

# Doing more with less

The secret to cost-effective, energy-efficient DNS

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# What does the cost-effective & energy-efficient DNS service look like?

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```
Virtual Machine Console
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GNU/Linux 12 vm tty1

root@vm:~#
root@vm:~# cat /etc/os-release
PRETTY_NAME="Debian GNU/Linux 12 (bookworm)"
NAME="Debian GNU/Linux"
VERSION="12 (bookworm)"
ID="debian"
HOME_URL="https://www.debian.org/"
SUPPORT_URL="https://www.debian.org/support"
BUG_REPORT_URL="https://bugs.debian.org/"
root@vm:~# systemctl status named
named.service - Internet Systems Consortium DNS Server
Loaded: loaded (/lib/systemd/system/named.service; disabled; vendor preset: enabled)
Active: active (running)
Main PID: 408 (named)
Tasks: 4 (limit: 2299)
Memory: 16.9M
CGroup: /system.slice/named.service
         └─408 /usr/sbin/named -u bind
```

**Resilience is the goal**  
**i.e. the capacity & diversity matters a lot!**

# What is the capacity of your DNS anycast?

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- Do you know, how much DNS traffic it can actually handle?
- Did you ever test it in practice?



# How to get more?



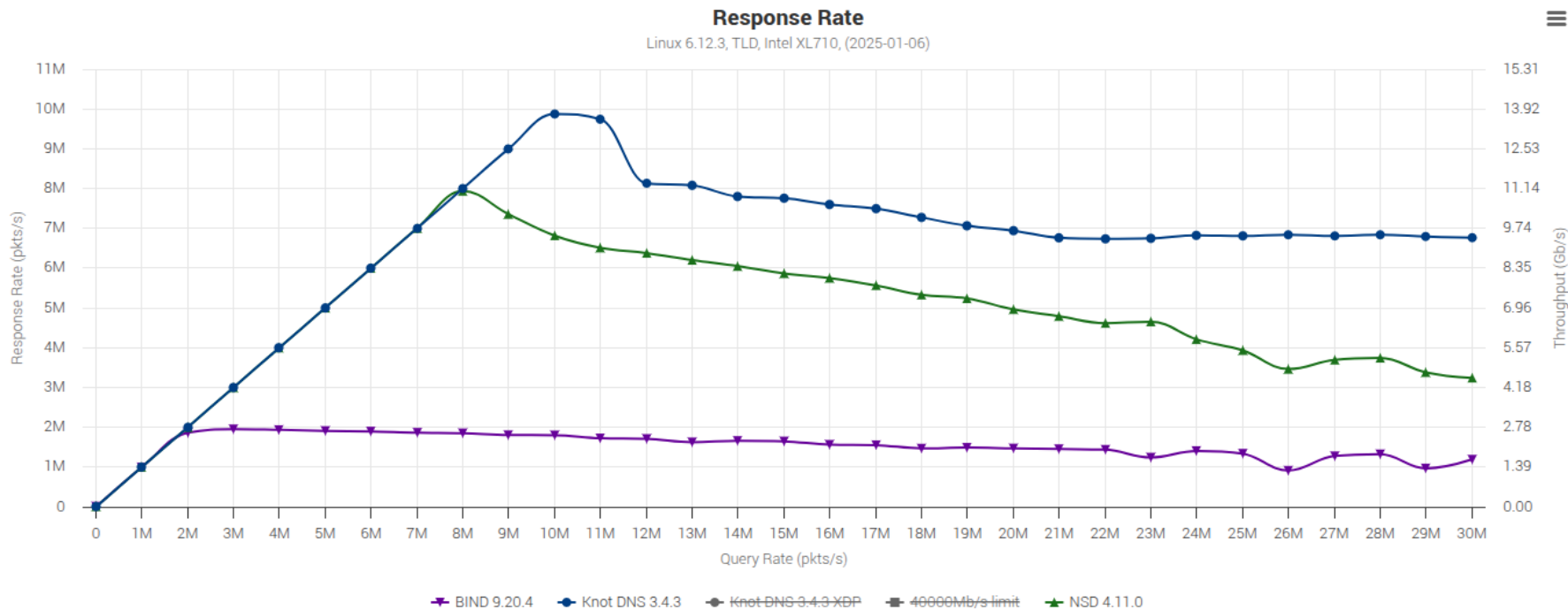
# How to get more?

- Deploy more DNS nodes
  - i.e. more CAPEX and OPEX costs
- HW upgrade
  - with 5Y lifecycle you will get higher performance (~2x)
  - and lower power consumption (by ~20%)

# Can you have more with just a SW adjustment?

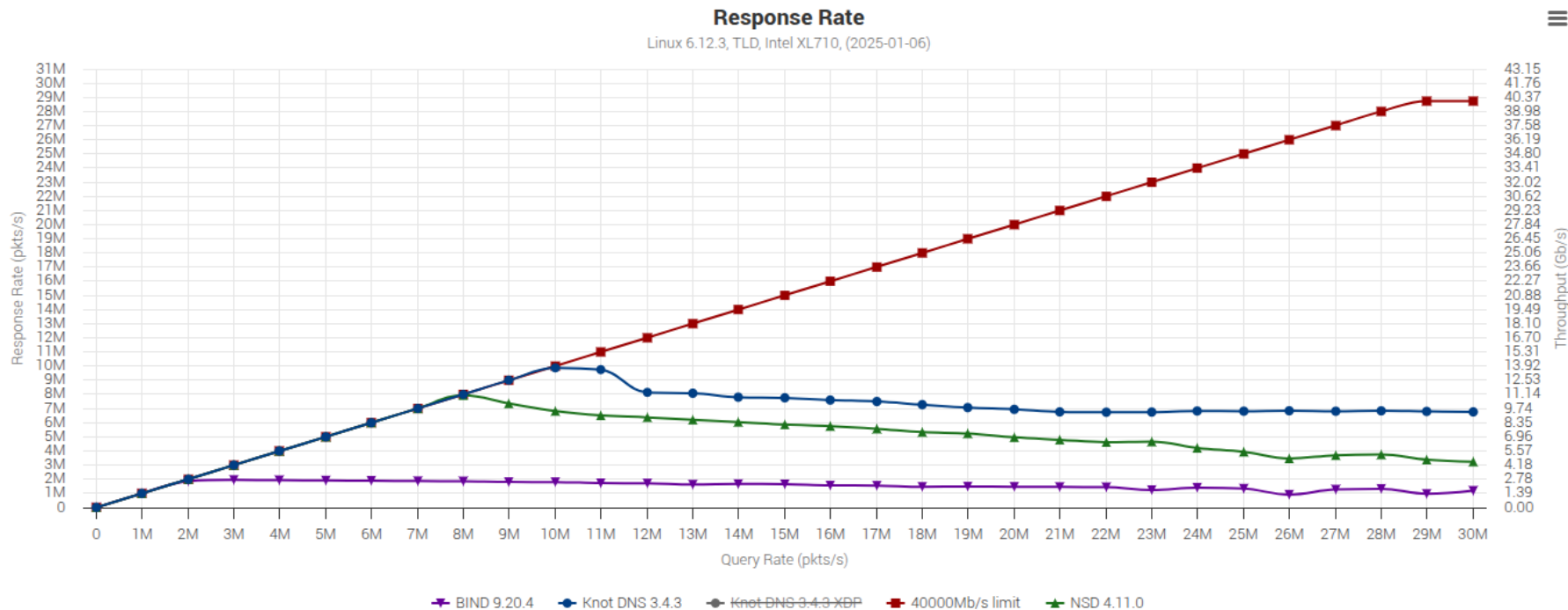
# Can you have more with just a SW adjustment?

- And how much more?



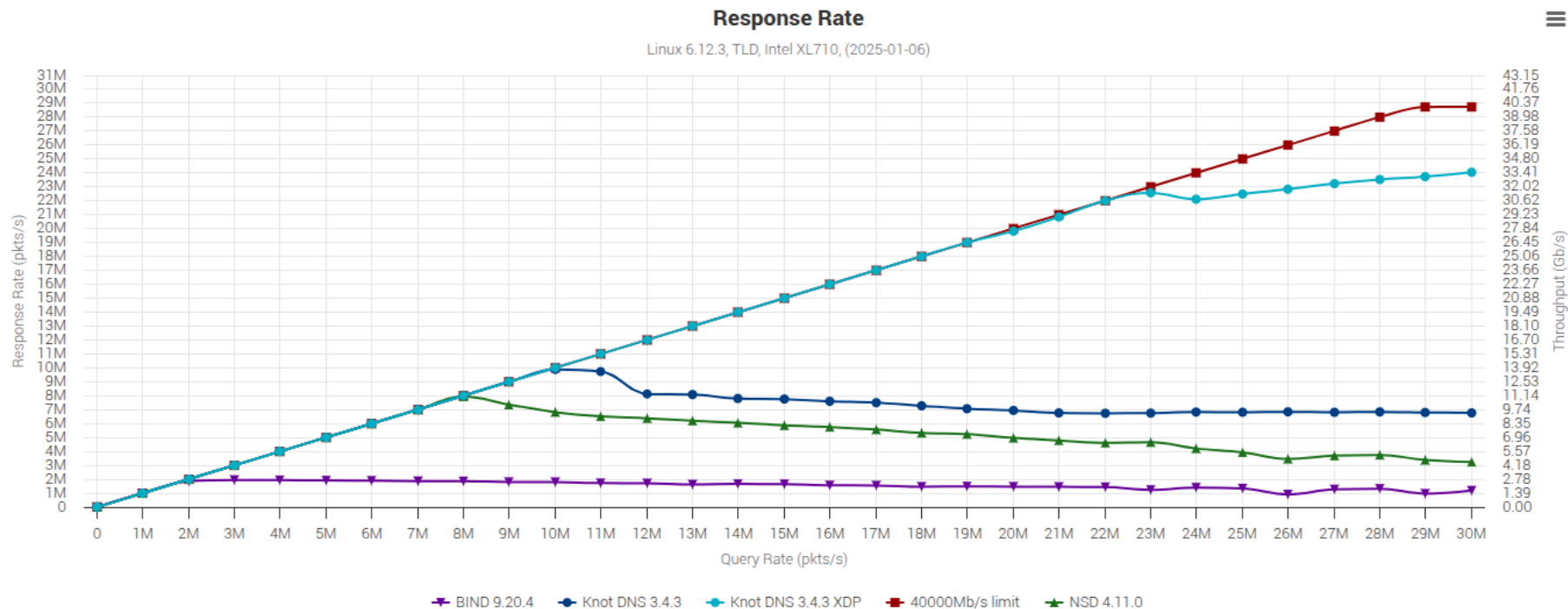
# Can you have more with just a SW adjustment?

- Is that enough?



# Can you have more with just a SW adjustment?

- How to reach the maximum? With XDP!



# KnotDNS in XDP mode

- Enables you to use close to 100% of available HW resources
  - ~ 3x more compared to KnotDNS in standard mode
  - ~ 5x more compared to NSD
  - ~ 23x more compared to Bind!

# What is XDP?

- XDP (eXpress Data Path)
- High-performance network data path bypassing most of the operating system networking stack
- Large technology companies including Amazon, Google and Intel support its development in Linux kernel and are using it heavily
- Microsoft released free and open source implementation XDP for Windows

# How do we use XDP with KnotDNS in CZ.NIC



# CZ.NIC DNS anycast: 2017 - 2018

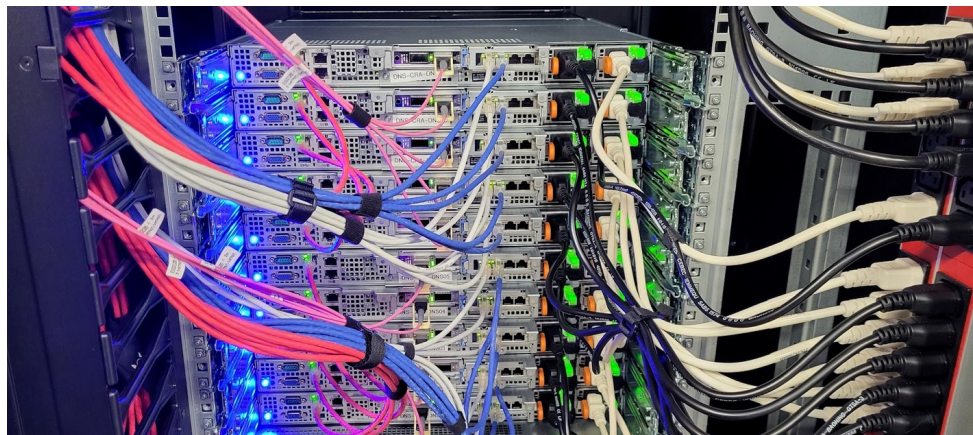
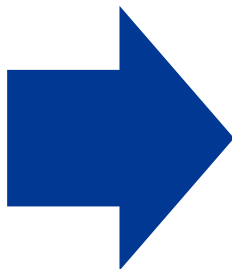
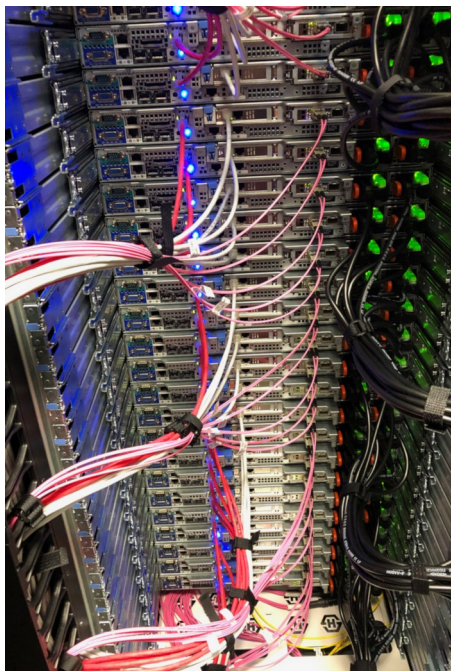
- Core locations in Prague:
  - building two 100GE DNS stacks (30 servers each)
  - 210GE network capacity to NIX.CZ + 130GE IP transit
  - without XDP

# CZ.NIC DNS anycast: 2023 - 2024

- Upgrade of core locations
  - 30x 10GE DNS servers → 10x 40GE
  - 30x 10GE DNS servers → 16x 25GE
- Building 3rd high capacity DNS stack
  - 4x 100GE DNS servers
- Core network and first line to NIX peering upgraded to 400GE
  - 510GE capacity to NIX + 300GE IP transit
  - 2nd core location network upgrade to 400GE undergoing in 2025
- Deployment of KnotDNS XDP
  - Used preferably in locations with high traffic (Prague, Frankfurt, Seattle, Stockholm etc.)
  - Continue to use locations without XDP and with different DNS SW for diversity
- Besides that:
  - New locations in Sydney, South Africa, Kyiv and US deployed
  - New traffic with new DNS anycast hosting for .UA and .DK

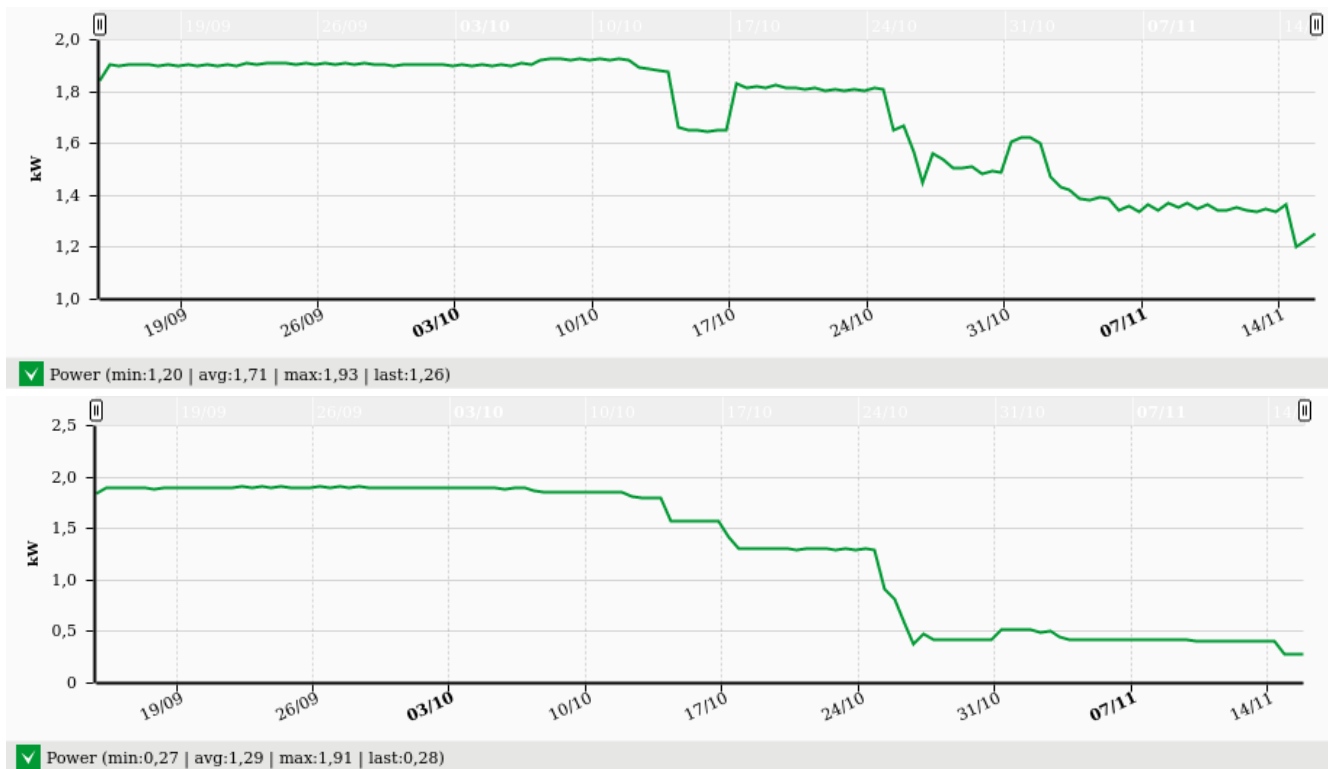
# 1st DNS stack upgrade

- 30x 10GE servers → 10x 40GE servers
- 100GE → 400GE capacity



# DNS stack upgrade

- Electricity consumption went down by 2,3kW (60%)



# Overall numbers for 1st DNS stack upgrade

- 66% rack-space savings
  - ~ 66% CAPEX savings for server HW
  - ~ 66% HW waste savings
  - 60% lower energy consumption
  - 4x higher capacity of the stack
  - 12x per server capacity gain
- } significantly lower carbon footprint
- } ready for attacks as volumes grows

# Performance testing

- Testing stack based on 10x 40GE servers
  - Used HW ordered for another high-capacity stack before upgrading
  - kxdpgun tool to generate traffic
- Results:
  - **One single high-capacity stack** answered 100% of DNS queries up to **240M QPS**
    - 10.000x more than actual traffic on .CZ TLD
  - Handles the same amount of answers even when overloaded by queries!

# KnotDNS XDP operation

- KnotDNS XDP is stable and ready for production usage
  - you have to follow HW compatibility list (documented & support available)
  - there are some differences in operations to take into account
- Way more effective in HW resources usage
  - number of anycast nodes can be misleading for capacity estimations
  - capacity difference between f.e. virtual node and bare metal XDP node is crucial
- Local traffic monitoring needs to be changed
- KnotDNS is the only DNS implementation with XDP, where is the diversity?

# TL;DR

- Think about the capacity and energy consumption of your infrastructure
- Capacity is indispensable for resilience
- Use KnotDNS XDP
  - it's stable and very effective
  - you will get much more capacity with the same HW
  - just be aware that it is HW dependent and has some specifics about the operations
- Lower CAPEX and OPEX costs enables you to do more with the same budget
- Lower carbon footprint enables you to meet higher ESG goals
- NSD
  - when XDP will be introduced (for real diversity)?



# Thank you!

Tomáš Hála

# Our projects

