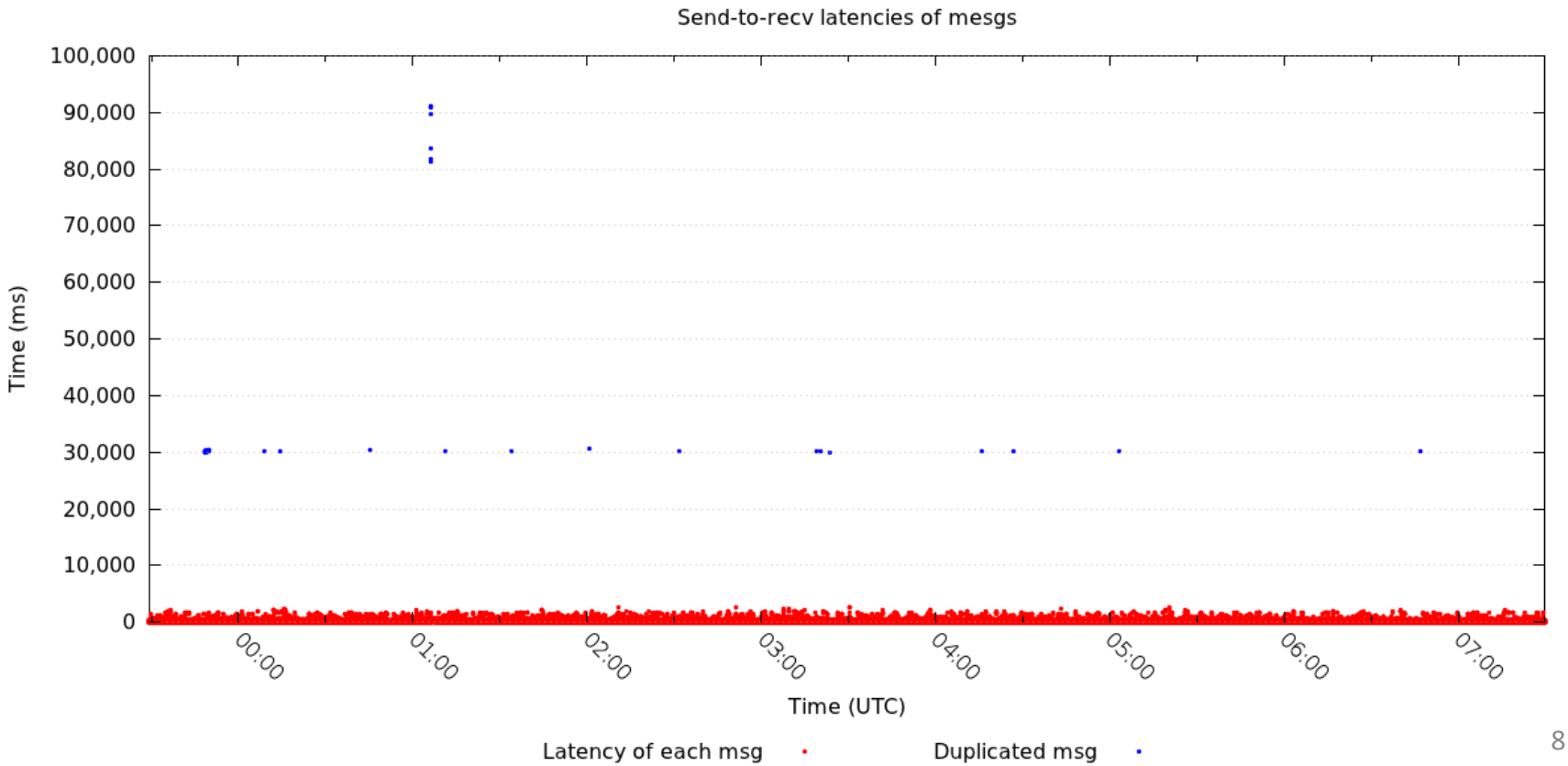
Rate-controlled measurement



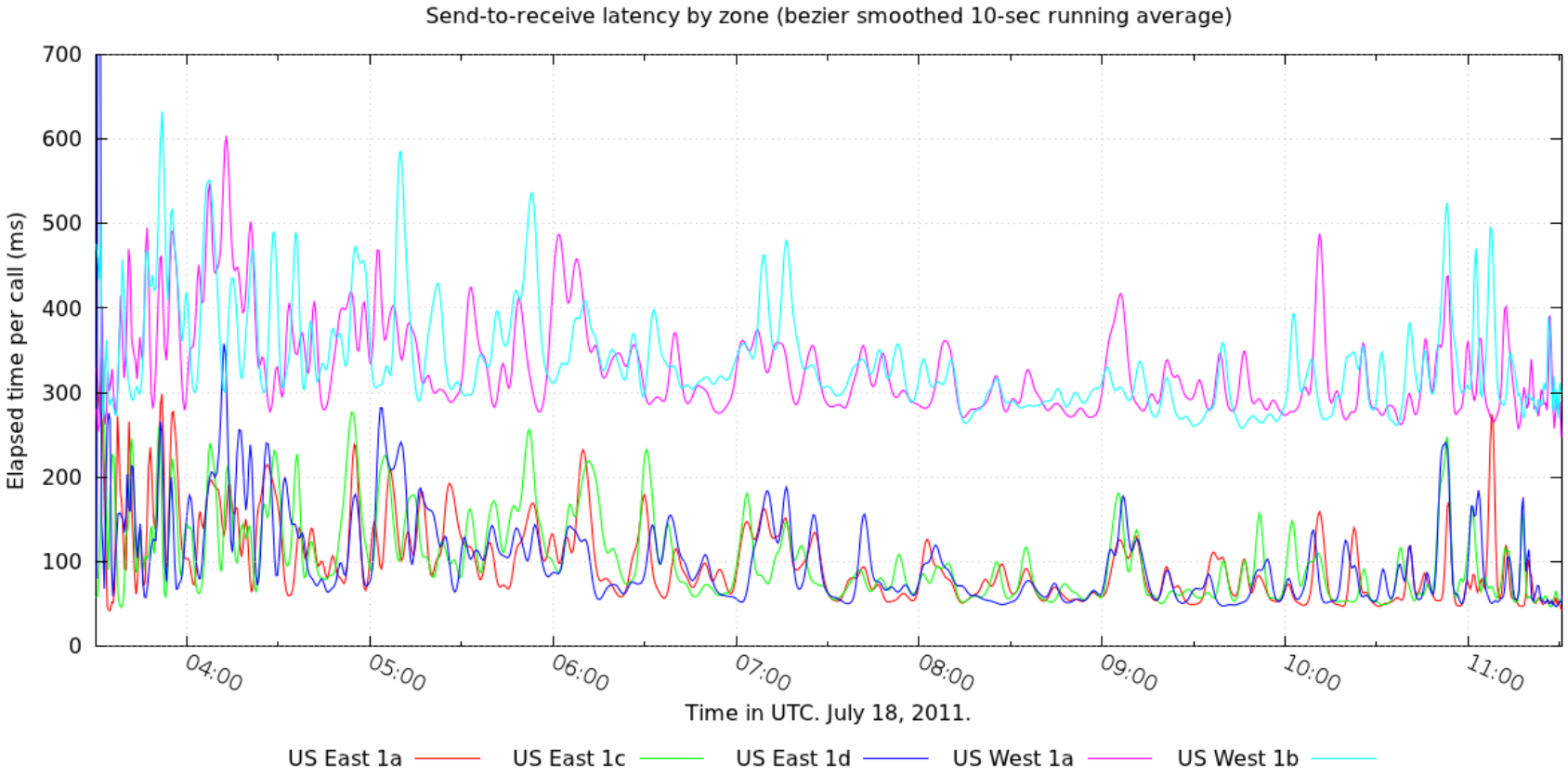
SQS performance measurement architecture

Huge latencies are gone!

- avg < 100 ms, max < 3 s
- Some big latencies turned out to be from duplicated messages. Message handling should be idempotent!



Performance by region/zone

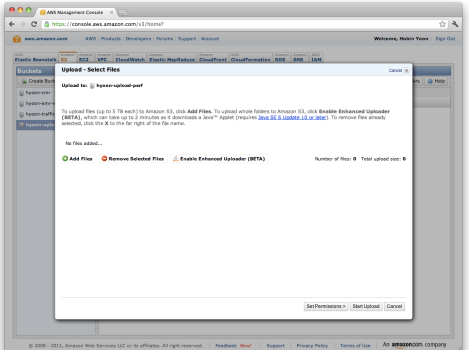


Message latency of SQS (Simple Queue Service)

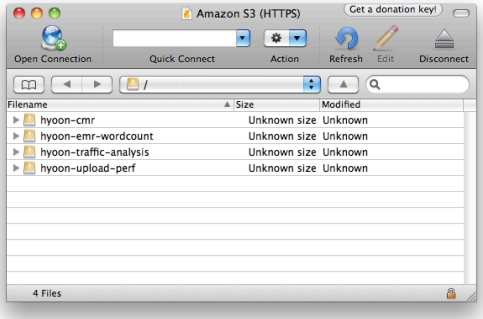
Optimizing upload performance to S3

There are various S3 upload tools…

- AWS web interface



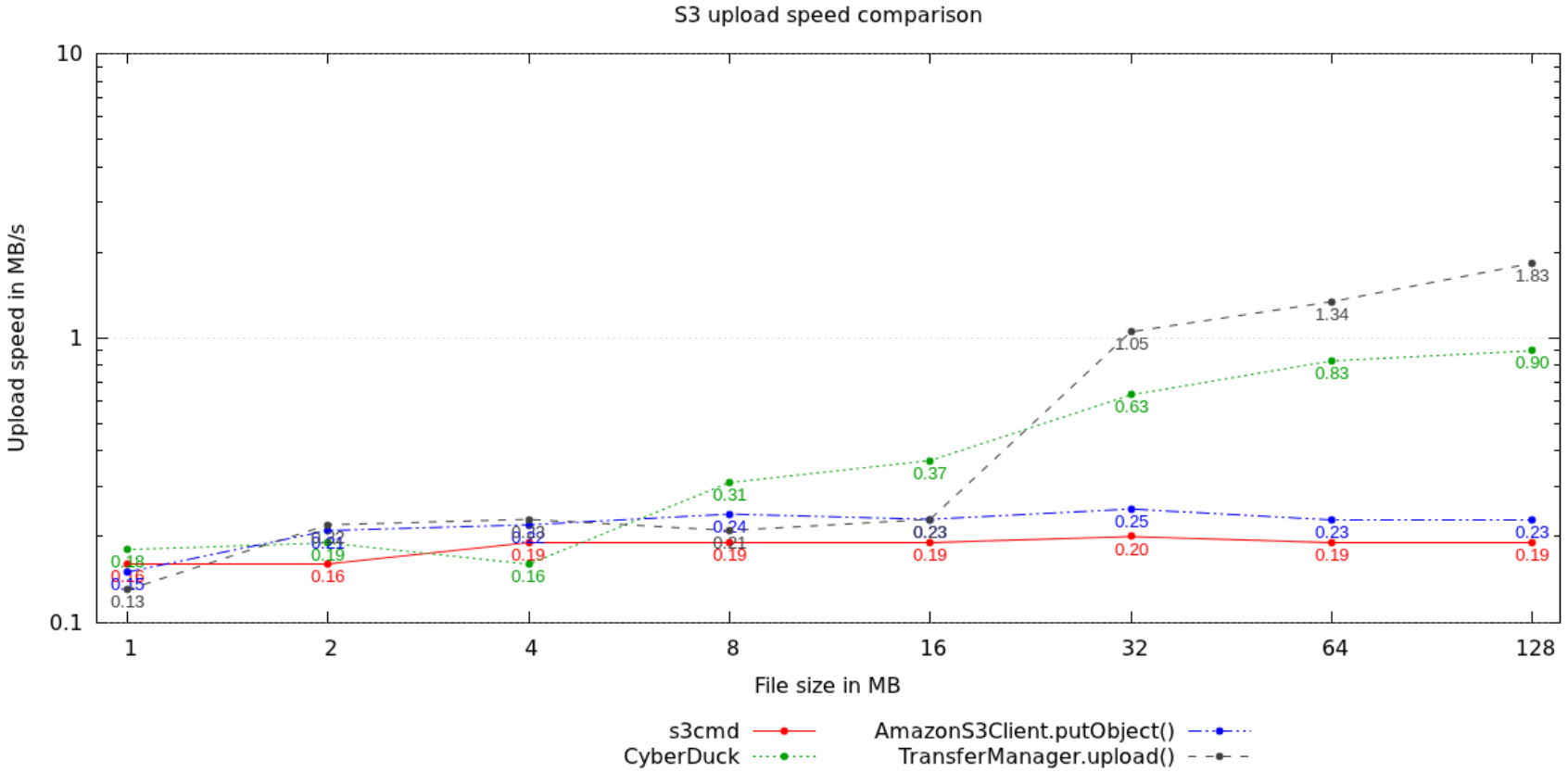
- CyberDuck



- s3cmd: command line S3 client

- Amazon Java APIs
  - Low level API: AmazonS3Client.putObject()
  - High level API: TransferManager.upload()

...with different performances



- # of connections: S3cmd 1, putObject 1, CyberDuck 5, and TransferManager 10.

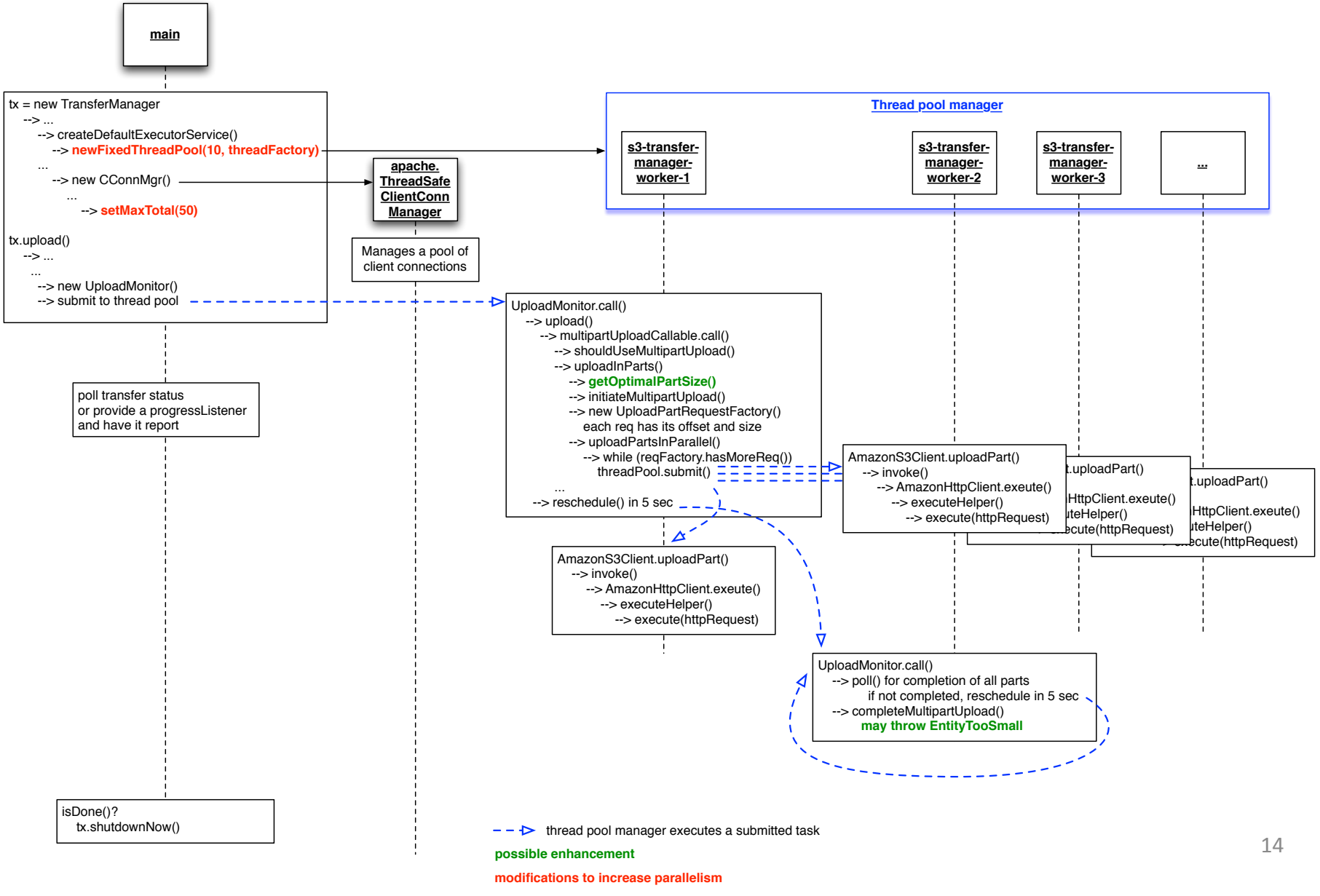
Multi-part upload of small files?

- TransferManager, with default configuration, does multi-part upload when file size > 16MB and chunk size >= 5MB

- S3 server does not allow it with smaller files…

  16:06:42.438 [s3-transfer-manager-worker-4] DEBUG com.amazonaws.services.s3.transfer.internal.UploadMonitor.call(UploadMonitor.java:159) - Status Code: 0, AWS Request ID: 3784CB129EBAEF41, AWS Error Code: EntityTooSmall, AWS Error Message: Your proposed upload is smaller than the minimum allowed size, S3 Extended Request ID: 7cymUI2eF7Ui9nTv3Tsl59JwPzWMdXl+K4R4Pb0rNmzJ/cC5Xzxo7UT6NMlCket6

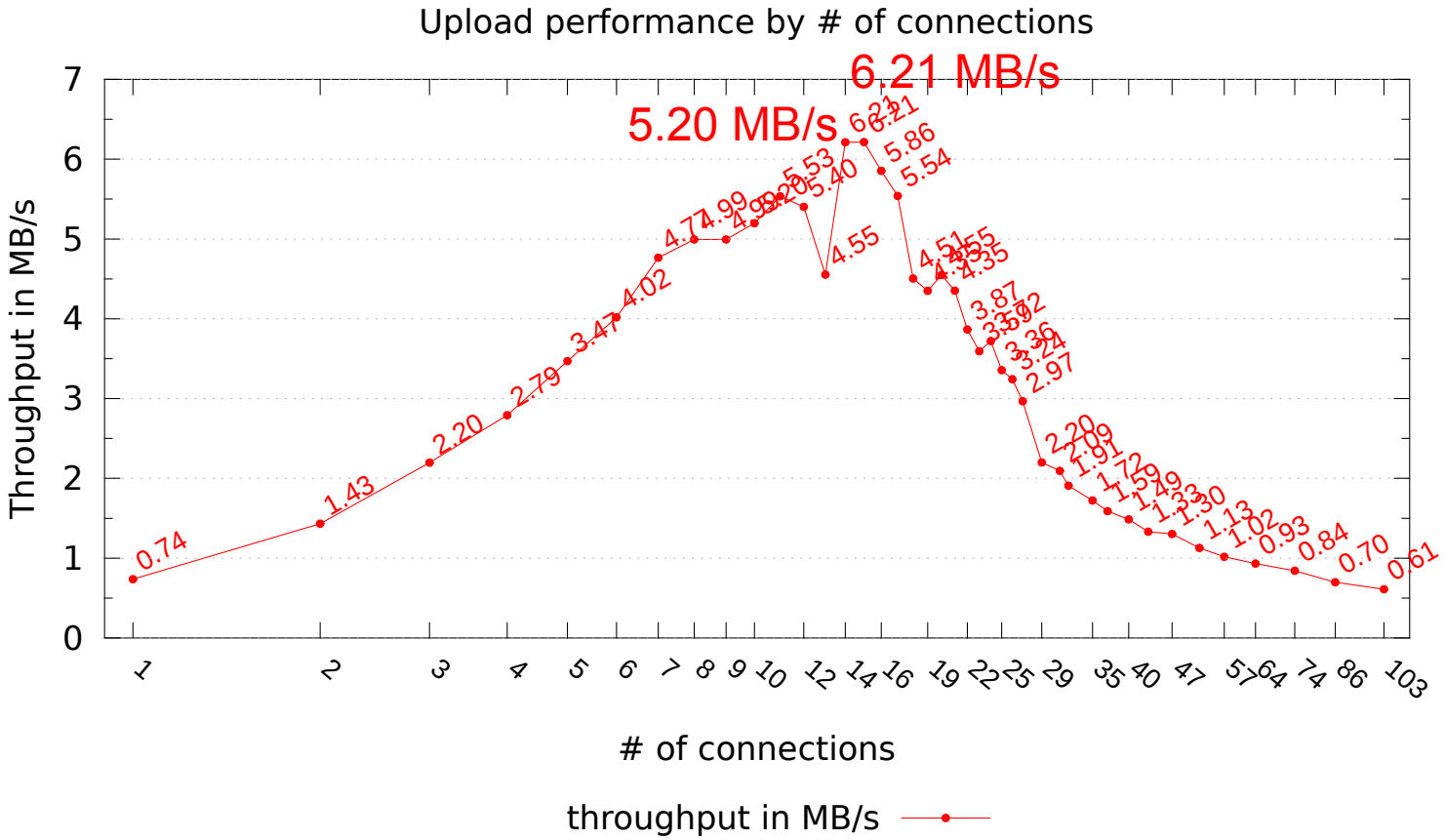
A closer look at TransferManager



With more threads and connections…

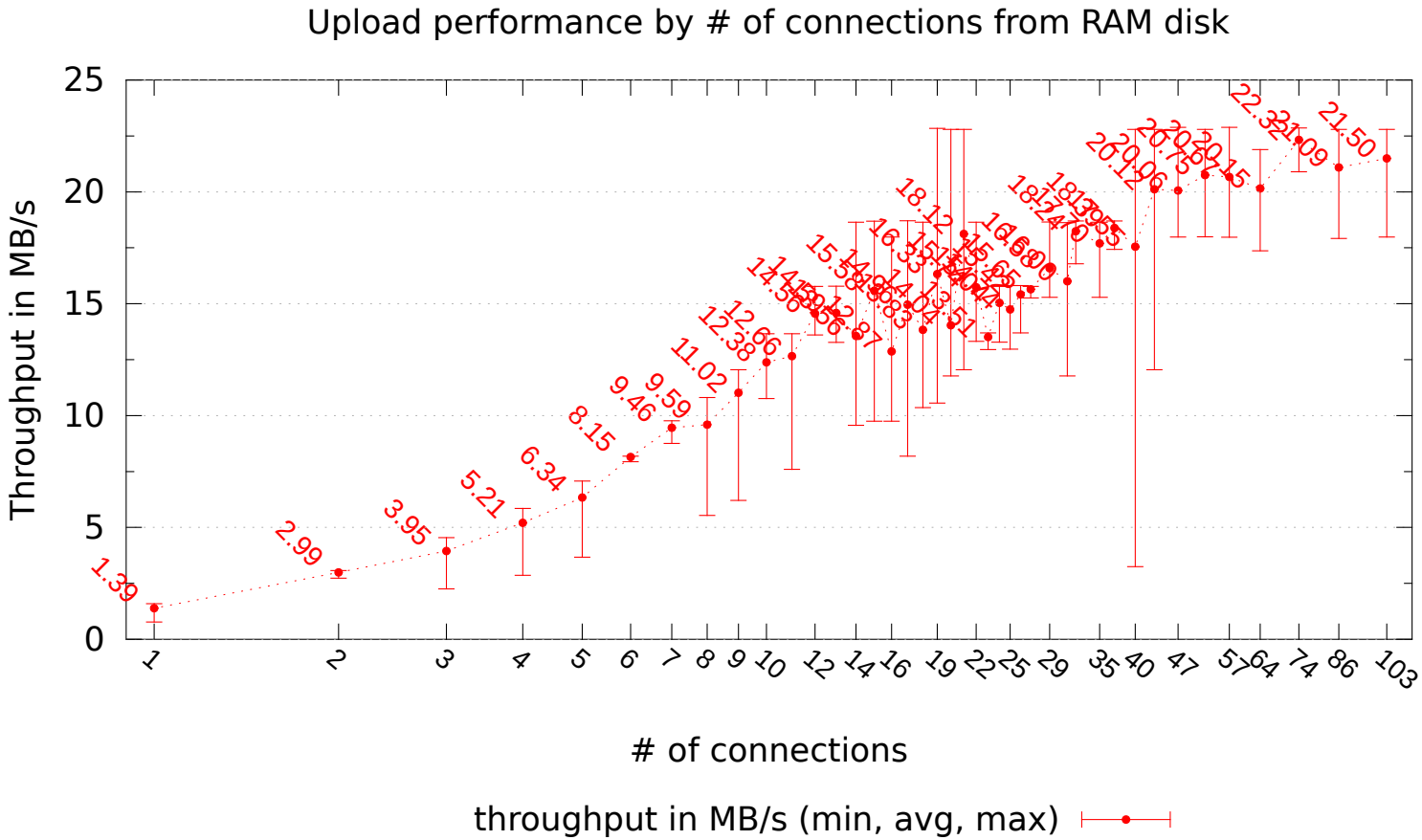
- Connection manager puts a limit on the # of connections - 50 connections.
  - to 200 connections.
- A pool of fixed # of worker threads - 10 threads.
  - with CachedThreadPool, which creates threads as needed and reuse ones when they are available.

… got 20% performance gain



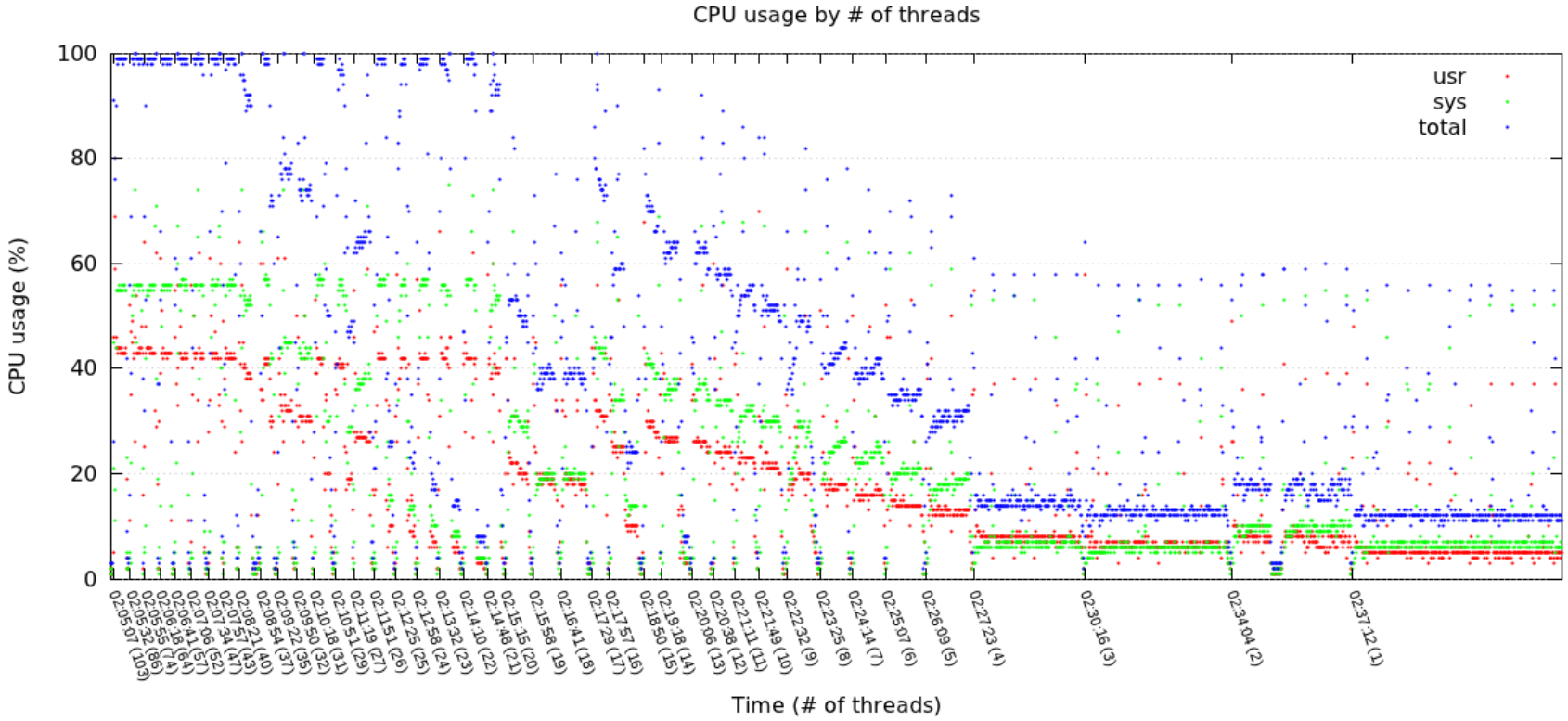
- from 5.20 MB/s with 10 connections, which is the max # of conn. With unmodified code,
- to 6.21 MB/s with 14 connections,
- but it start to decrease… because of HDD?

Data from RAM disk



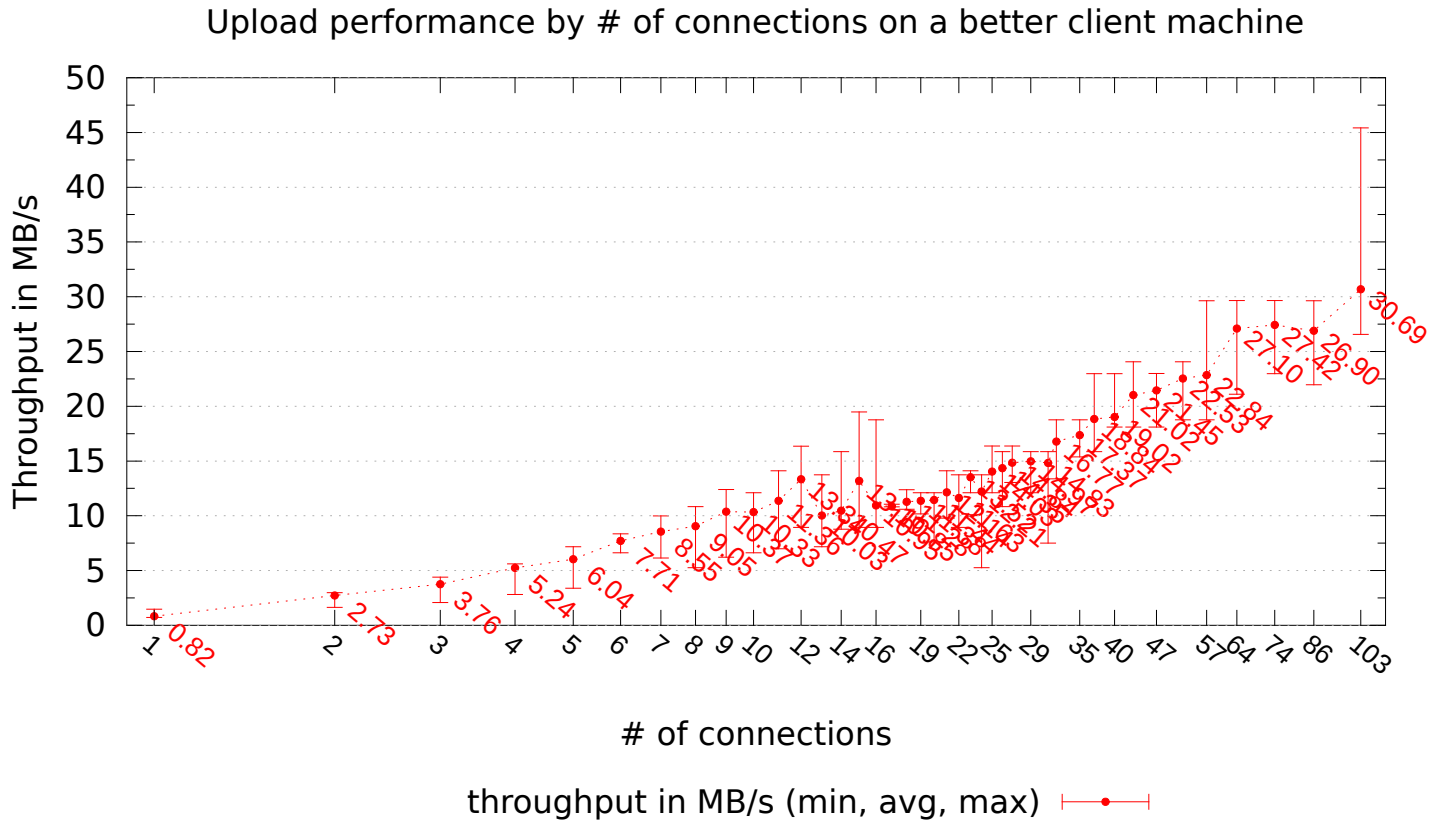
- Scaled up to 22.32 MB/s, which is 3.6 x more gain.
- Now the bottleneck is… CPU?

CPU usage



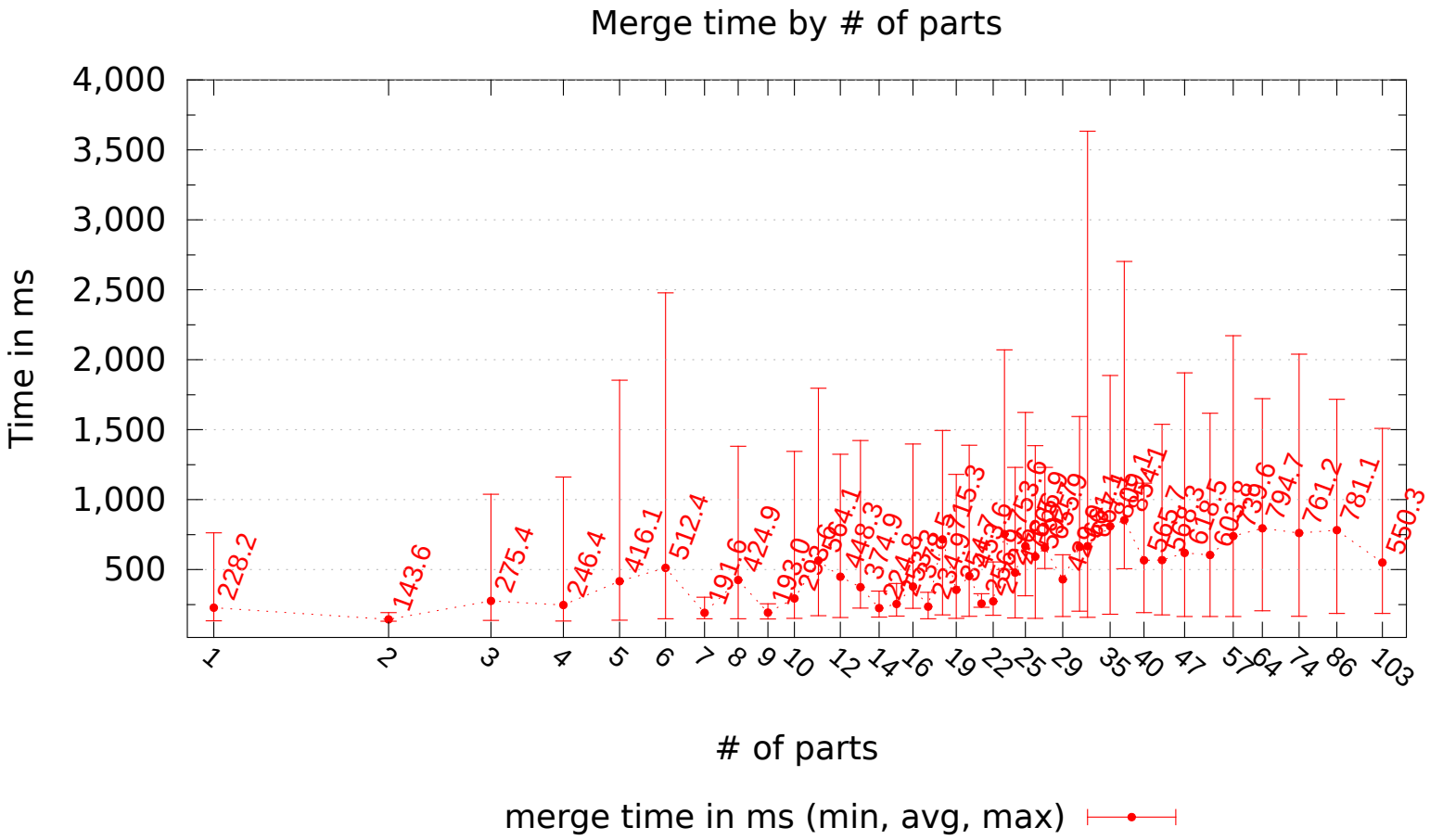
- CPU saturates around 20 threads.
  - On Macbook Pro 4,1. Core2 Duo 2.6GHz.
- On a better machine?

On a better machine



- 30.69 MB/s from 22.32 MB/s, which is 38% more gain.
- Switched to Xeon Quad Core 2.8 GHz, 12 GB of DDR3 RAM, 7200 rpm HDD
- from Core 2 Duo 2.6 GHz, 4 GB of DDR2 RAM, 5400 rpm HDD

Merging parts



- < 1 sec. Good scalability.

Lessons learned

- With minimal modifications to TransferManager and by detecting and eliminating bottlenecks one by one, high throughput can be achieved.
  - Unmodified code (5.20 MB/s)
  - More connections and threads (6.21 MB/s)
  - Data from RAM disk (22.32 MB/s)
  - With a better client (30.69 MB/s)

More throughput?

- Network may not be a bottleneck.
  - iperf from the client machine to a large EC2 instance showed 1 Gb/s with 120 connections.
- More throughput could have been achieved with either
  - more # of parts (with a bigger file) or
  - with multiple instances of TransferManagers.

Thank you!!

Comments or Questions?