Performance effects of DNSSEC validation

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Hypothesis

- "DNSSEC validation requires more resources"
  - Is that valid in 2022?
- What "resources," specifically?
  - Latency, bandwidth, OS sockets, CPU, memory?
Test data set: source

- Real traffic capture
  - Anonymized
  - European telco, February 2022
    - Lots of signed domains!
  - Mix of landline & mobile clients
Test data set: scaling

- Testing with 9 – 135 k QPS
  - "Queries are not equal"
    - Cache hit/miss, size, ...
- Down-sampling
  - A client IP address randomly included/excluded
    - All queries from a given client included/excluded
Test setup

- Resolver: BIND 9.18.4
  - Empty cache, validation on/off
- Client simulator: DNS Shotgun
  - Keeps query timing/cache hit rate
- Live Internet
  - Measure, rinse, repeat: 10 times
- Custom resource monitoring
Scenario # 1

9 k QPS
9 k QPS, Cold cache latency

Logarithmic percentile latency histogram: test time 0 - 60 s

- Client timeout
- Higher latency
- Smaller latency

Response time [ms]

Slowest percentile

Blue line: validating
Orange line: non-validating
9 k QPS, Hot cache latency

Logarithmic percentile latency histogram: test time 540 - 600 s

- client timeout
- higher latency
- smaller latency

Response time [ms]

Slowest percentile
9 k QPS, TCP sockets

TCP sockets in use (system-wide, /proc/net/sockstat, "inuse")

- Validating (last minute average: 61 Sockets)
- Non-validating (last minute average: 61 Sockets)
9 k QPS, TCP sockets

TCP sockets in time-wait state (system-wide, /proc/net/sockstat, "tw")

- validating (last minute average: 126 Sockets)
- non-validating (last minute average: 112 Sockets)
9 k QPS, UDP sockets

UDP sockets in use (system-wide, /proc/net/sockstat, "inuse")

- validating (last minute average: 37 Sockets)
- non-validating (last minute average: 37 Sockets)
9 k QPS, packets out

Packets transmitted to the Internet (system-wide, /proc/net/dev)

- validating (last minute average: 0.68 kPackets)
- non-validating (last minute average: 0.68 kPackets)
9 k QPS, bytes in

Data received from the Internet (system-wide, /proc/net/dev)

- Validating (last minute average: 0.15 MiB)
- Non-validating (last minute average: 0.15 MiB)
9 k QPS, CPU time

CPUs usage (BIND process only, cgroup)

- validating (last minute average: 57 %)
- non-validating (last minute average: 55 %)
9 k QPS, memory

Memory usage including kernel memory for process (cgroup, BIND process only)

≈ +10%

validating (last minute average: 173 MiB)
non-validating (last minute average: 157 MiB)
Scenario # 2

135 k QPS
135 k QPS, Cold cache latency

Logarithmic percentile latency histogram: test time 0 - 60 s

- Client timeout
- Higher latency
- Smaller latency

Response time [ms]

- Validating
- Non-validating

Slowest percentile

Response time [ms]

Response time [ms]
135 k QPS, Hot cache latency

Logarithmic percentile latency histogram: test time 540 - 600 s

- client timeout
- higher latency
- smaller latency

Response time [ms]

Slower percentile
135 k QPS, TCP sockets

TCP sockets in use (system-wide, /proc/net/sockstat, "inuse")

- validating (last minute average: 115 Sockets)
- non-validating (last minute average: 110 Sockets)
135 k QPS, TCP sockets

TCP sockets in time-wait state (system-wide, /proc/net/sockstat, "tw")

- Validating (last minute average: 0.97 kSockets)
- Non-validating (last minute average: 0.76 kSockets)
135 k QPS, UDP sockets

UDP sockets in use (system-wide, /proc/net/sockstat, "inuse")

- validating (last minute average: 151 Sockets)
- non-validating (last minute average: 141 Sockets)
135 k QPS, packets out

Packets transmitted to the Internet (system-wide, /proc/net/dev)

- validating (last minute average: 3.78 kPackets)
- non-validating (last minute average: 3.73 kPackets)
135 k QPS, bytes in

Data received from the Internet (system-wide, /proc/net/dev)

- Validating (last minute average: 0.83 MiB)
- Non-validating (last minute average: 0.84 MiB)
135 k QPS, CPU time

CPUs usage (BIND process only, cgroup)

- Validating (last minute average: 725 %)
- Non-validating (last minute average: 703 %)
135 k QPS, memory

Memory usage including kernel memory for process (BIND process only, cgroup)

- Validating (last minute average: 715 MiB)
- Non-validating (last minute average: 658 MiB)

≈ +9 %
Performance effects of DNSSEC validation

- Negligible impact on
  - Latency
  - Bandwidth
  - CPU consumption
  - OS sockets
- Memory consumption increase ≈ +10%

Questions?
https://lists.isc.org/pipermail/bind-users/
Thank you!

• Main website: https://www.isc.org
• Software downloads: https://www.isc.org/download or https://downloads.isc.org
• Presentations: https://www.isc.org/presentations
• Main GitLab: https://gitlab.isc.org