Benchmarking CurveCP

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Outline

CurveCP?

Encrypted application-layer protocol for internet communication.

CurveCP in a Nutshell

- Brain child of Dan Bernstein (djb)
- To be used instead of TCP
- Packet-based encryption on top of UDP
- Treat crypto as instantaneous
- Advanced packet scheduler

Claimed CurveCP Security Features

- mandatory server authentication
- optional client authentication
- no man-in-the-middle attacks possible
- active and passive forward secrecy

Claimed CurveCP Availability Features

- no RST-type attacks possible
- protection against traffic prediction
- can not be used for amplification attacks
- no SYN-flooding-type attacks possible
- worst-case CPU loads kept small

Claims about CurveCP Efficiency

- bigger overhead than plain TCP
- for short connections, less traffic than HTTPS
- for short connections, much less traffic than SSH

Claimed CurveCP Decongestion Features

- minimizes packet-loss
- minimizes significant latency increases
- therefore mitigates buffer bloat

Claimed CurveCP Addressing Features

- multiple CurveCP servers can share single IPv4 address and port
- CurveCP servers inherently anti-aliased from addresses
- rapid failover to redundant server if original is down
- session/connection not invalidated if IP address changes

Major Topics for Investiagtion

Create CurveCP-enabled SSH-like remote shell
Create CurveCP-enablet SCP-like remote file copy tool
Benchmark CurveCP vs SSH/SCP/HTTPS

- CPU usage
- available Bandwidth
  - ideal
  - competetive
- message latencies

Verify CurveCP robustness claims

Remote Shell/Copy via CurveCP

Results:

- CurveCP-enabled remote ptty fully functional
- `http://github.com/benthor/remotty`

Problems:

- Only Python implementation so far
- Useless for meaningful benchmarks
- No real session handling yet
- Doesn't support file transfer yet

CurveCP-enabled file transfer?

For now based on `cat`/`dd`

- No support for arbitrary files yet

Bonus: CurveCP enabled VPN

Results:

- Can create tunnel devices connected via CurveCP
- ICMP can be successfully tunneled

Problems:

- TCP only works for small packets so far
- Only Python implementation

Benchmarking: Methods

Tools:

- plain dd
- custom stream copy tool with statistics (`ddstat`)
- sysstat suite
- ethtool

Saturating 10Mbit Link

Results:

- CPU usage of SSH/SCP/HTTPS very similar

Problems:

- CurveCP scheduler is *too nice*

Best-case Payload Bandwidth on 10MBit Link

Results:

- SSH/SCP/HTTPS: nearly the full 10MBit/s
- CurveCP: between 600KB/s and 800KB/s, average 650KB/s

Problems:

- CurveCP scheduler is *too nice*

CurveCP and TCP: Competitive Scheduling (10MBit Link)

Problems:

- CurveCP bandwidth drops to 0
- no matter who starts first
- no matter if LAN or Internet connection

Trying to saturate 100Mbit Link

Results:

- SSH/SCP/HTTPS can saturate
- CurveCP probably CPU bound

Problems:

- Detailed measurements skew CPU usage

Best-case Payload Bandwidth on 100MBit Link

Results:

- SSH/SCP/HTTPS: nearly the full 12.5MB/s
- CurveCP: tops out at 4MB/s

CurveCP and TCP: Competitive Scheduling (100MBit Link)

Results:

- CurveCP bandwidth 1/100th of that of TCP: 120KB/s
- More than one connection: share up to 240KB/s

CurveCP vs SSH: Latencies

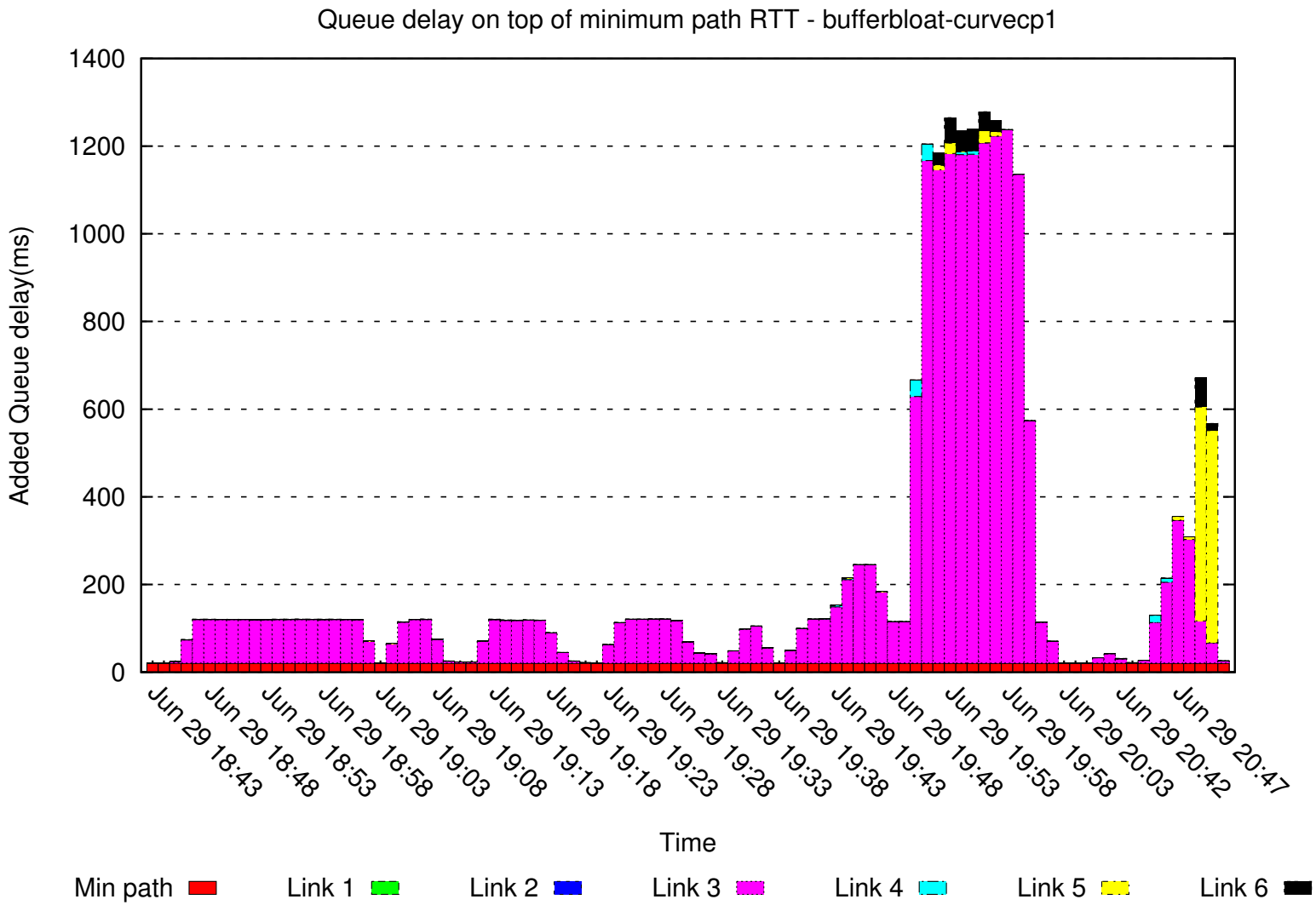
Results:

- (Extremeny) similar latencies to within fractions of ms

Problems:

- Does not take SSH handshake into account

Bonus: CurveCP and Buffer Bloat



Questions not yet answered

Will be addressed in paper:

- Compare SSH handshake to CurveCP
- CurveCP overhead in general
- CurveCP addressing and failure modes

Encountered Problems

Problem: (Reverse) HeisenBugs

Packet scheduler gets confused:

- when UDP statistics are collected
- when in the presence of irregular TCP traffic

Result:

- endless tracing/profiling/code-reviewing

Problem: FreeBSD

- CurveCP pipes close prematurely
- file descriptor issues

Problem: Confusing CPU statistics

- disagreement between tools
- reported percentages add up to over 100

Conclusion

- Remote shell: works
- Remote copy: possible
- Performance: comparable to (but worse than) SSH/HTTPS
- Decongestion: works somewhat
- Verdict: CurveCP worthy of attention

More Info

`http://curvecp.org`

Questions?