Methodologies for Generating HTTP Streaming Video Workloads to Evaluate Web Server Performance

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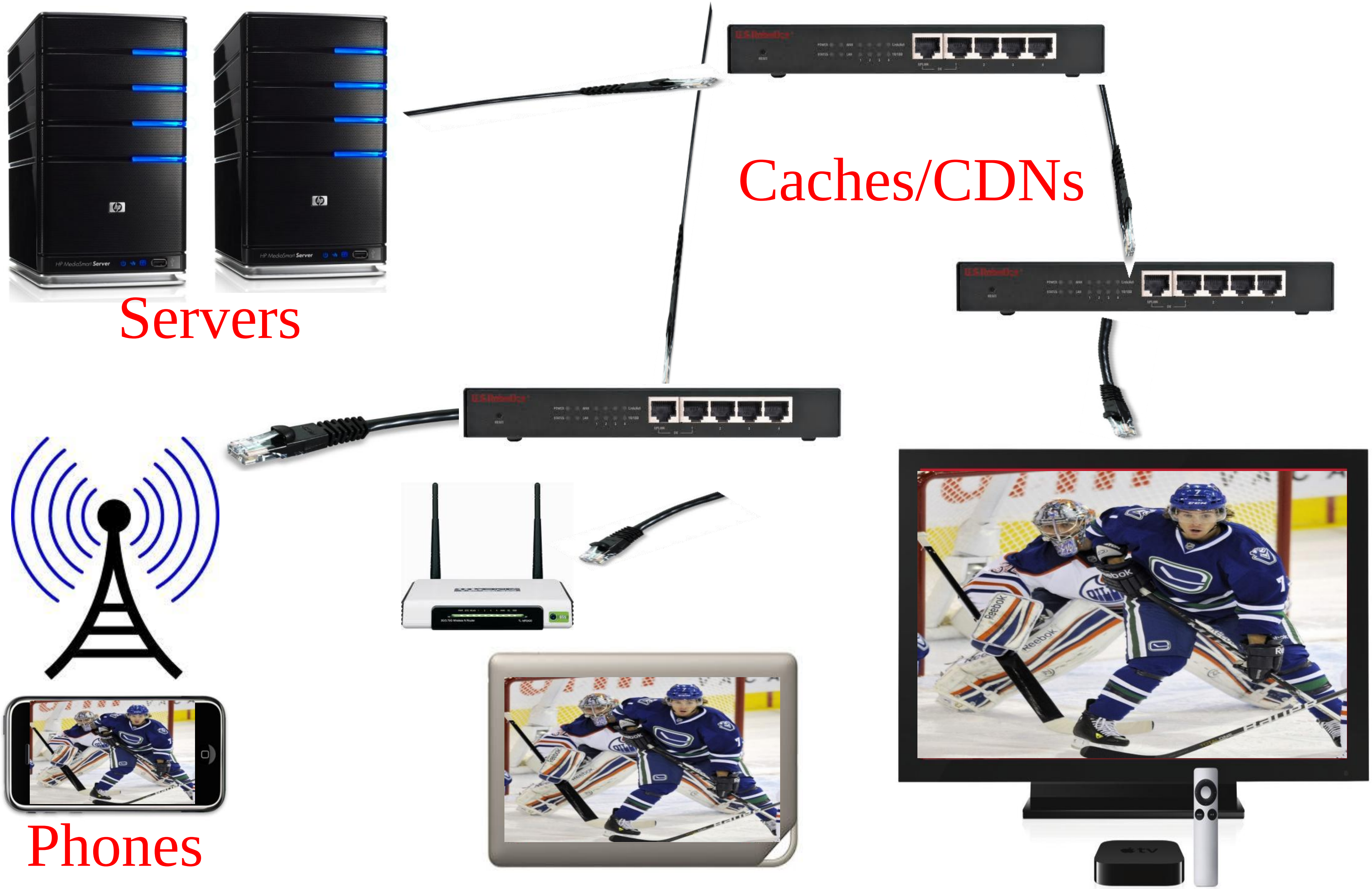
HTTP Streaming Video

HTTP Ecosystem



Servers

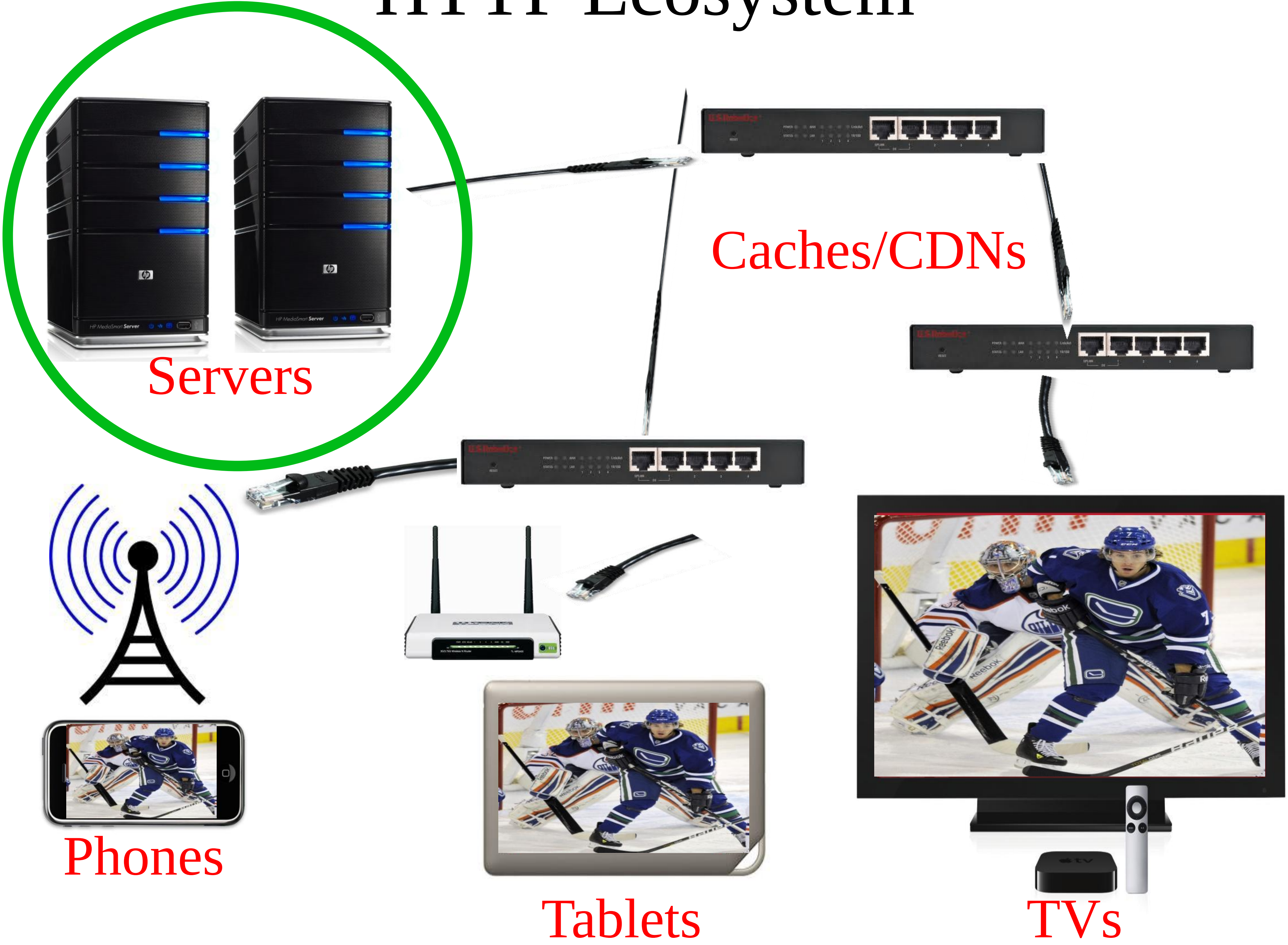
Caches/CDNs

Phones

Tablets

TVs

HTTP Ecosystem



Servers

Caches/CDNs

Phones

Tablets

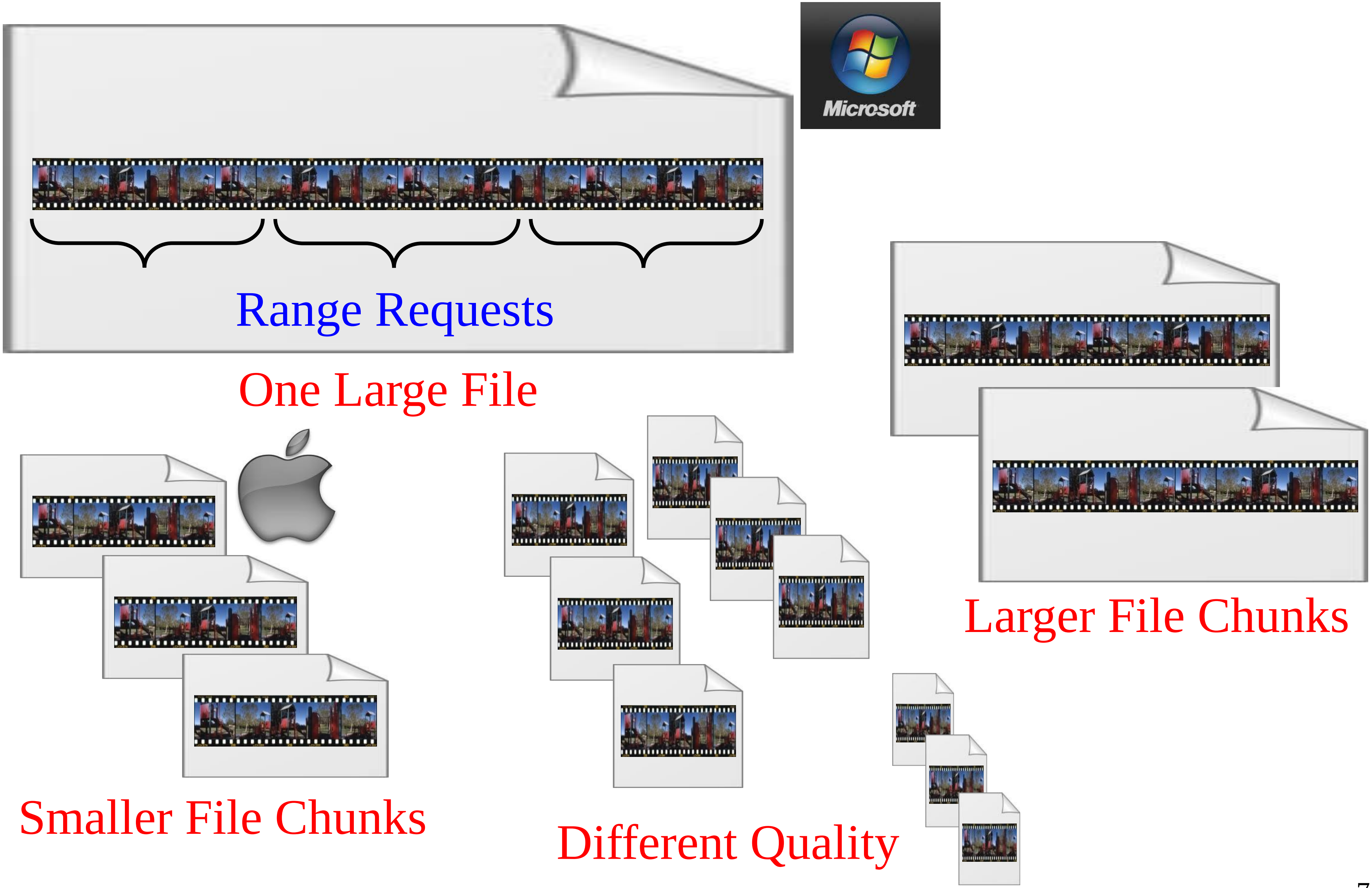
TVs

Buffering …

Video and Client Characteristics

- Video is buffered
    - Start at full speed
    - Remainder at rate of consumption
- Clients usually do not watch until the end
- Change quality of video
- Pause, skip forward or back
- Long-tail distribution of content

Storage and Request Options



Range Requests

One Large File

Larger File Chunks

Smaller File Chunks

Different Quality

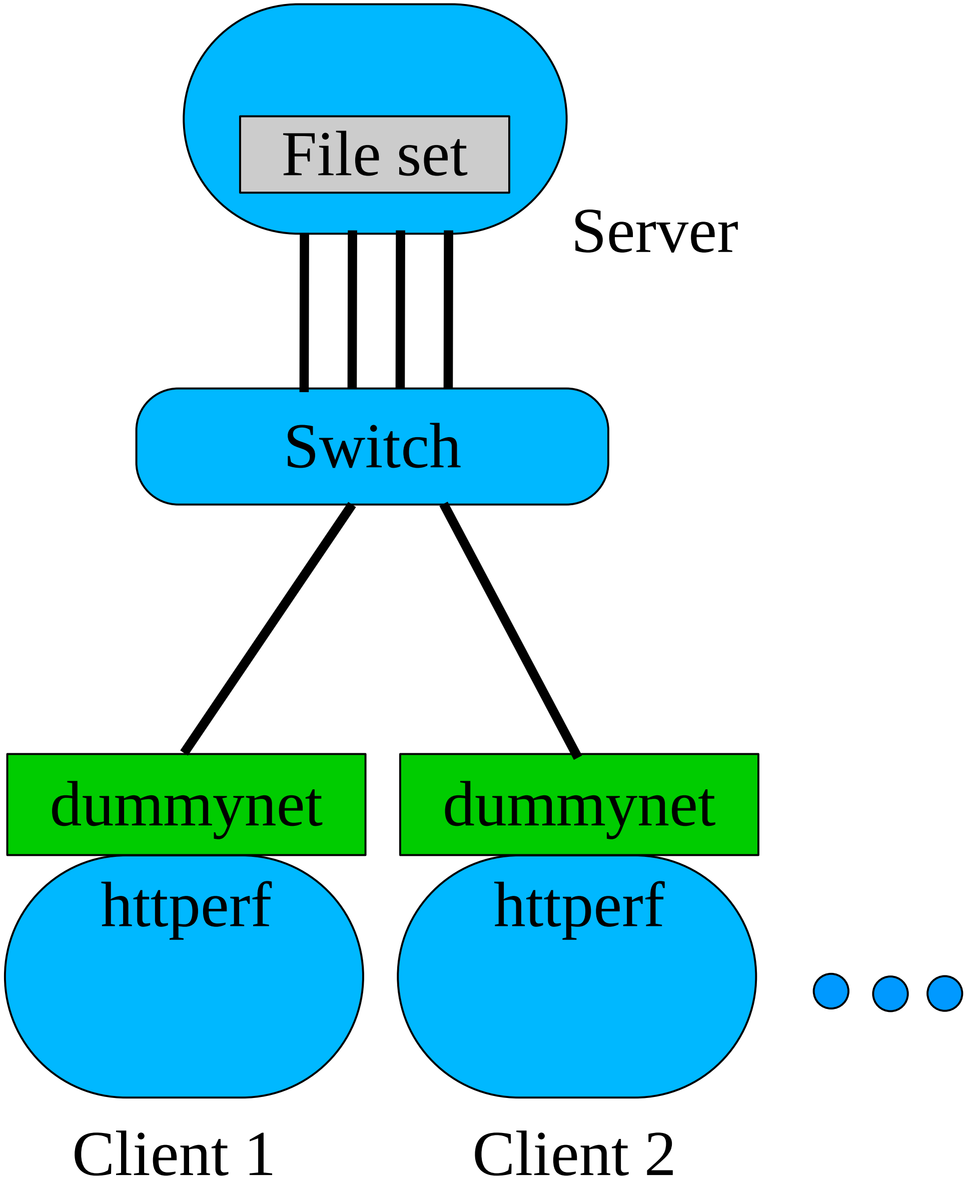
Methodology Goals

- Flexible
  - Many types of videos and users
- Representative
  - Based on workload measurements and studies
  - Limited client network access
- Practical
  - Experiments repeatable
  - Reasonable execution time
  - In a lab

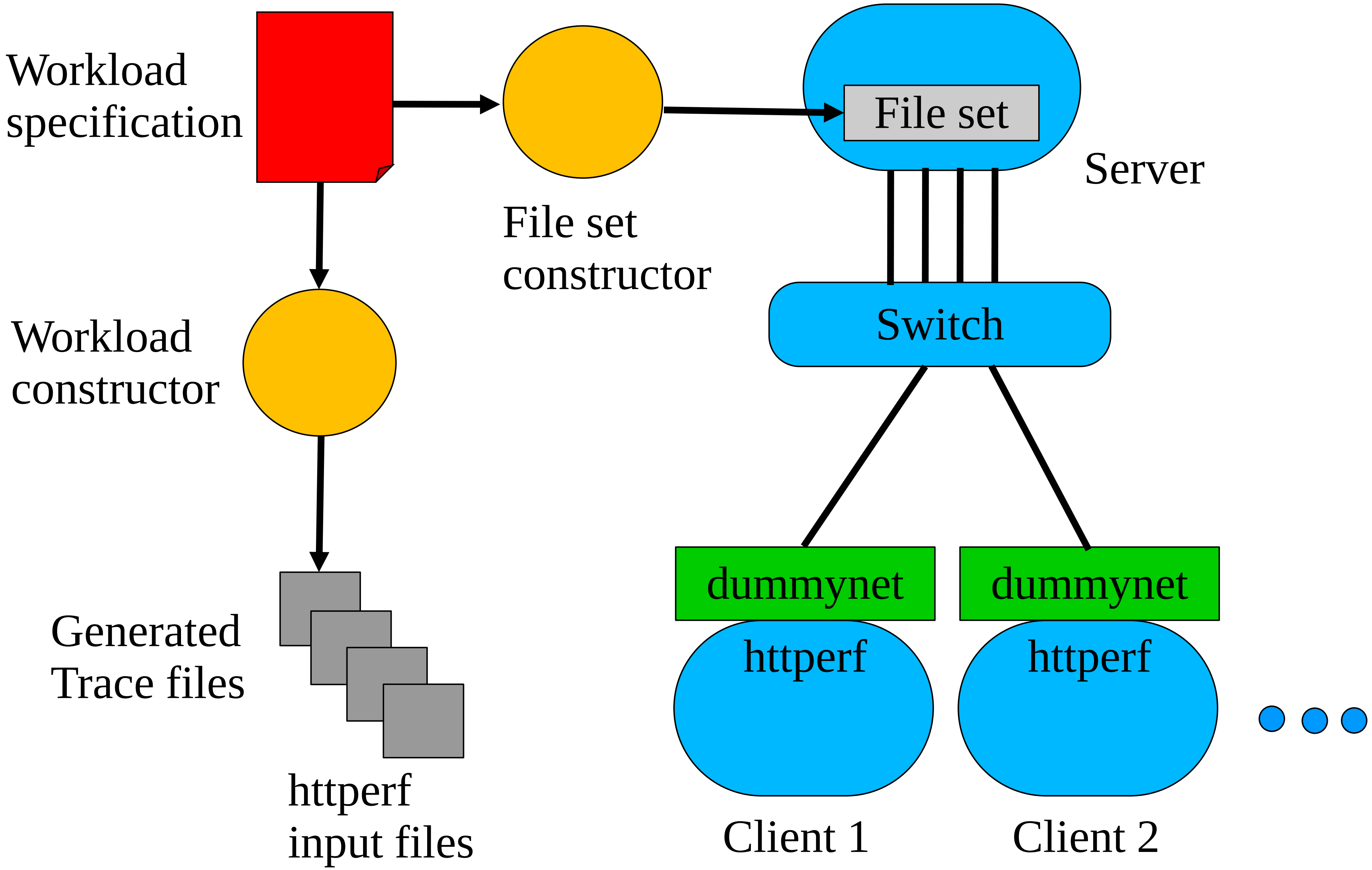
Related Work

- Benchmarks and Workload Generators
  - YouTube Workload generation [Abhari et al, ’10]
  - SPECweb2009
  - BenchLab [Cecchet et al, WebApps ’11]
- Measurement Studies
  - YouTube Everywhere [Finamore et al, IMC ’11]
- Client Testing
  - DASH Dataset [Lederer et al, MMSys'12]

Environment



Overview of the Methodology



Workload specification

File set constructor

File set

Server

Switch

Workload constructor

Generated Trace files

httperf input files

dummynet

httperf

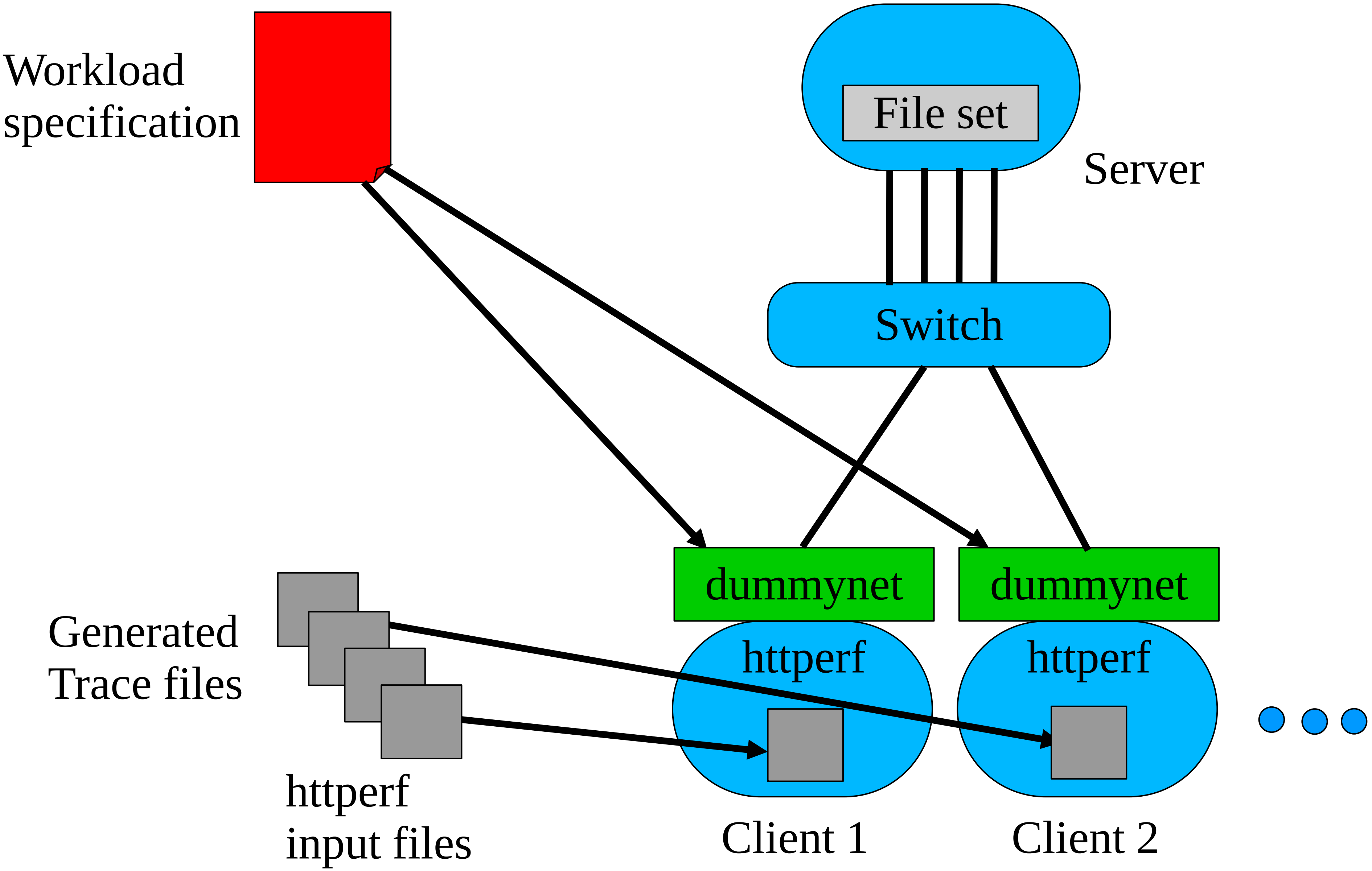
dummynet

httperf

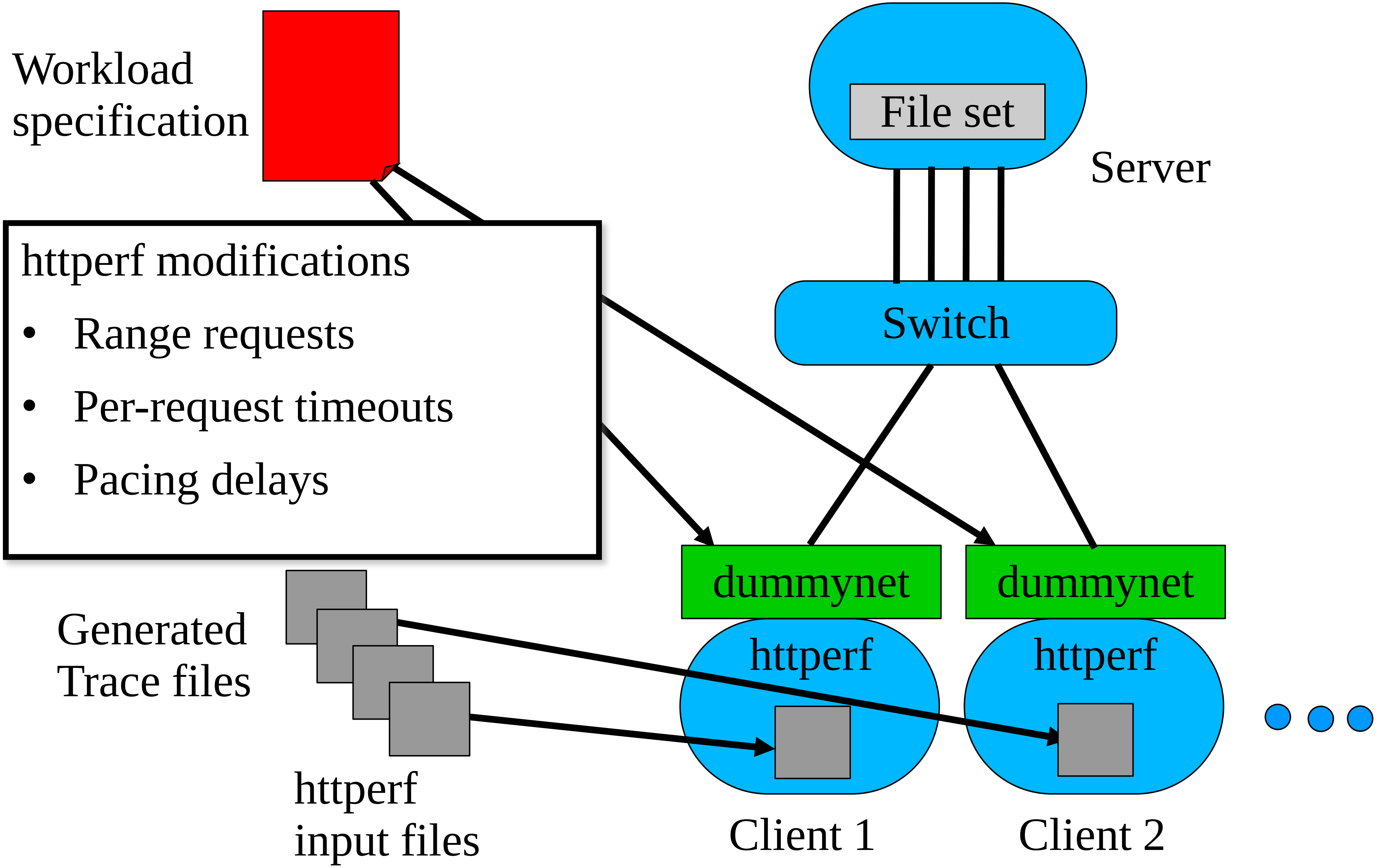
Client 1

Client 2

Running Experiments



Running Experiments



Workload specification

httperf modifications

- Range requests
- Per-request timeouts
- Pacing delays

Generated Trace files

httperf input files

File set

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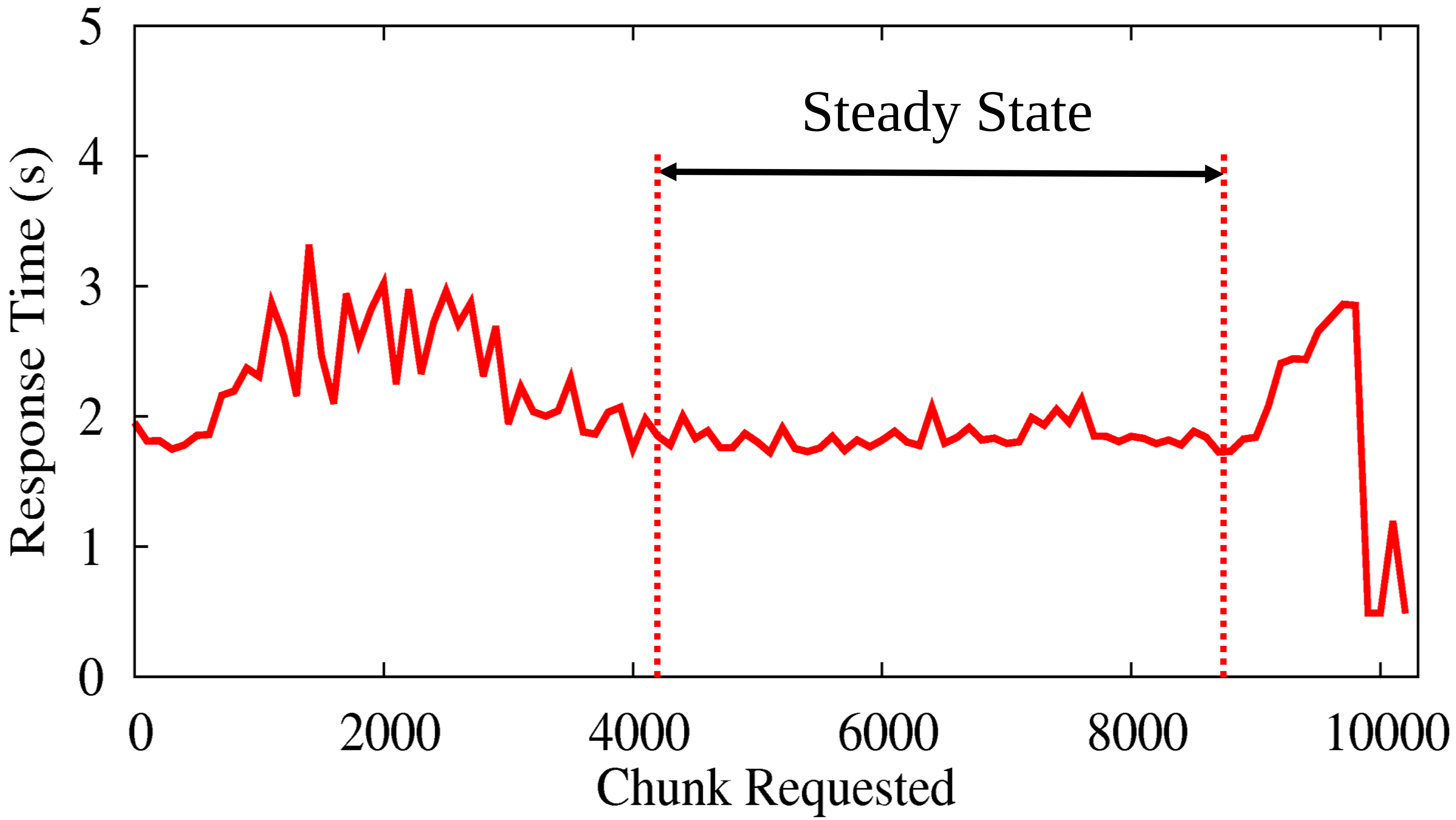
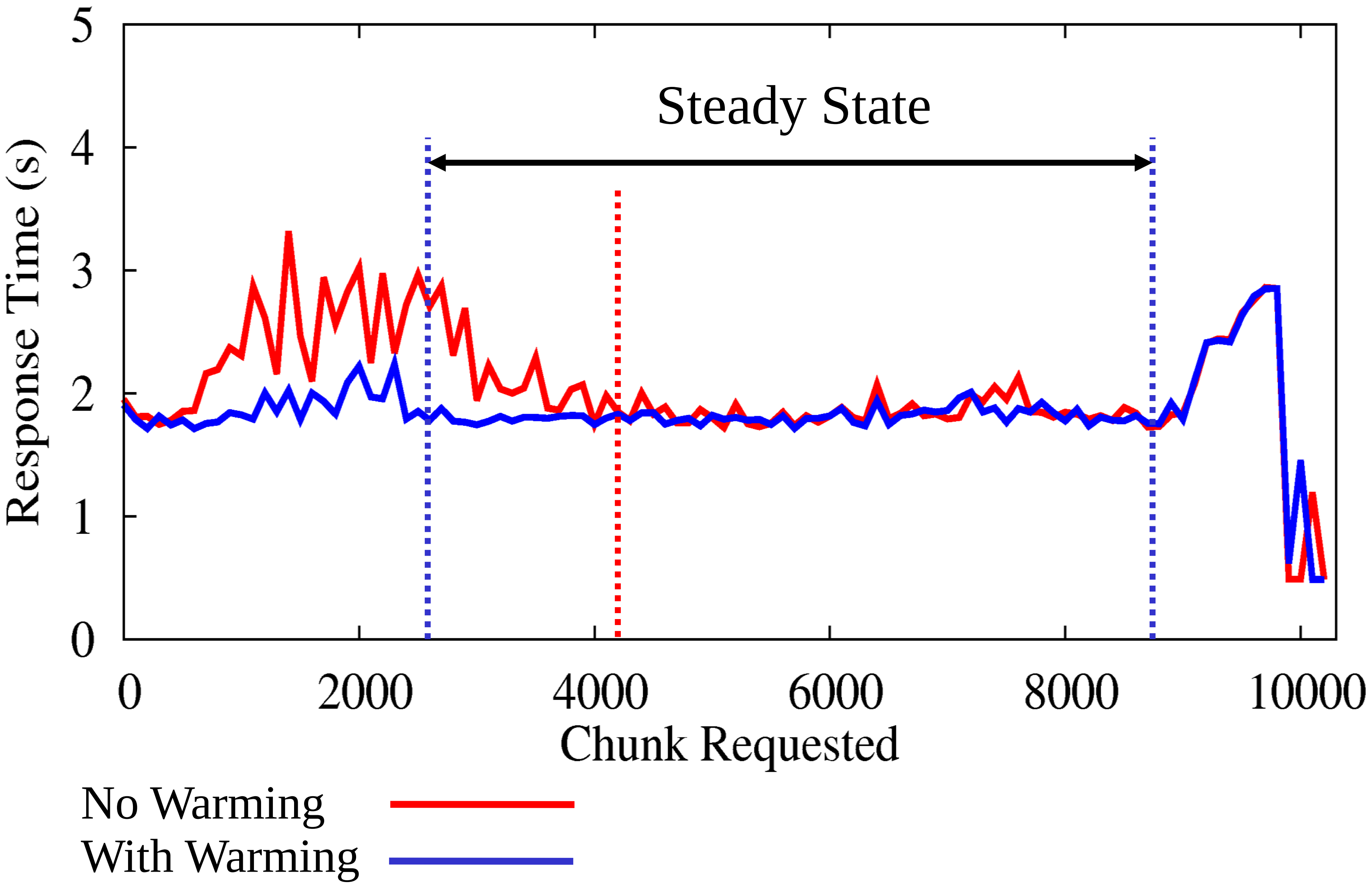
Client 1

Client 2

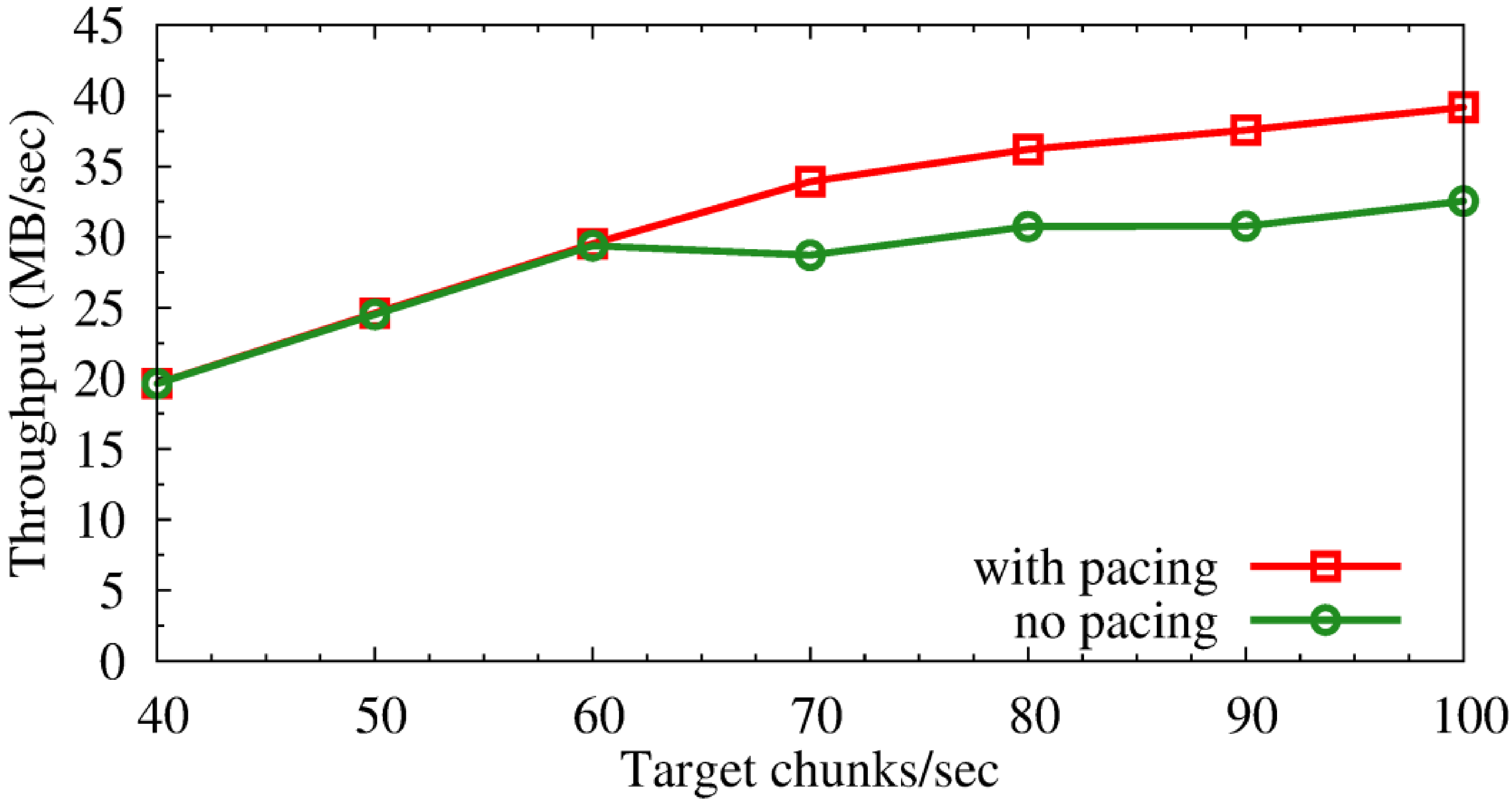
Experiment Progress



Experiment Progress



Effect of Pacing



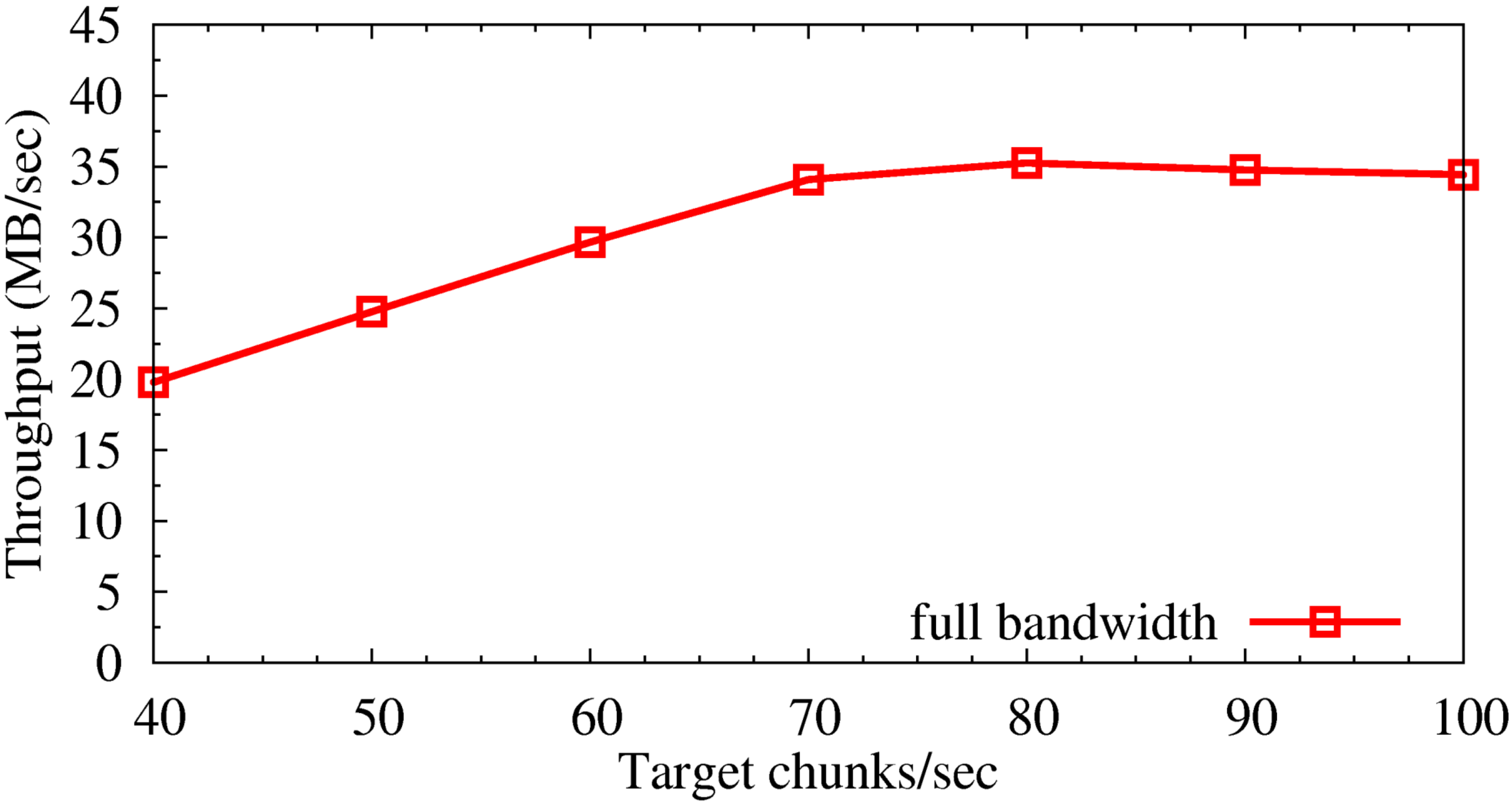
throughput with 0.5 MB chunks

Client Network Limiting

- Lab environment not realistic
  - Different devices and different network speeds
  - Not lab network speeds (e.g. 1 Gbps)

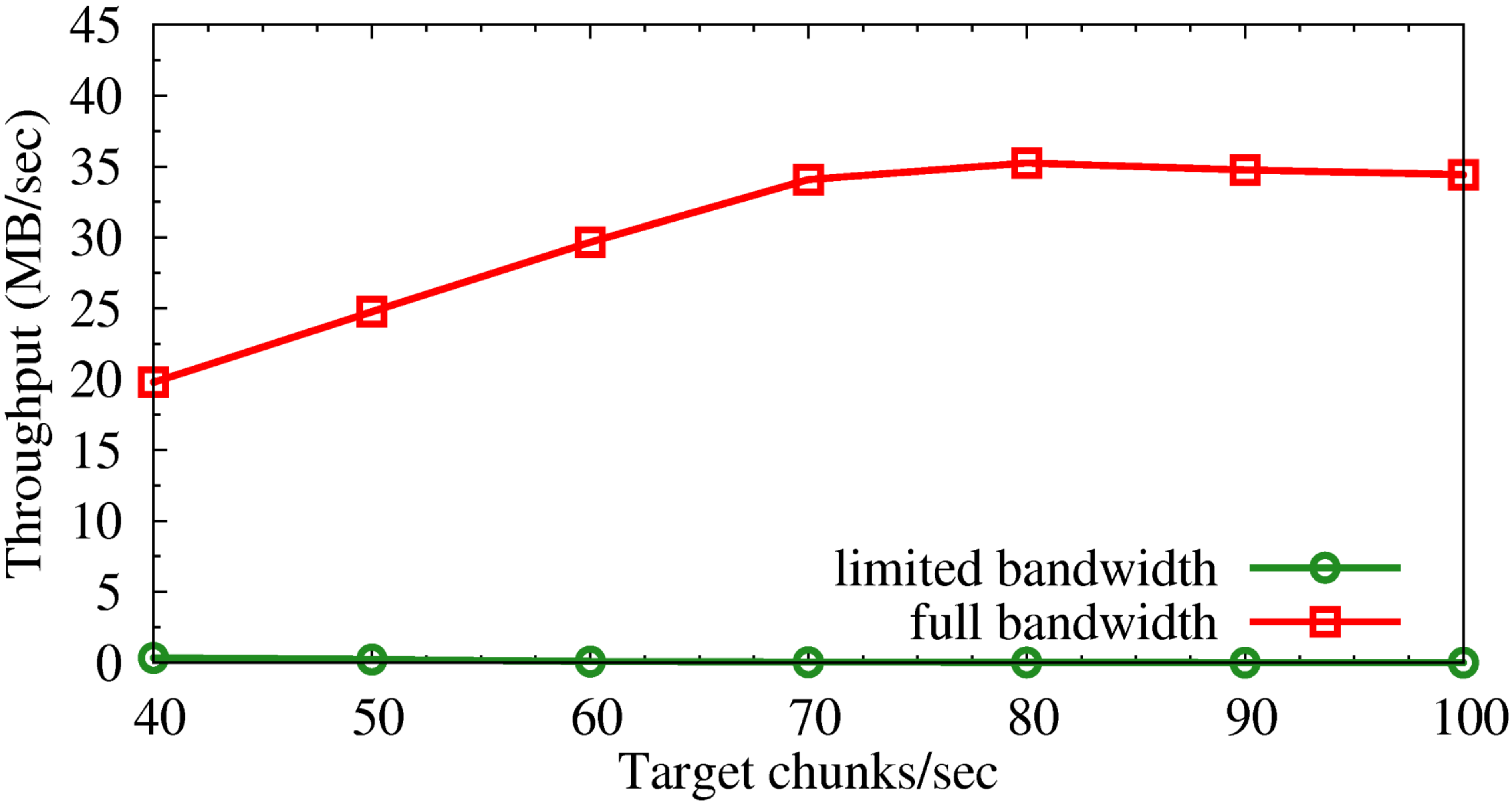
- Preliminary tests: poor disk throughput
- Simple experiment: Service videos one at a time
  - Expected to improve disk throughput

Client Network Limiting



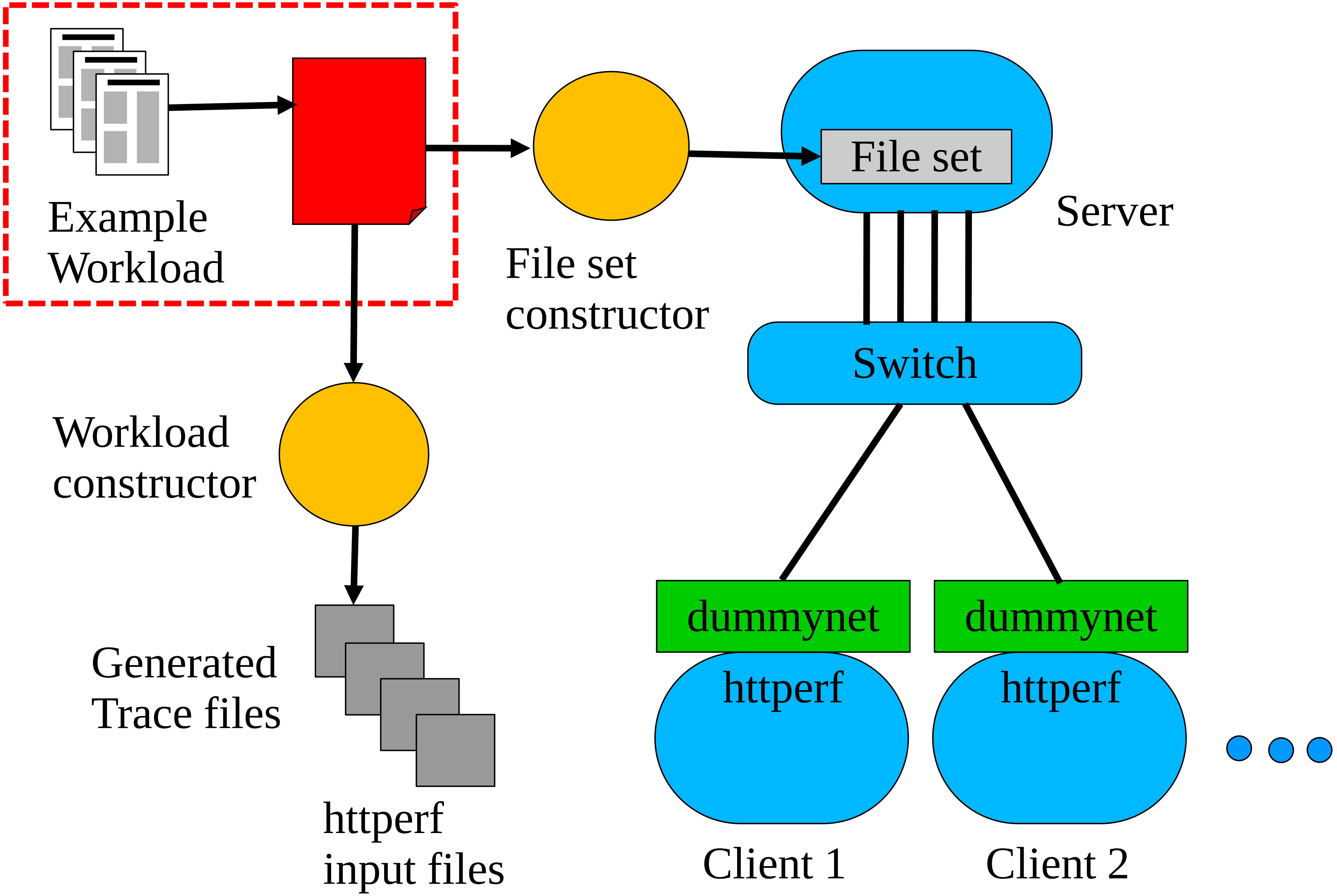
Single-connection throughput with 0.5 MB chunks

Client Network Limiting



Single-connection throughput with 0.5 MB chunks

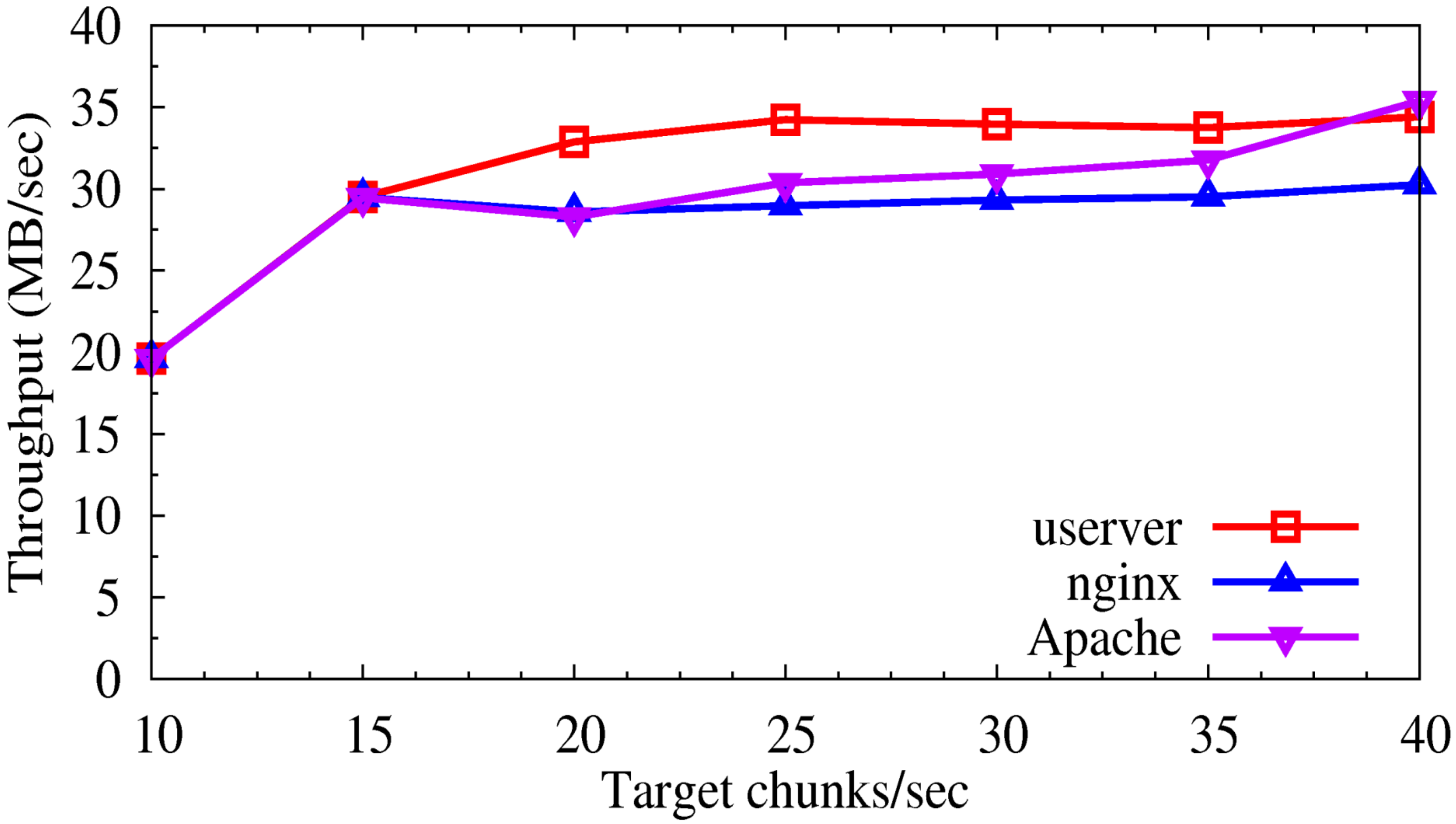
Example Workload



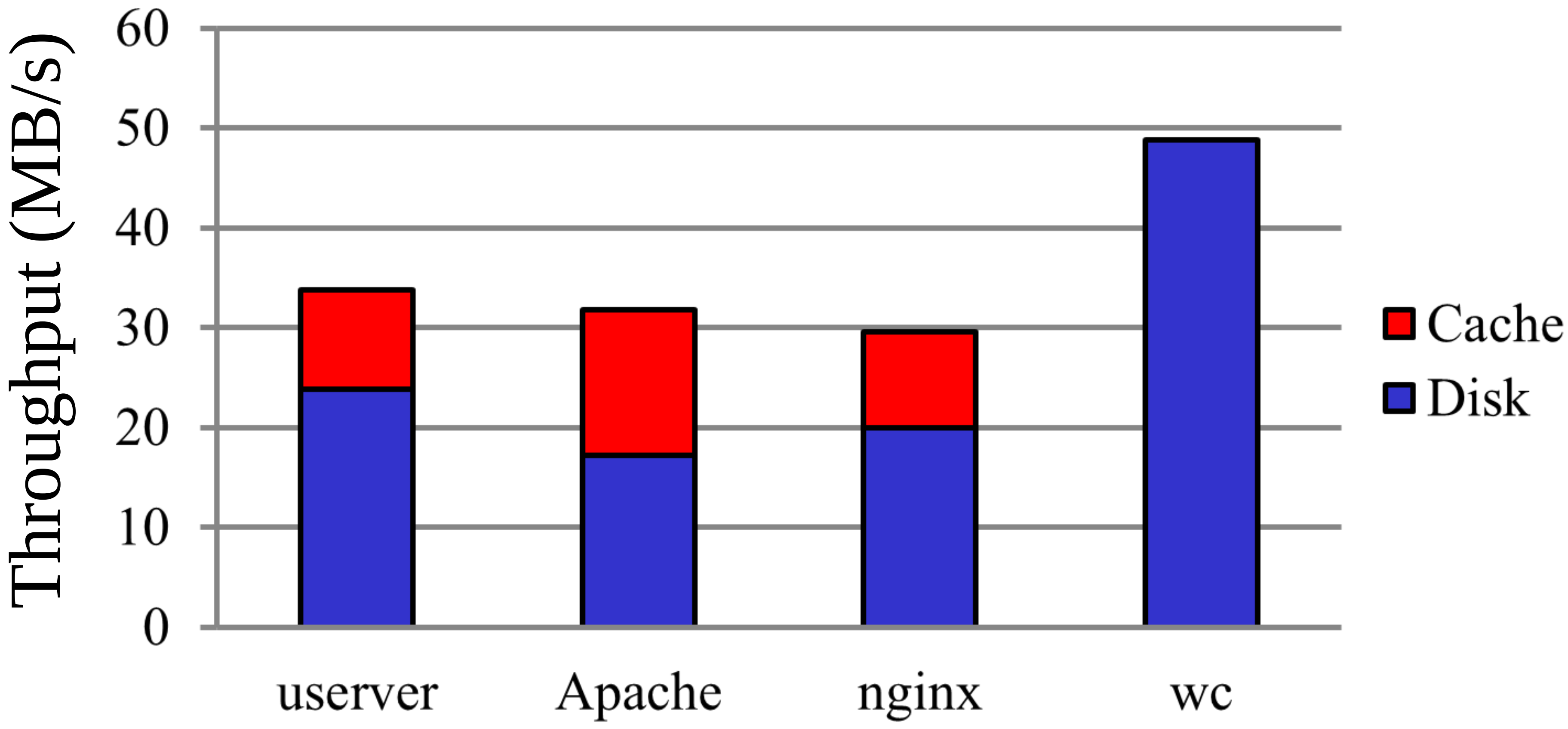
Example Workload

- Video session characteristics [Finamore et al, IMC ’11]
    - Video popularity and duration like YouTube
    - Viewing length distribution like YouTube
- Network Characteristics
    - Bandwidth 10 Mbps, 3.5 Mbps, and 1 Mbps [Akamai]
    - One-way delay 50 ms [N.A. coast-to-coast]
- Server File Set Characteristics
    - Chunks size 0.5 & 2 MB [10 & 40 second chunks]

Throughput with 2 MB chunks



Web Server Throughput

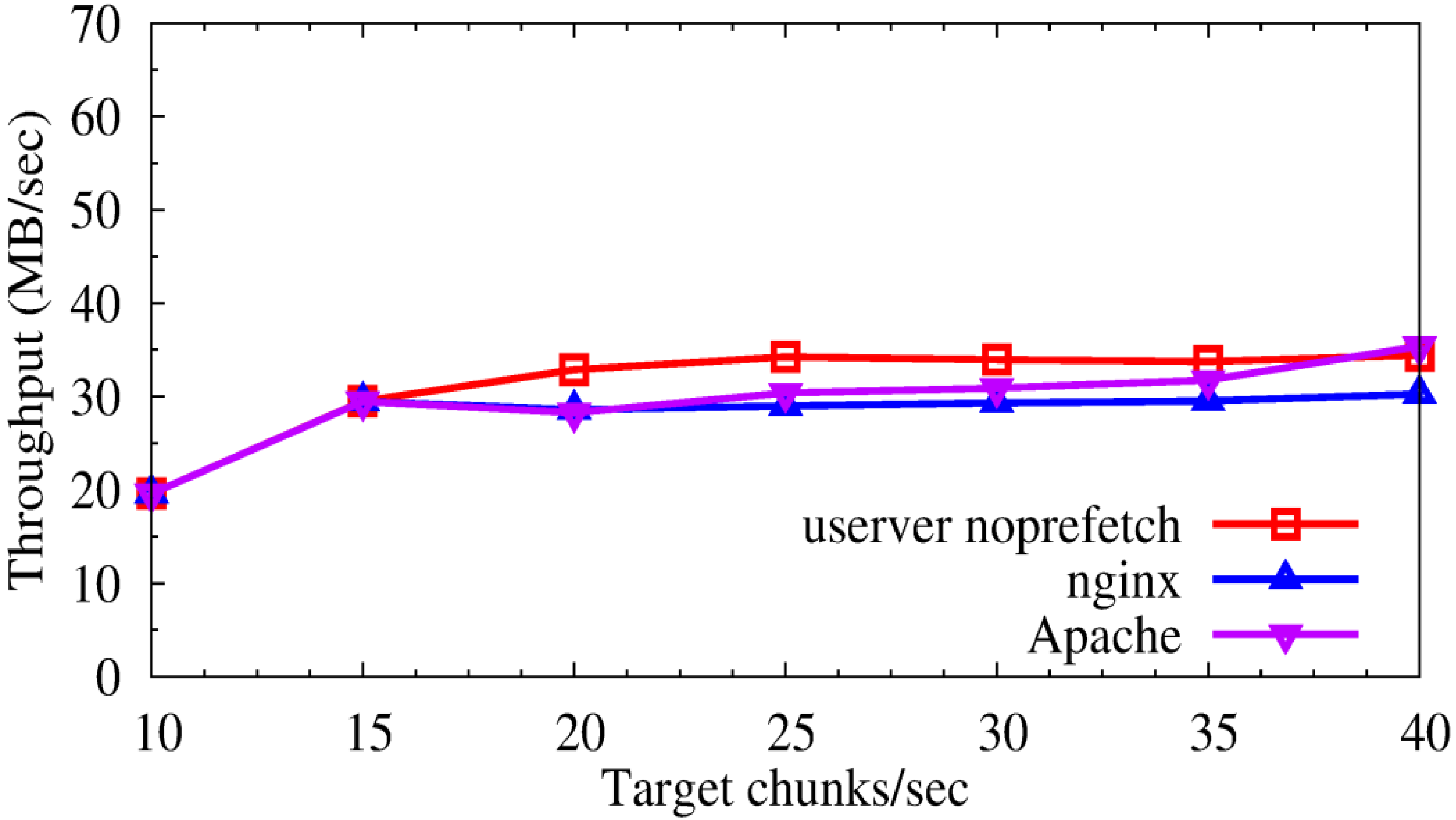


Throughput at 35 chunks/sec with 2 MB chunks

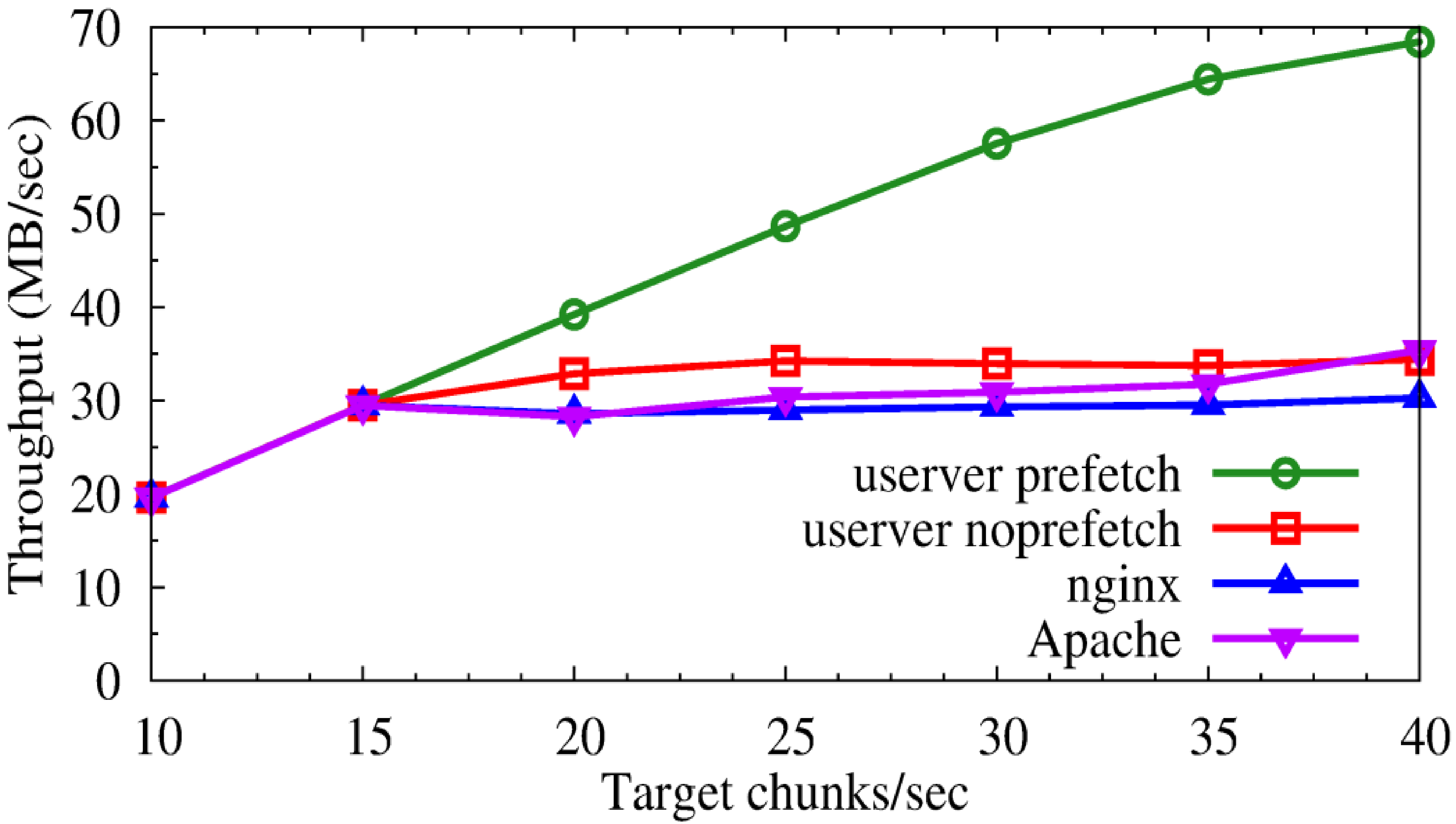
Sequential Prefetching with userver

- Problem:
  - userver uses multiple threads to service requests
  - FreeBSD interleaves concurrent read requests (fairness)
- Ideas:
  - Sequentialize disk access (file/chunk at a time)
  - Agressive application prefetching (entire chunk)

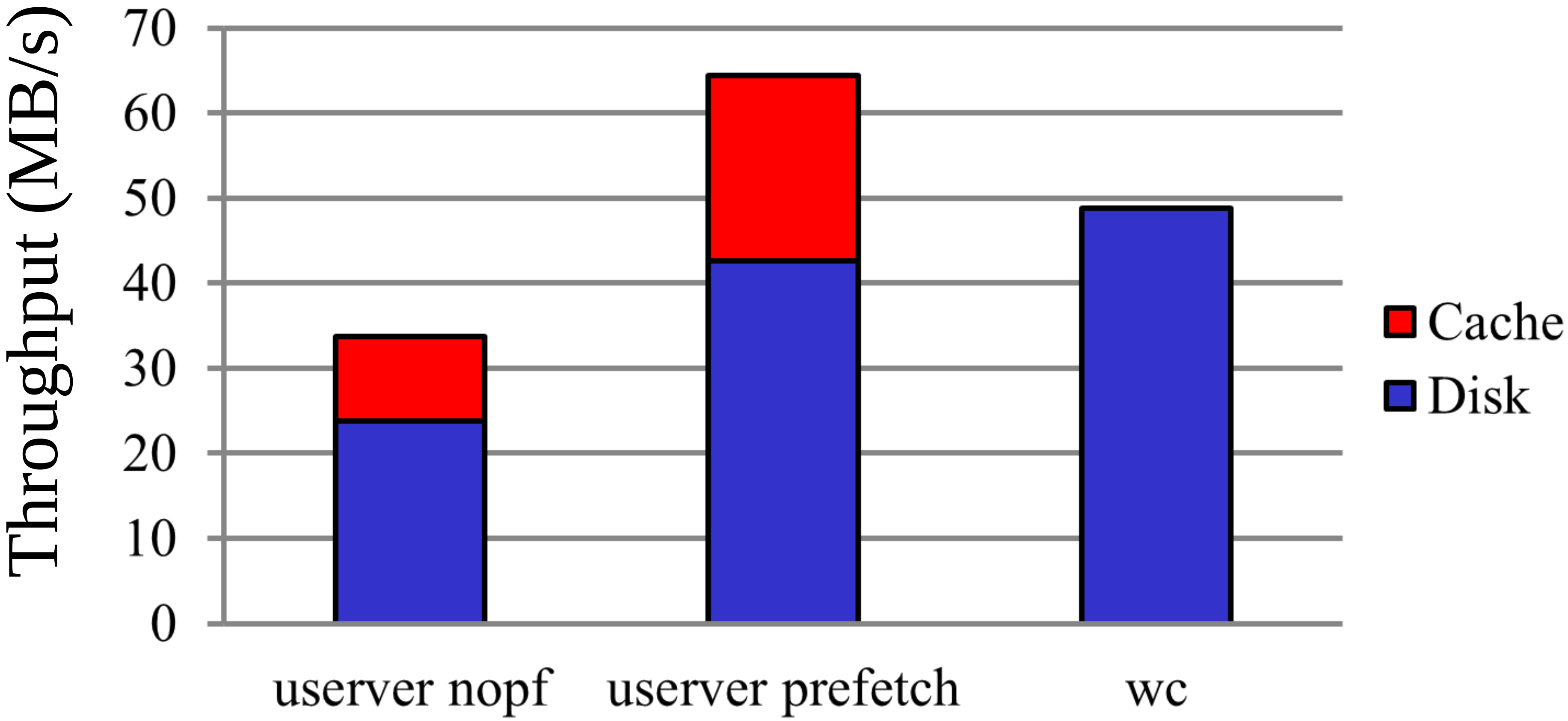
Throughput with 2 MB chunks



Throughput with 2 MB chunks



Improved Disk and Total Throughput



Throughput at 35 chunks/sec with 2 MB chunks

Summary and Conclusions

- Workload Methodology
  - Flexible, representative, practical, useful
- Demonstrate:
  - Client pacing affects results
  - Must emulate client network speeds
- Web servers can be improved
- Study HTTP ecosystem

`cs.uwaterloo.ca/~brecht/papers/systor-2012`

Future Work

- To chunk or not to chunk [Our work, NOSSDAV ’12]
- Sensitivity analysis
- More server improvements
- Library to use with Apache and nginx

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END