OpenAFS Out-of-Band TCP

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Agenda

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- Why is AFS so slow?
- Project Background
- OOB Design
- Current Status (numbers!)
- Future Directions

Why is AFS so slow?

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- Define “performance” / “slow”
- AFS-specific factors (cache, CBs, etc)
- Inherent UDP restrictions
  - Firewalls, checksum offloading, etc

Why is AFS so slow?

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- Rx implementation and protocol
  - See Simon's talk(s)
- Rx window size
  - (32 * 1400) / RTT
  - 1ms RTT: ~43 MiB/s
  - 10ms RTT: ~4 MiB/s

Project Background

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- AFS too slow for customer
  - Need fix quickly
- Declined approaches:
  - RxOSD vicep-access
  - RxOSD non-vicep-access
  - RxTCP
  - RxUDP improvements

Project Background

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- Compromise on TCP OOB
  - Rx handles args, aborts, auth, etc
  - No long-lived TCP conns
  - Tie TCP conn to Rx call
- Rapid development
- First pass not public

Project Background

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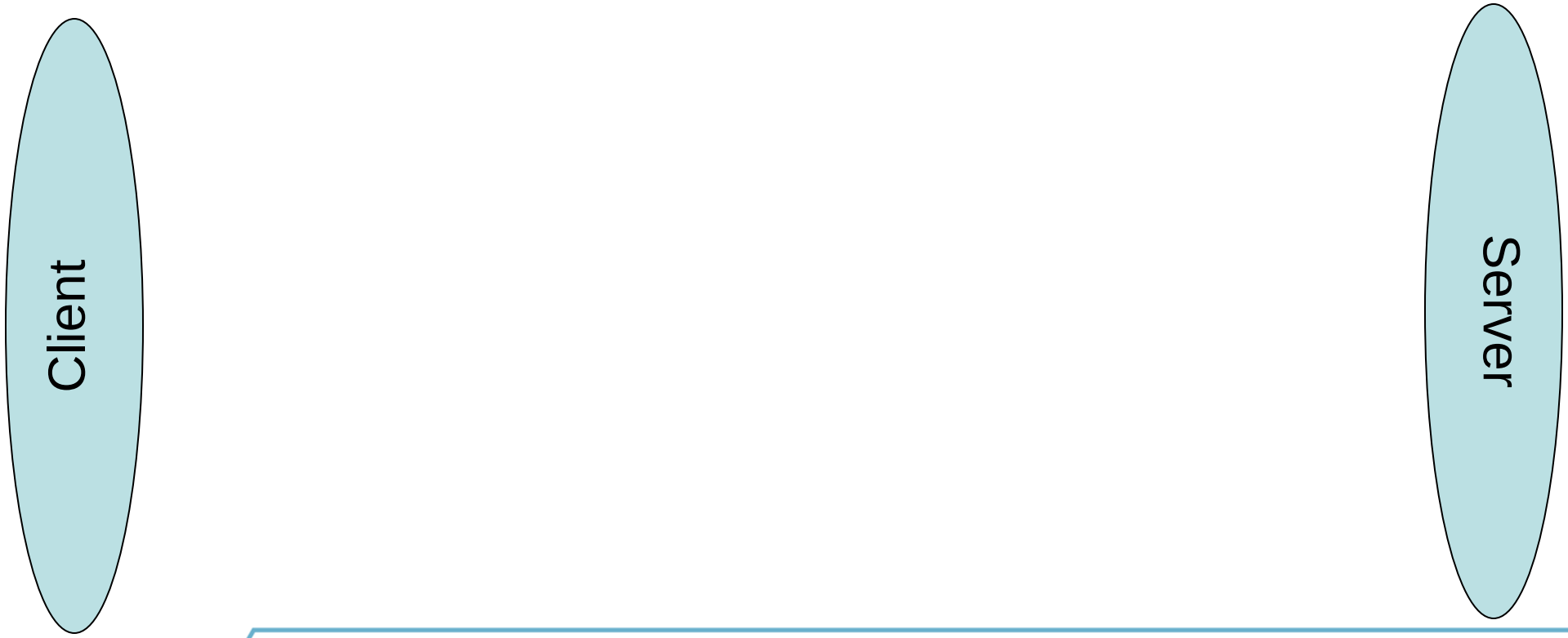
- Started in August/September 2011
- 1.4 client/server delivered in October
- 1.6 client in February
- Production deployment in March/April
- 1.6 server in May

OOB Design

- Designed for rapid dev
- FTP-like control/data channels
- Very similar to existing FetchData64
- Not just for TCP

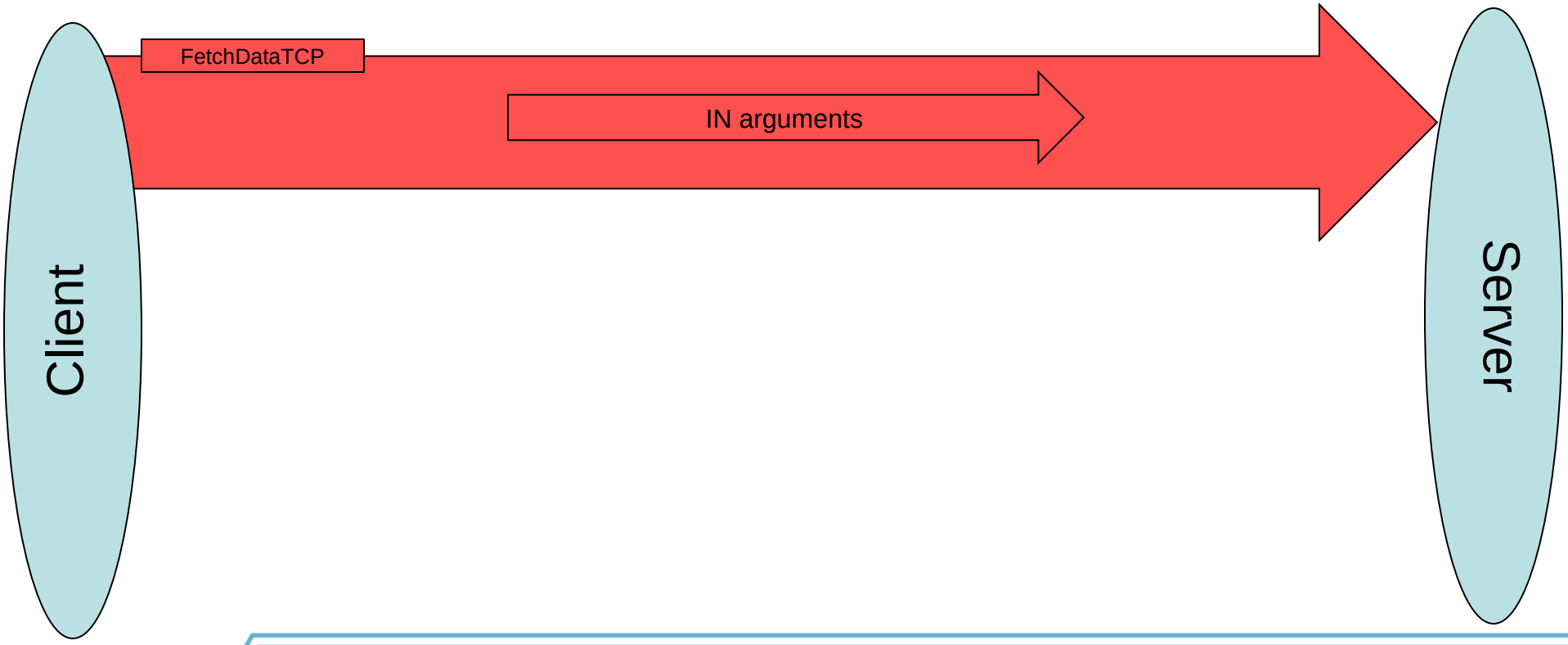
OOB Design (protocol)

Say a client wants to fetch a file…



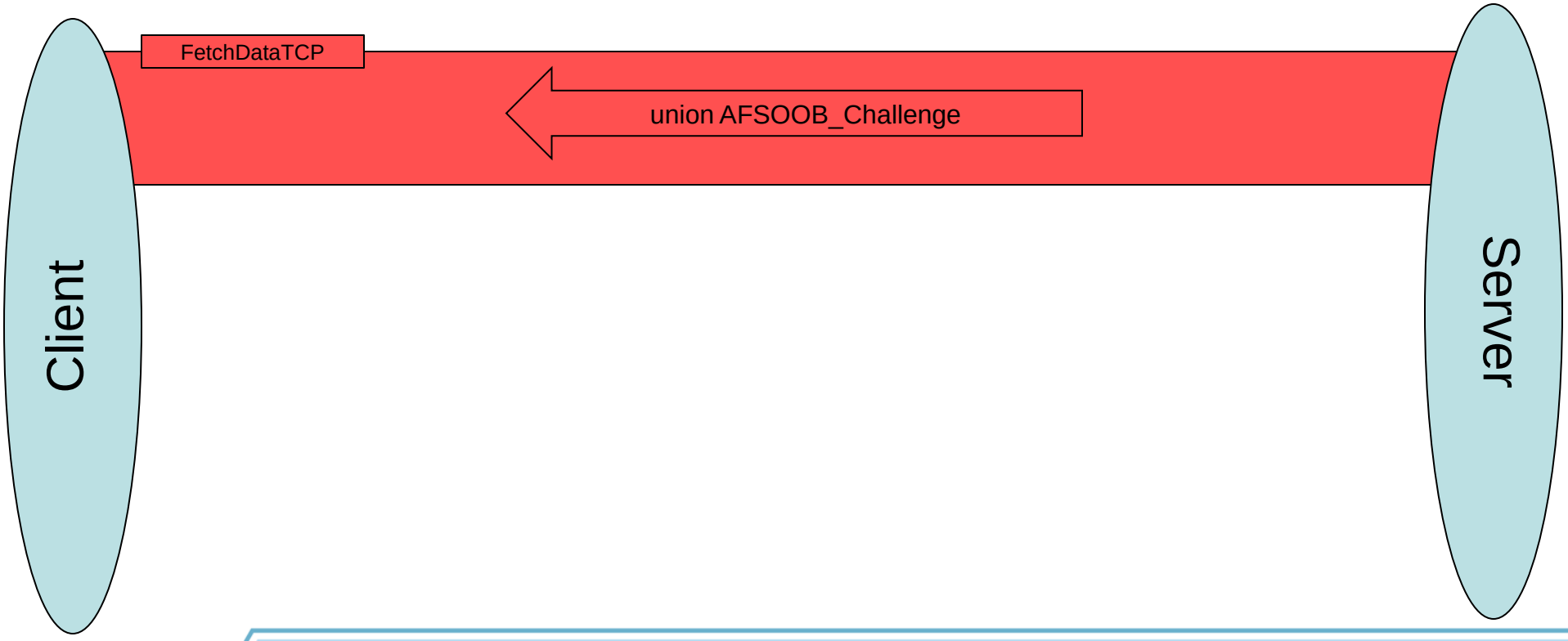
OOB Design (protocol)

Client starts split FetchDataTCP call



OOB Design (protocol)

Server sends TCP information



OOB Design (protocol)

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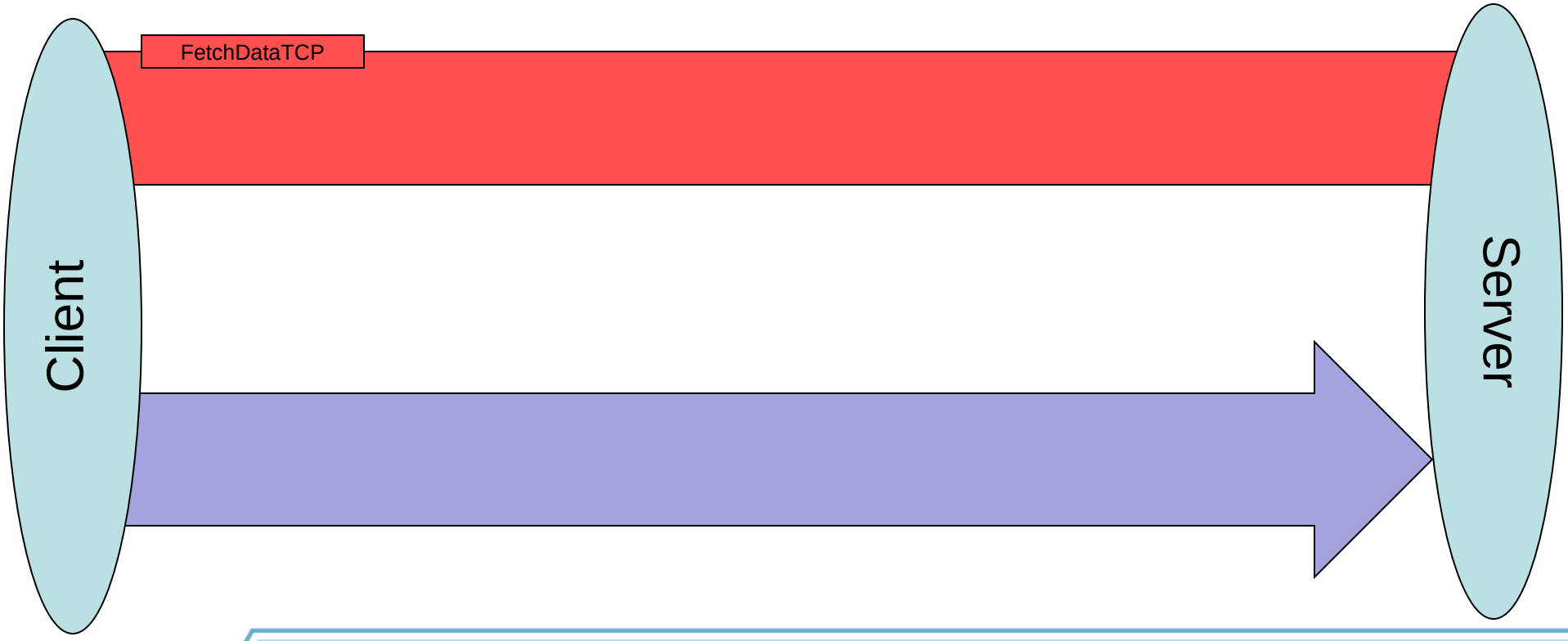
Client creates TCP connection



OOB Design (protocol)

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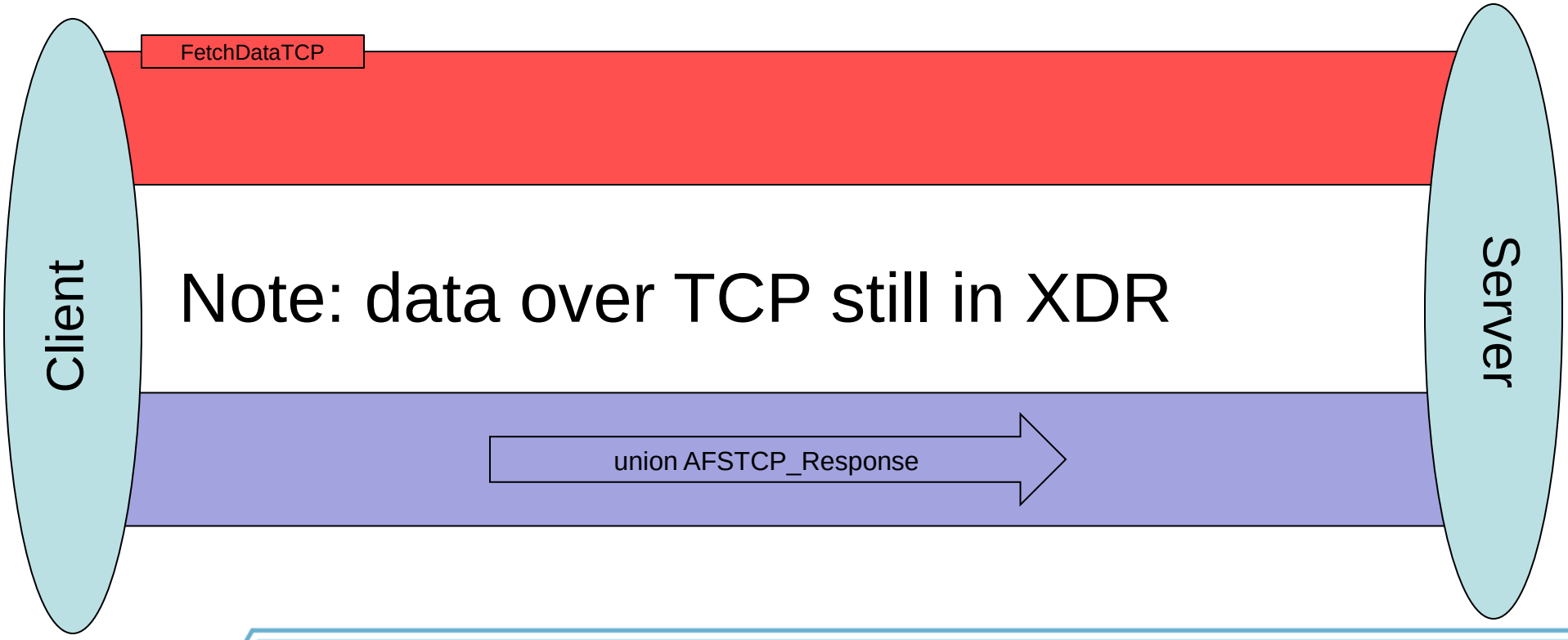
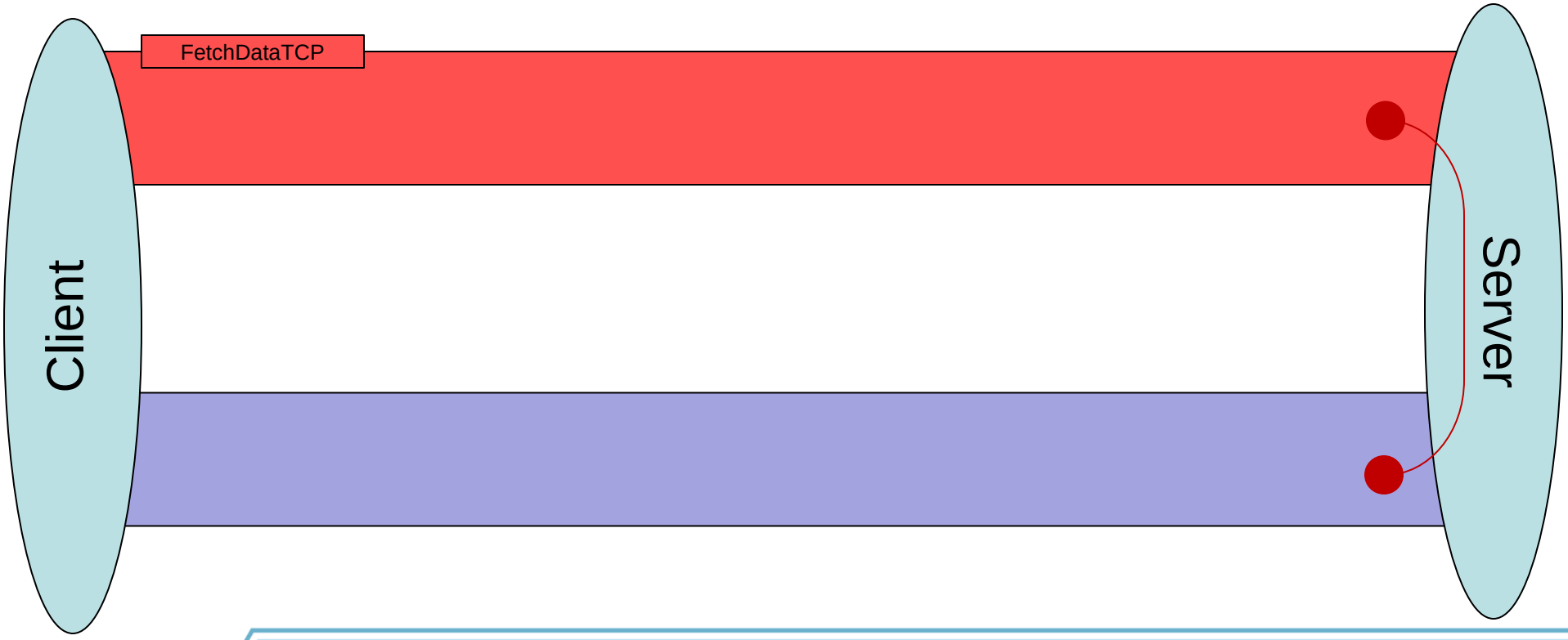
Client send conn metadata (IDs Rx call)



OOB Design (protocol)

Server associates connection



OOB Design (protocol)

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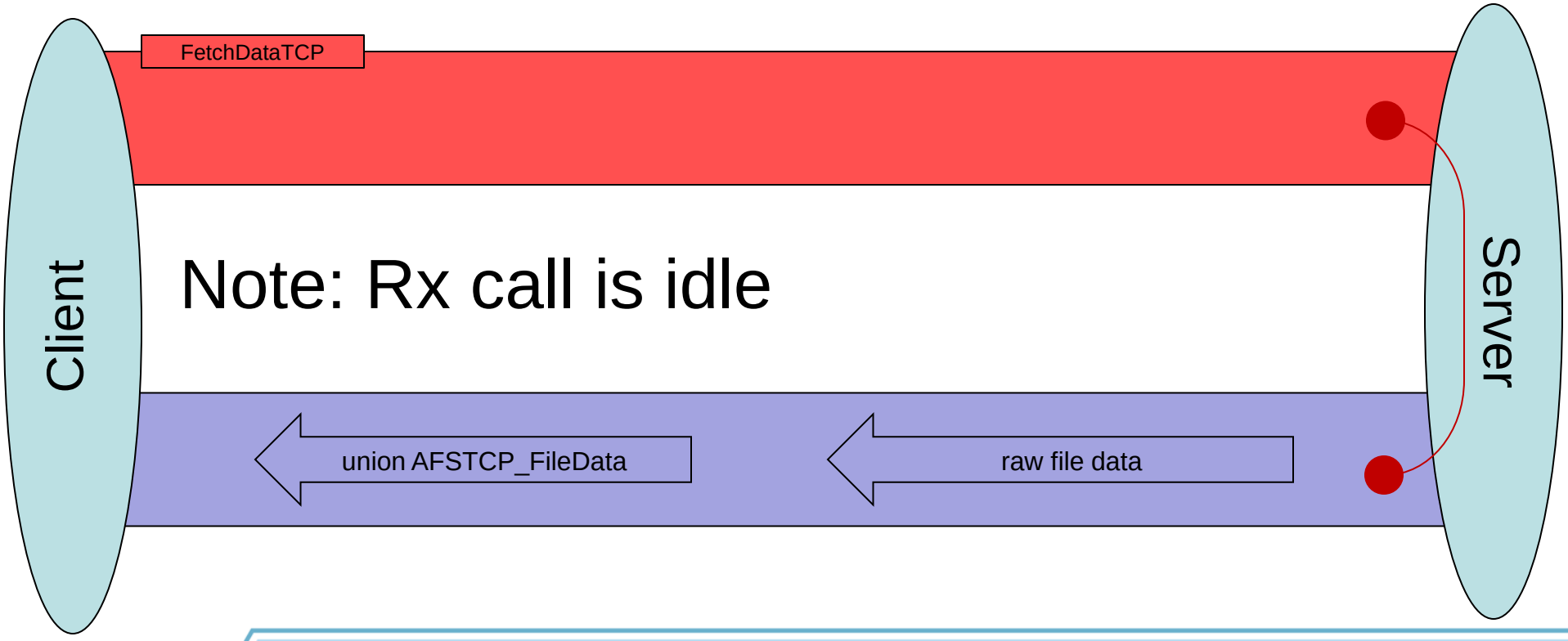
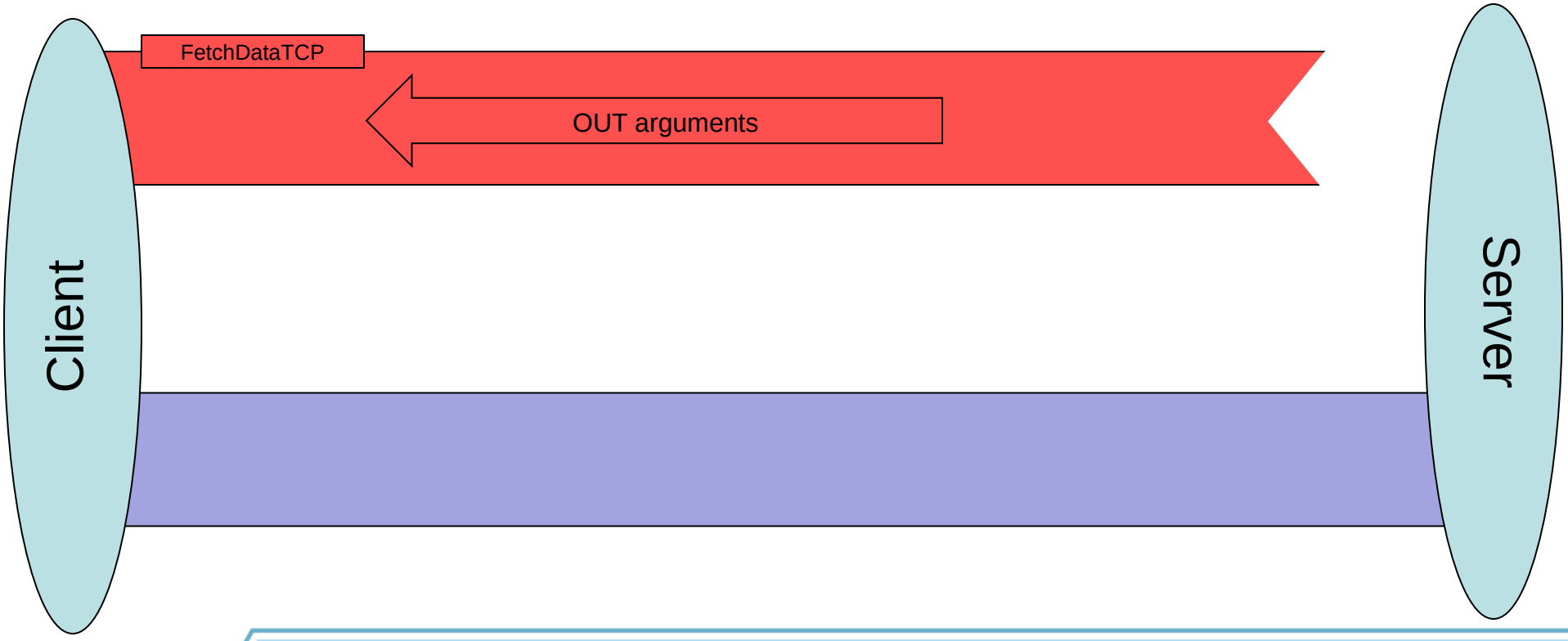
Server sends file data



OOB Design (protocol)

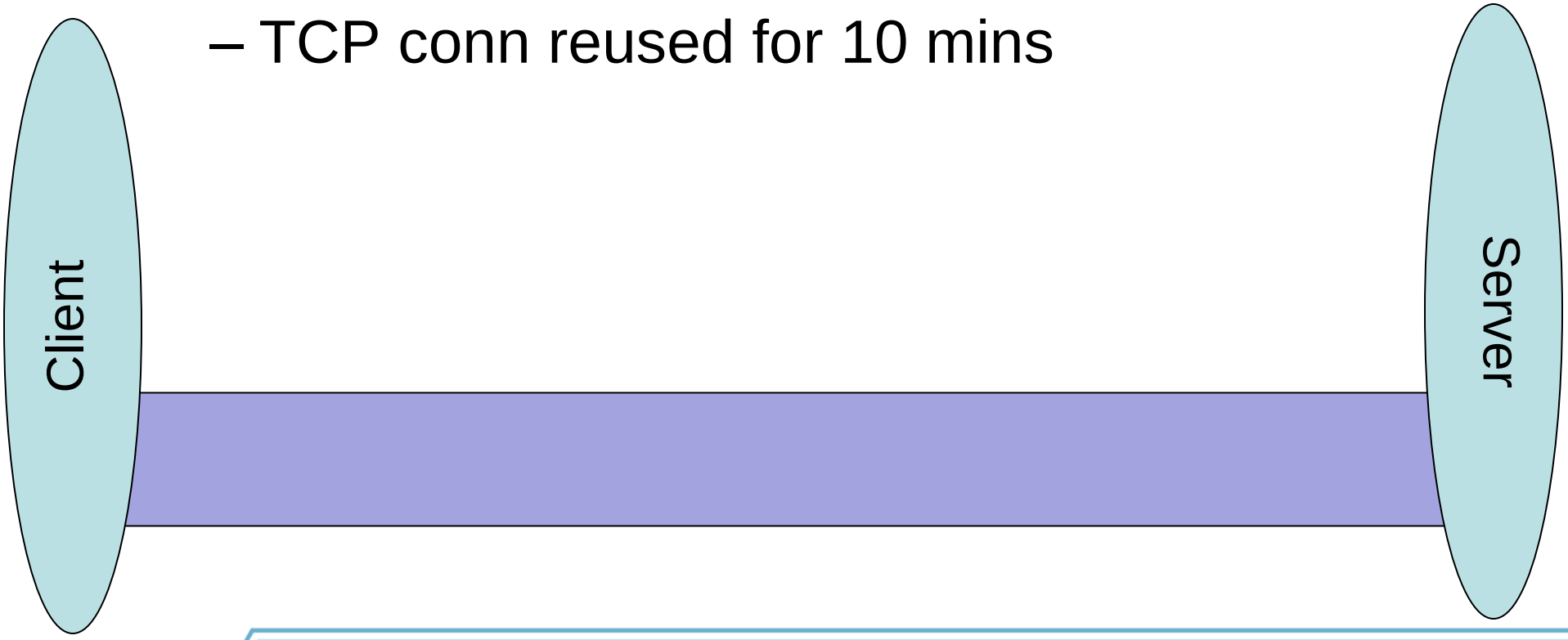
Server ends FetchDataTCP call



OOB Design (protocol)

Transfer is complete

- TCP conn reused for 10 mins



OOB Design (client)

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- Cache-bypass-like threshold
  - sysctl afs.oob_tcp_thresh
- RXGEN_OPCODE server detection
- Parameters tweakable via sysctl

OOB Design (server)

- libevent
- Async connection receipt
- TCP conns handed to Rx thread
- TCP conn always after Rx call

OOB Design (limitations)

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- Extra round-trip
- Not extensible well
- Client code organization

Implementation Details

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- rx_FlushWriteNotLast
- rxkad_Encrypt
- rx_SetErrorProc
- Linux configurable readahead
- osi_BlockSignals

Current Status

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- 1.4, 1.6, client, server
- Linux now, but portable
- Cache bypass
- Zero-copy fetch
- Non-standard protocol published
- Source available on request

Performance

Performance

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- 10GigE
  - Write: 300s MiB/s (~3gbps) memcache
  - Read: 500s MiB/s (~4-5gbps) memcache
  - Read: 700s MiB/s (~6gbps) bypass
- afscp even higher with high chunksize
- Same results when capped at 7gbps

Performance

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- Major limiting factors:
  - Chunksize (or bypass readahead size)
  - Cache overhead
  - Extra RTT
- Benchmarks are “remote”

Future Directions

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- Standardize new OOB protocol
  - Extra RTT, UUIDs, cap bit, ext-union
- Platform support
- Volserver OOB

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Questions?

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Thanks!

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