Remotely snooping on traffic patterns using network protocols

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thanks to Pēteris Birkants

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Contents

- Network throughput theory
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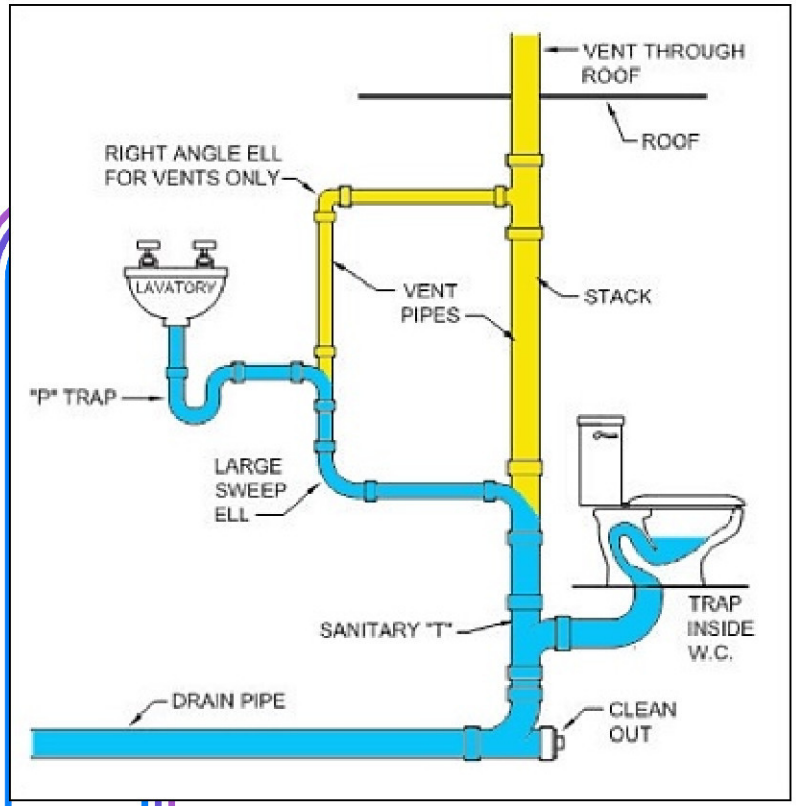


image source: Cornell University

"This is a series of tubes"

– Your plumber

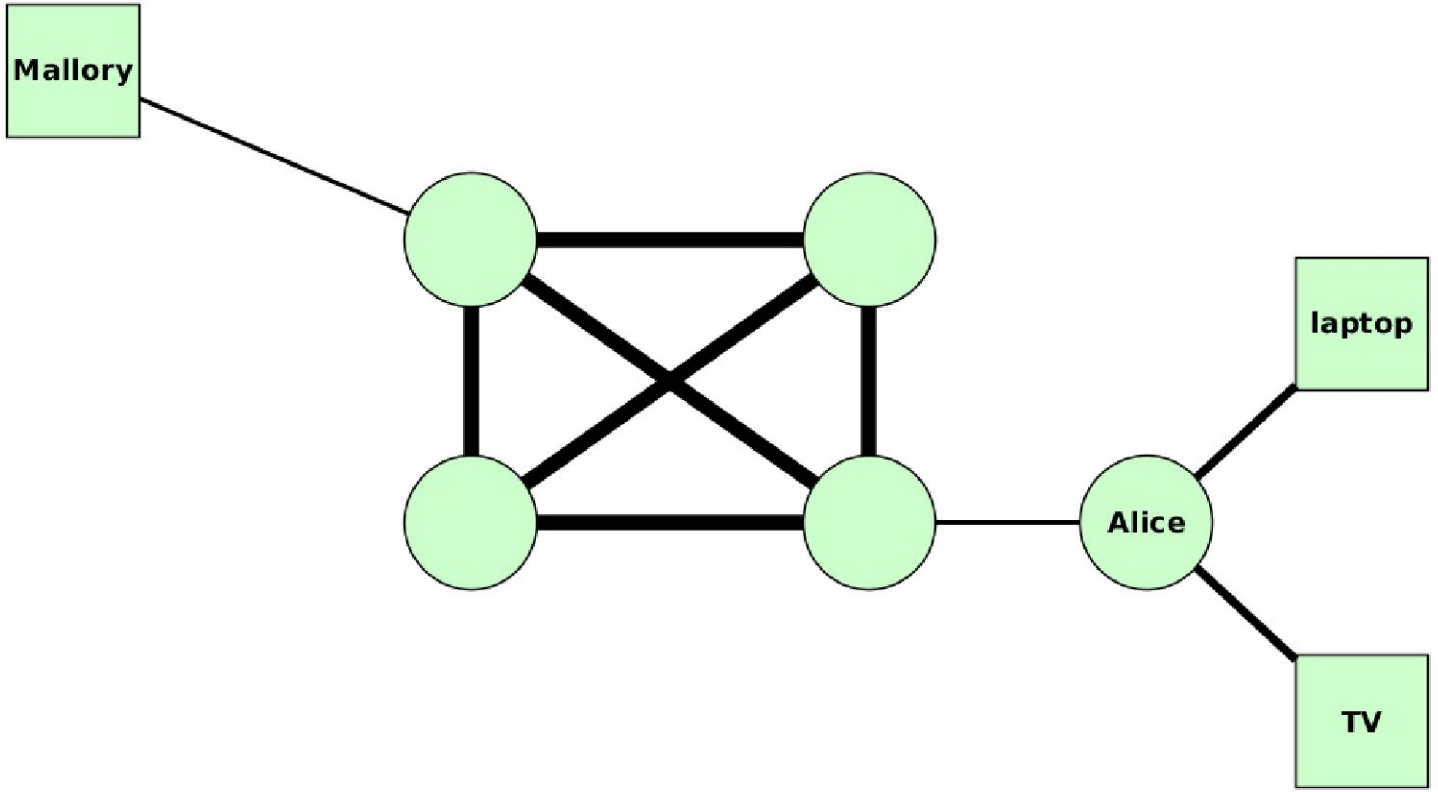
– No, not Al Gore

Bandwidth vs Throughput vs Latency

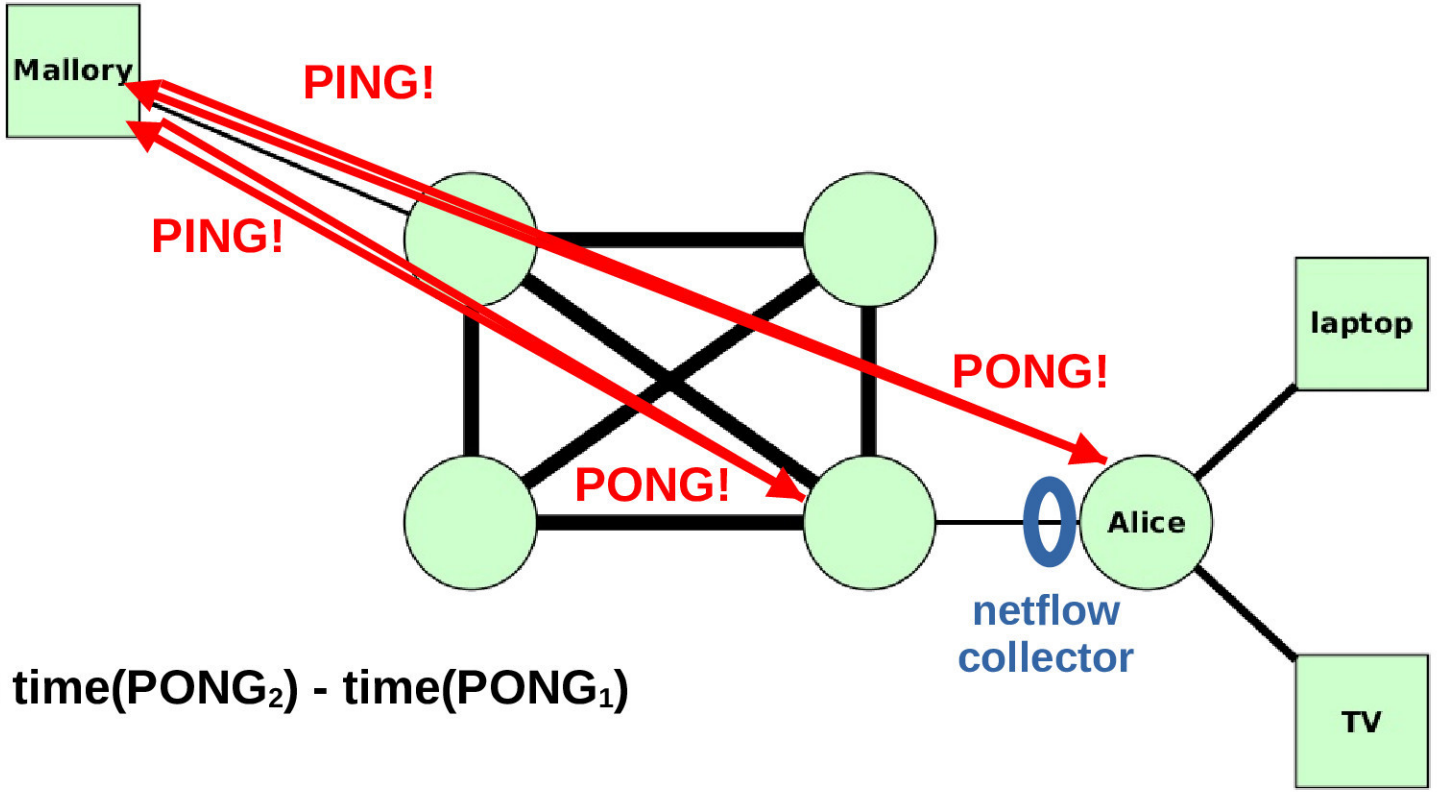
- Bandwidth – how wide is the pipe
- Throughput – how much stuff is traveling through the pipe
- Latency – how long until the one „drop” travels through

- latency = f(throughput/bandwidth)

Targeted network layout



Measurement methodology



Δ = time(PONG$_2$) - time(PONG$_1$)

Quick GNU coreutils quiz

- What does `tr=""` mean in the command

```
stdbuf -i0 -o0 -e0 tr = " "
```

?

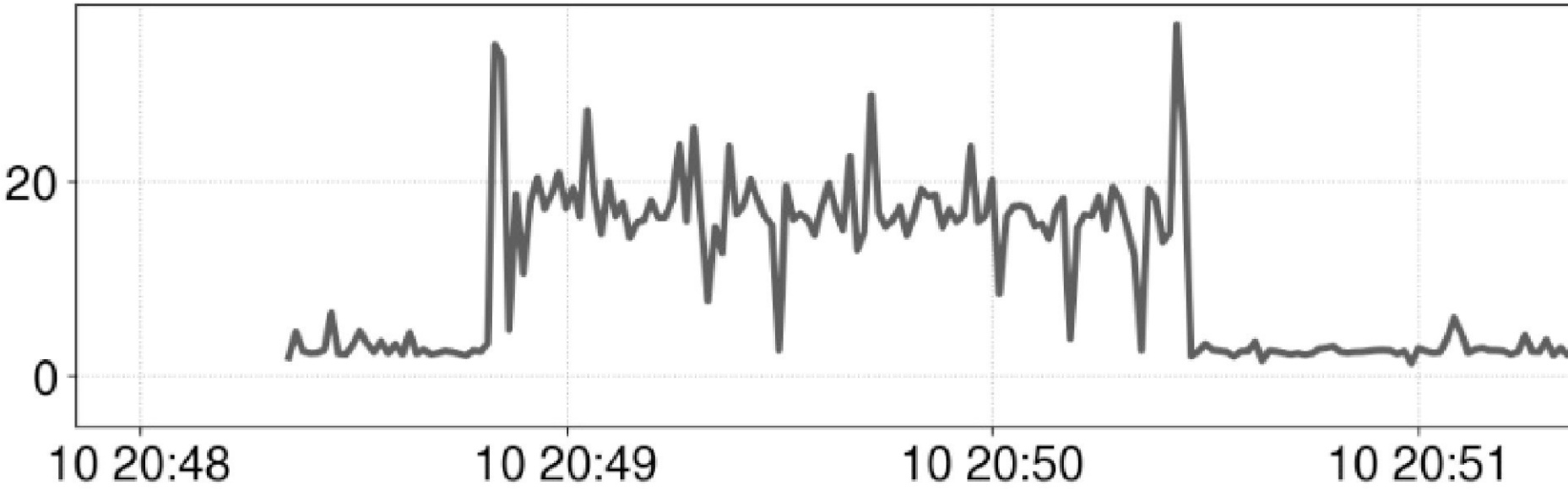
Tooling prototype (April 2024)

- Terminal1
  - while [$(date +%s) -lt $STARTTIME]; do sleep 0.001; done;
  - ping $TARGET -s 10000 | unbuffer tr = " " | unbuffer selcol 6 10 | unbuffer grep -v of | tee -a test-target
- Terminal2
  - while [$(date +%s) -lt $STARTTIME]; do sleep 0.001; done;
  - ping $UPLINK -s 10000 | unbuffer tr = " " | unbuffer selcol 6 10 | unbuffer grep -v of | tee -a test-gate

Tooling prototype (April 2024)

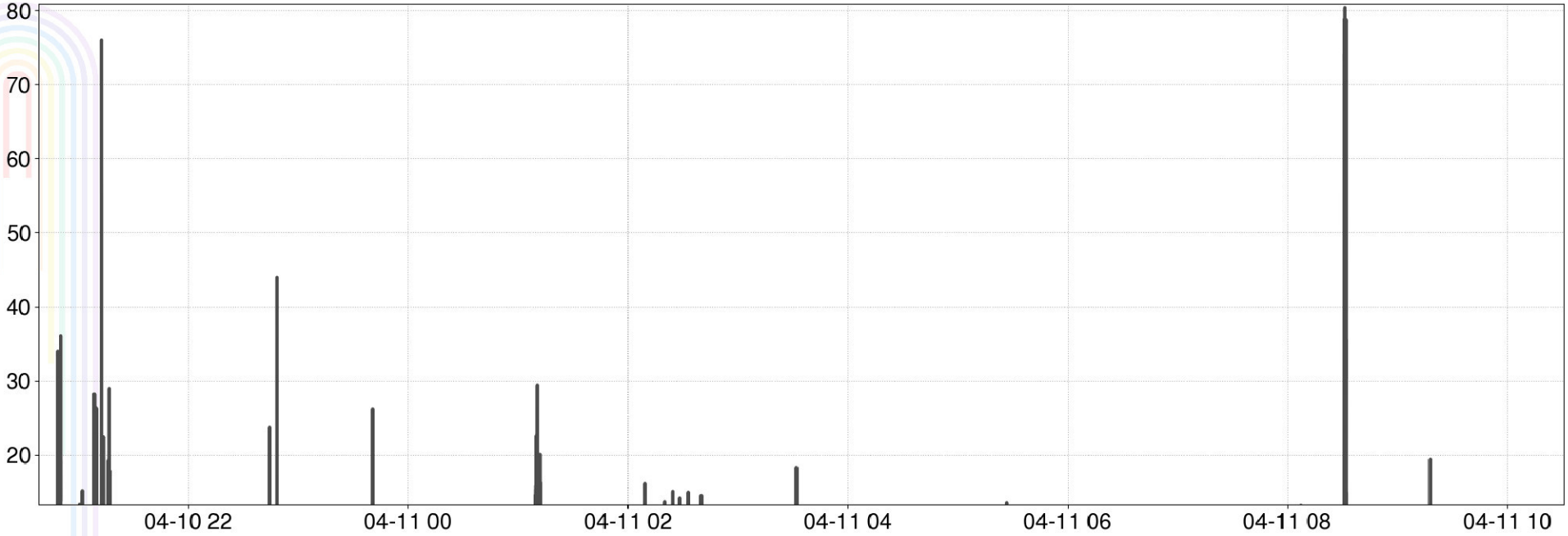
- Visualize
  - paste test-target test-gate | awk '{print $2-$4}' | chart plot output.png noheader noindex grid
- 5 lines, bash-terminal

1st test



A computer on Alice's network (100BASE-TX) is downloading 1 GiB file (unshaped).

Accidental extended test



Alice's network (100BASE-TX) with multiple devices monitored overnight.

Tooling attempt (June 2024)

```
import asyncio
from concurrent.futures import ThreadPoolExecutor
from scapy.all import IP, ICMP, sr1
import time
from datetime import datetime
```

- Doesn't work
- 58 lines, python3

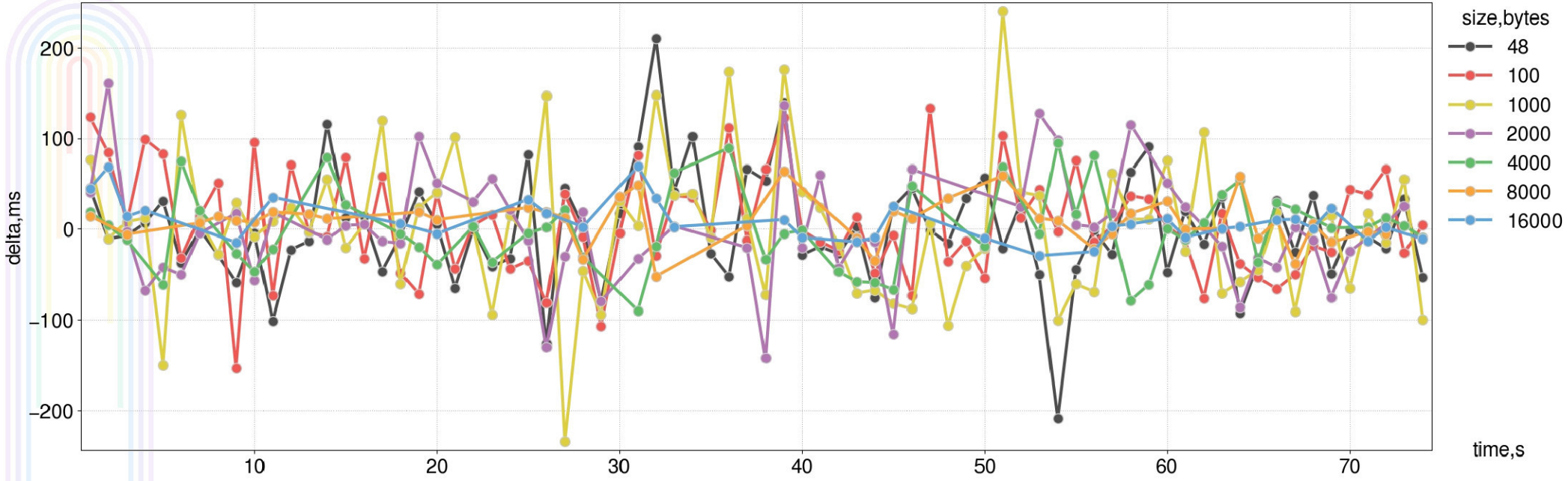
Tooling (Aug 2024)

- Works
- Determines IP of ISP's router
- Supports multiple payload sizes
- Can get desync'ed quickly
- 3 files, 71 lines, bash

Tooling (Sep 2024)

- Resynchronizes every tick
- Not limited to 1 packet per second
- 75 lines, bash

What's the best packet size?

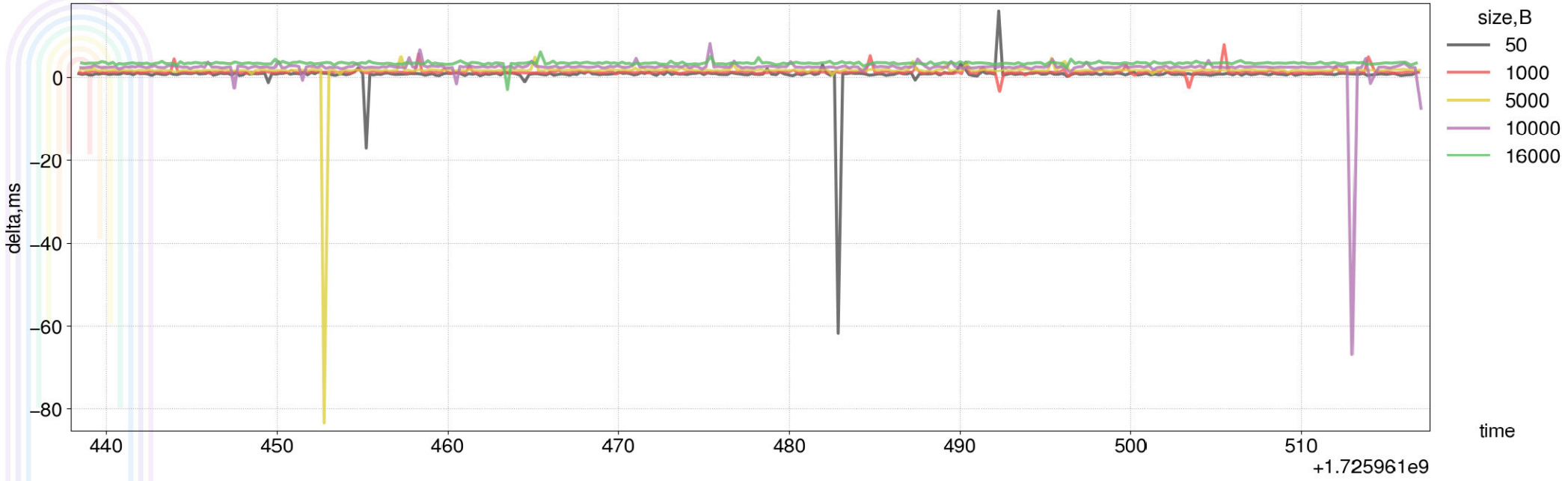


Idle network, sending all packet sizes simultaneously.

Tooling (Oct 2024)

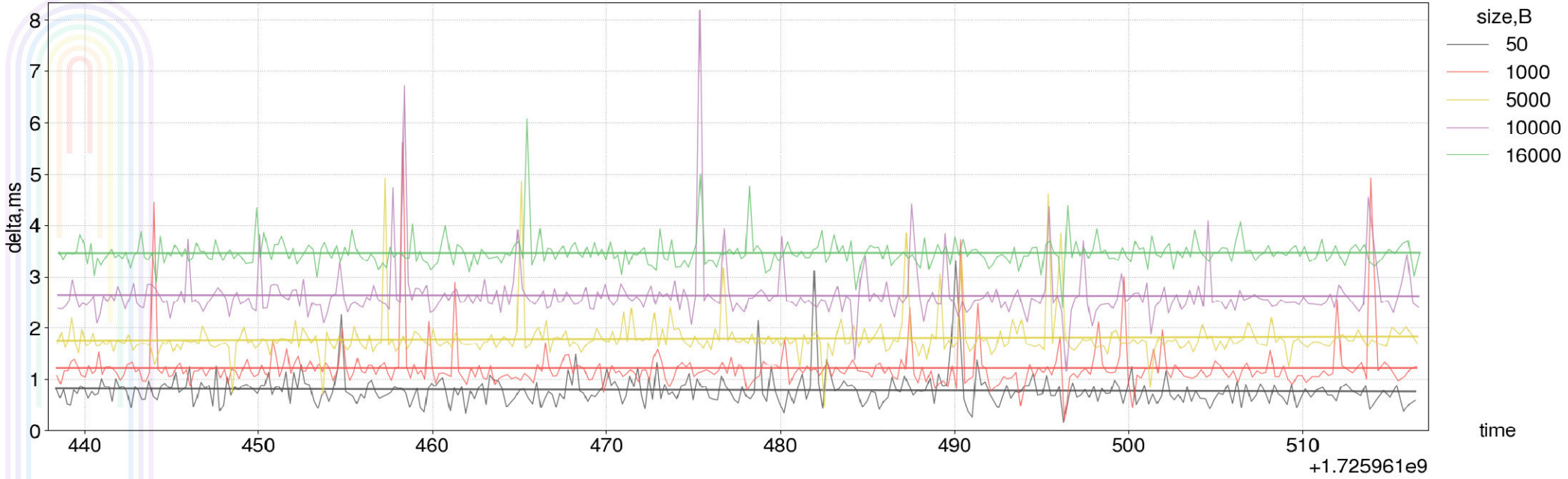
- Sends packets one by one
- Data is actually useful again
- 72 lines, bash

What's the best packet size?



Idle network, sending different packet sizes one-by-one.

What's the best packet size?

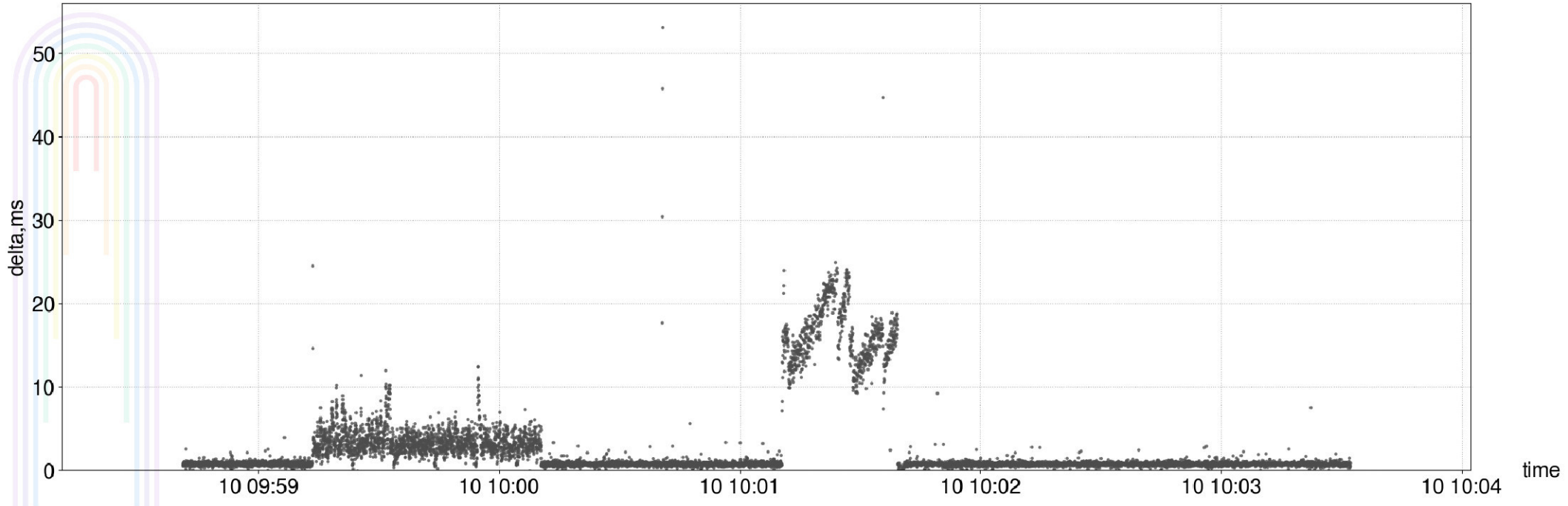


Idle network, sending different packet sizes one-by-one.
Filtered out negative values and network jitter.

Estimating bandwidth remotely

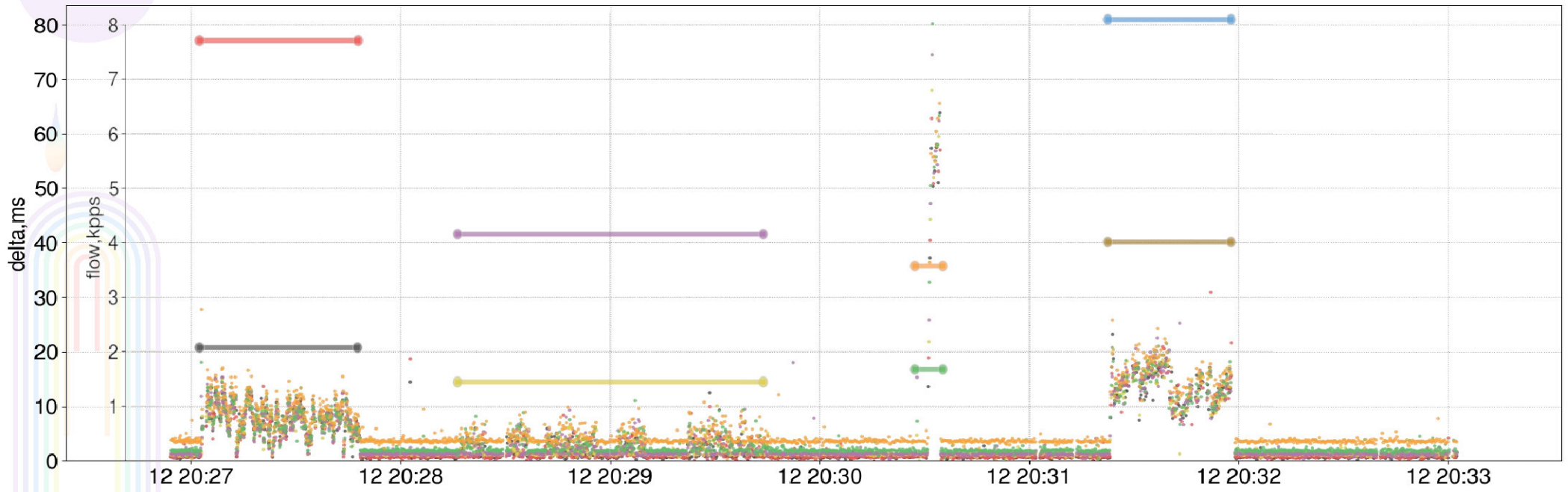
$$\frac{(L+h)-(S+h)}{\Delta_L-\Delta_S}\times 2=\frac{L-S}{\Delta_L-\Delta_S}\times 2=\frac{16000-50}{0.00346-0.000789}\times 2=11943092\,Bps=95.54\,Mbps$$

Speed test



Speed test being run from the target network.
Packet size: 50 bytes

Traffic patterns



size,B
- 50
- 100
- 1000
- 2000
- 5000
- 16000

connection
- 1.2 Mbps target:49296->90.130.70.73:80/tcp
- 92.5 Mbps 90.130.70.73:80->target:49296/tcp
- 0.7 Mbps target:56346->80.233.168.140:443/udp
- 42.4 Mbps 80.233.168.140:443->target:56346/udp
- 0.6 Mbps target:50062->185.199.109.153:443/tcp
- 40.9 Mbps 185.199.109.153:443->target:50062/tcp
- 97.1 Mbps target:45664->90.130.70.73:80/tcp
- 1.6 Mbps 90.130.70.73:80->target:45664/tcp

Any questions?

scan this pidgeon code
to access the source[1]

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[1] RFC 1149 compatible network device required

Support tools

https://github.com/0ki/presentation-toolkit

- (chart)

https://github.com/0ki/shellscripts

- (command line magic)