

Flamethrower

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Flamethrower: DNS Performance Testing Tool

<https://github.com/DNS-OARC/flamethrower>

Apache Public License 2.0

Built as an alternative to *dnstperf*.

Initial requirements:

- ▶ Better source port distribution
- ▶ Solid TCP support
- ▶ Realistic query rate patterns
- ▶ Possibility to integrate into a CI/CD pipeline

Flamethrower Quick Start

```
> flame \  
-r foo.example.test. \  
-T SOA \  
-Q 2000 \  
-l 5 \  
a.ns.example.test
```

```
flaming target "a.ns.example.test" (192.0.2.100) on  
port 53 with 10 concurrent generators, each sending  
10 queries every 1ms on protocol udp  
query generator [static] contains 1 record(s)
```

```
-----  
1.87965s: send: 2001, avg send: 2877, rcv: 1581,  
avg rcv: 2240, min/avg/max resp:  
23.4206/17.1624/52.33ms, in flight: 1285, timeouts:  
0
```

```
-----  
runtime      : 7.88192 s  
total sent   : 11756  
total rcvd   : 9223  
min resp     : 23.3888 ms  
avg resp     : 27.9633 ms  
max resp     : 33.3626 ms  
avg rps      : 1834  
avg qps      : 2350  
avg pkt      : 31.92 bytes  
timeouts     : 2533 (21.5464%)  
responses    :  
    SERVFAIL: 441  
    NOERROR: 8782
```

Flamethrower Internals

Flamethrower is written in C++14 (17).

Notable dependencies:

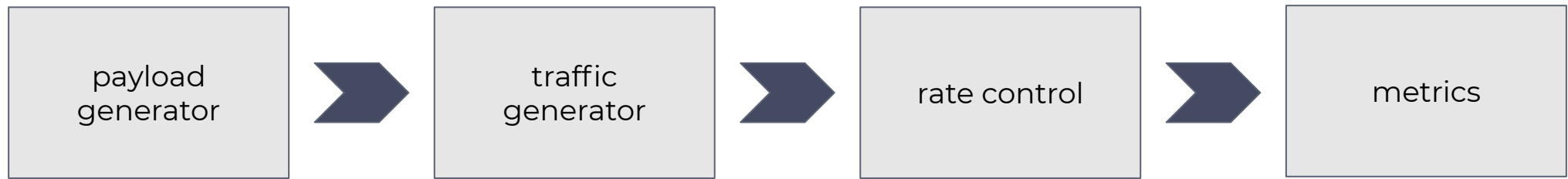
- ▶ LDNS - DNS library

<https://nlnetlabs.nl/projects/ldns/about/>

- ▶ uvw - asynchronous I/O (modern C++ wrapper for libuv)

<https://github.com/skypjack/uvw>

Flamethrower Architecture



Payload Generators

- ▶ **static** — Single query name and type.
- ▶ **file** — Consumes dnssperf-compatible input file (i.e. pairs of query name and type).
- ▶ **randompkt** — Random binary garbage.
- ▶ **numberqname** — Names prefixed with a random numeric label:
 - ▶ 1234.example.test.
 - ▶ 42.example.test.
 - ▶ ...
- ▶ **randomqname** — Names prefixed with random binary labels:
 - ▶ j4kJx\000zz3d\064sa.example.test.
 - ▶ bo4._kf\042.example.test.
 - ▶ ...
- ▶ **randomlabel** — Names prefixed with random non-binary labels:
 - ▶ XRY4HFY9dpItTb.example.test.
 - ▶ ady1.clo.ZUqV4gji.example.test.
 - ▶ ...

Traffic Generator

Flamethrower runs in a **single thread** only.

Max query rate ~100k queries/s on a single core.

Traffic generator config options:

- ▶ **-c** Number of concurrent traffic generators.
- ▶ **-q** Number of queries to send in a batch.
- ▶ **-d** Time (delay) between batches.

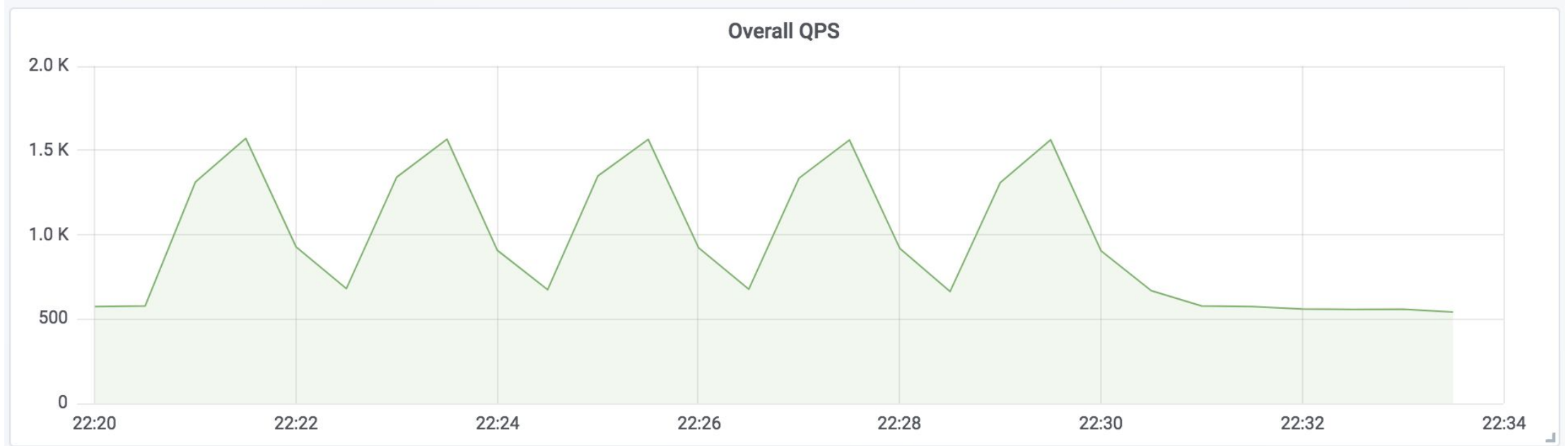
Protocol selection option:

- ▶ **-P udp** Default. One bound UDP socket per traffic generator.
- ▶ **-P tcp** One TCP sessions per traffic generator. Keeps the session open.
- ▶ **-P dot** DNS-over-TLS.

Rate Control

Constant rate: `flame -Q 1000`

Variable rate: `flame --qps-flow '1000,60000;100,60000;...'`



Metrics

```
27.8948s: send: 1000, avg send: 1025, recv:
995, avg recv: 1018, min/avg/max resp:
63.1087/27.7805/98.1353ms, in flight: 81,
timeouts: 17
```

```
run id      : c50c74a39823a4c1
run start   : 2019-02-01T22:38:01Z
runtime     : 122.894 s
total sent  : 120887
total rcvd  : 120581
min resp    : 62.7252 ms
avg resp    : 41.2032 ms
max resp    : 94.3204 ms
avg rps     : 987
avg qps     : 998
avg pkt     : 23.4042 bytes
tcp conn.   : 0
timeouts    : 306 (0.253129%)
bad recv    : 0
net errors  : 0
responses   :
NOERROR: 120581
```

Machine friendly variant available with:

```
> flame -o results.json
```

```
{"period_bad_count":0,"period_in_flight":81,"p
eriod_net_errors":0,"period_pkt_size_avg":16.4
,"period_response_avg_ms":27.63856731149192,"p
eriod_response_max_ms":79.465695,"period_respo
nse_min_ms":63.179727,"period_timeouts":0,"run
_id":"c50c74a39823a4c1","runtime_s":18.8935851
02,"total_bad_count":0,"total_net_errors":0,"t
otal_pkt_size_avg":21.57894736842105,"total_qp
s_r_avg":1032,"total_qps_s_avg":1043,"total_r_
count":19707,"total_response_avg_ms":42.745088
149163905,"total_response_max_ms":79.465695,"t
otal_response_min_ms":62.8965459999999994,"tota
l_responses":{"NOERROR":19707},"total_s_count"
:19892,"total_tcp_connections":0,"total_timeou
ts":114}
```

Samples

10 queries every 500 ms on 100 source ports over UDP (= 2000 q/s). Queries read from a dnsperf-compatible input file.

```
> flame -q 10 -d 500 -c 100 \  
-g file -f queries.txt \  
ns.example.test
```

10 queries every 250 ms on 250 source ports over UDP (= 10k q/s) with a query rate decay. Queries for a random subdomains on example.test. Metrics written into a JSON file. Target servers loaded from a file.

```
> flame -q 10 -d 250 -c 250 \  
--qps-flow '10000,5000;5000,5000;2500,5000;1250,5000;1000,40000' \  
-g randomlabel lblsize=10 lblcount=1 count=140000 -r example.test -T AAAA \  
-o peak.json \  
--targets servers.txt
```

1 “query” every 100 ms on 100 concurrent IPv6 TCP sessions (= 1000 q/s). Random “garbage” up to 100 bytes.

```
> flame -q 1 -d 100 -c 100 \  
-g randompkt count=10000 size=100 \  
-F inet6 -P tcp ns.example.test
```

New Features

Recently finished

- ▶ DNS-over-TLS support
- ▶ Target multiple servers

In progress

- ▶ DNS-over-QUIC support

Wanted

- ▶ Multi-processor support
- ▶ Query rate pattern from a pcap
- ▶ Improve performance
- ▶ Source address spoofing
- ▶ DNS-over-HTTP support



Hank Scorpio, The Simpsons ep. 155

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Thank you!

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