How to compile a Linux Kernel for your 100Gbps router.

Or, how to keep doing Software Routing until you really have to start using an ASIC, with open source software.

WC ZANOG - 23 Feb 2023, a follow up to Feb 2019 talk

Joe Botha 🖖

Frogfoot - when it was an ISP
Teraco - DC
Octotel - FNO
Atomic Access - Fibre ISP in Cape of Good Hope
https://www.atomic.ac/

My quick 20 year history with (Software) Routing

2000 - Frogfoot's 1st router: x86 PC
2006 - Rackmount x86 & wireless
2018 - Atomic software routing
2023 - Atomic software + ASIC routing

Read: ’The world in which IPv6 was a good design’

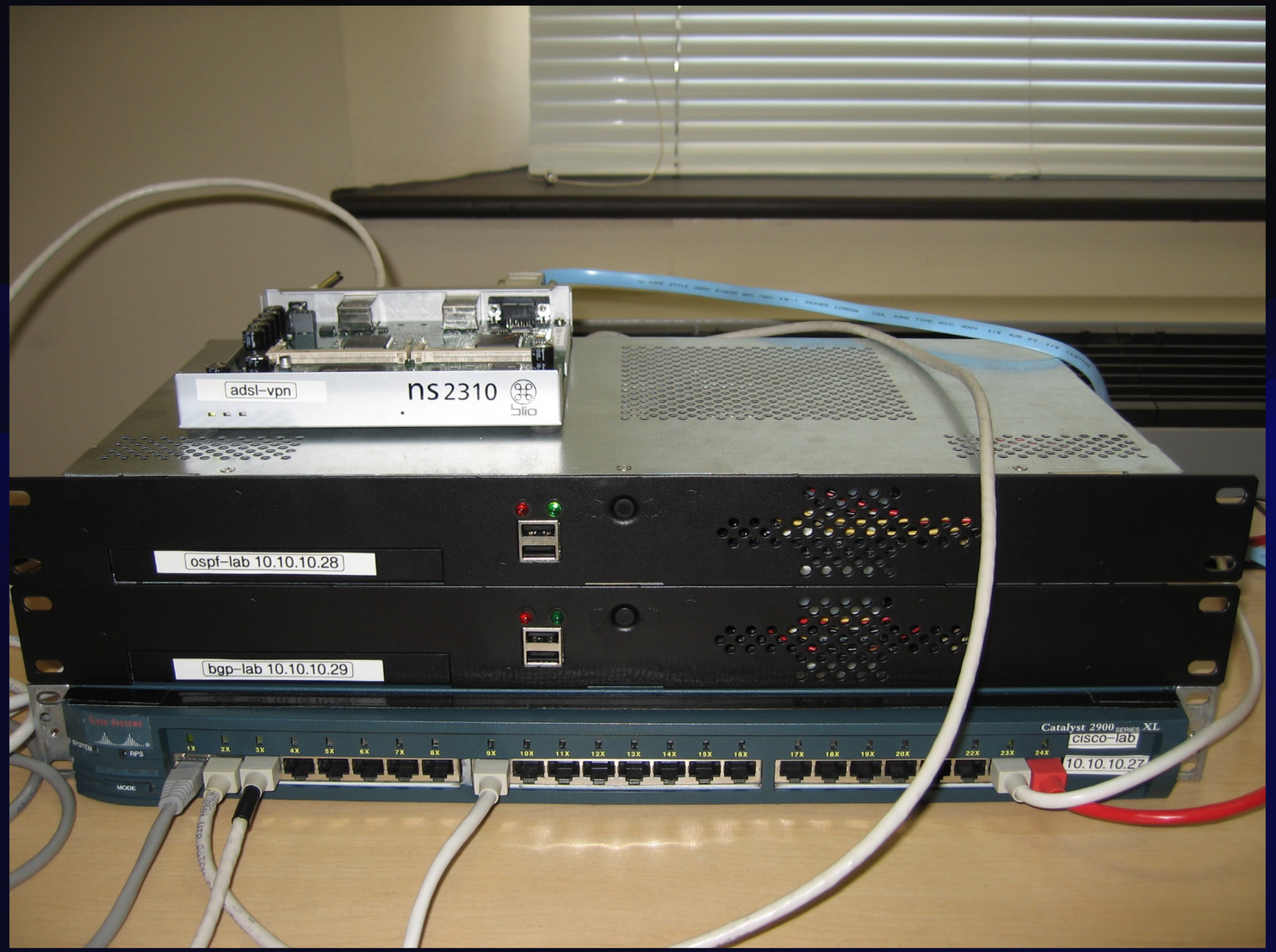
@ twitter.com/swimgeek

IETF vs IEEE & Routing vs Switching

Route packets with a CPU, until you can’t.

2000 - Frogfoot's 1st routers: x86 PC 🐸

2006 - x86, but embedded / rackmount



Open Networking History

2013 - Cumulus & ONIE 😎

2015 ~ Netflix, CDNs and rapid traffic growth

2016 - Mellanox & SwitchDev & Spectrum1

2018 - Atomic software routing 😐

- Xeon D & Intel i40e
- Debian 9
- FRR 3

vs commercial options / Arista 7280

2022 - Atomic recent routing 🧐

- Xeon D & Intel i40e & SR-IOV
- Debian 10 & Proxmox
- FRR7

Limits: softIRQ/core
~8Gbps with 8 cores
Intel NIC drivers are not great
Port density

Open Networking with ASICs

2018-2021 - found nothing really nice 😭

- DPDK & VPP, OVS, Vyos etc
- Broadcom, IPinfusion etc
- ONL and lots more…

> Mellanox NICs & Switches

“ASICs, magic and pro wrestling are closely guarded secrets”

Avoid ASICs with NDAs and buggy / closed SDKs

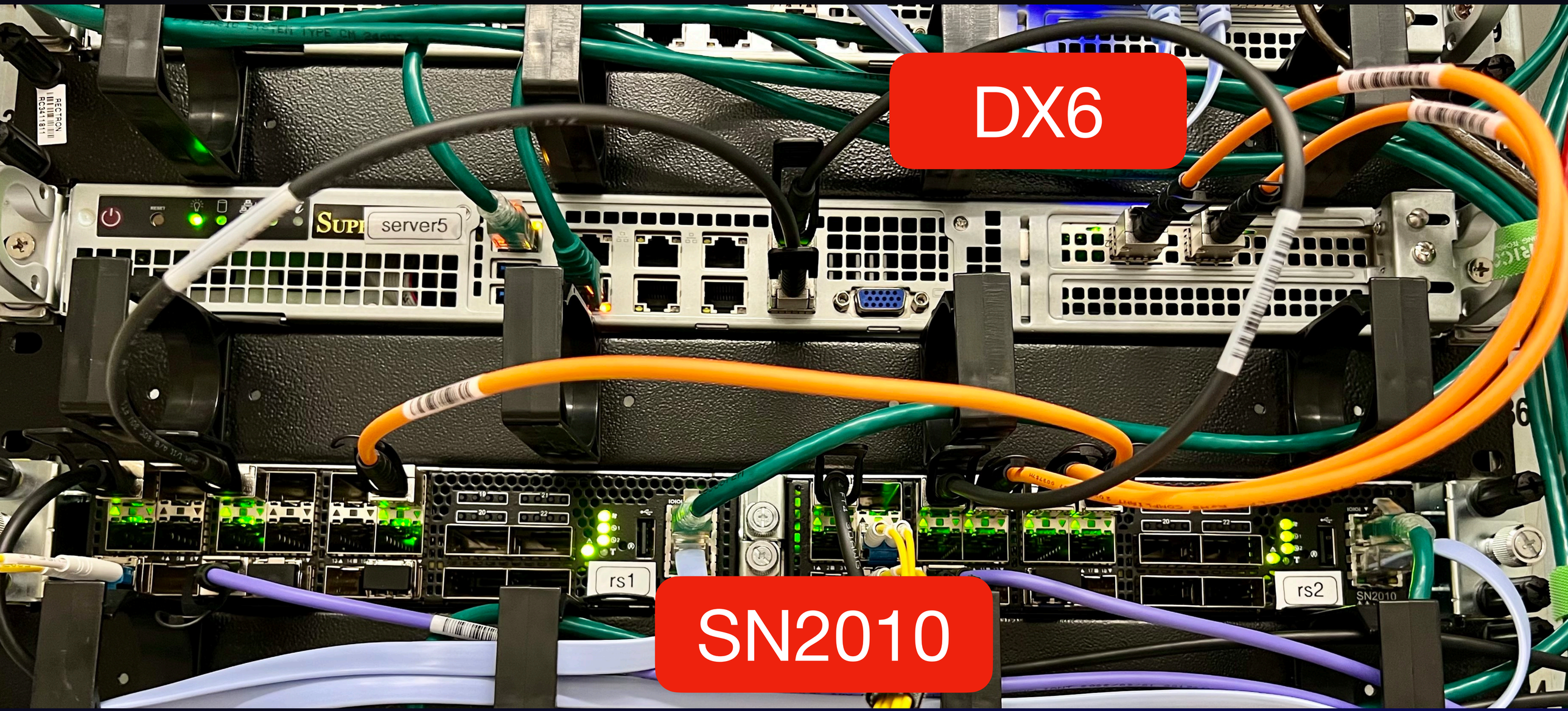
Could you build a 100Gbps router with Debian?

* Slide from 2019

2023 - Atomic routing, sw & hw 😊

- Border: Xeon D & Mellanox DX6 NICs
- Peering/BNG: SN2010 Mellanox NVIDIA

- Debian 11
- FRR 8


DX6
server5
rs1
rs2
SN2010

What you need to compile: 🙃

- Linux kernel 6.1 with SwitchDev
- Various hw sensors
- hw-mgmt
- ethtool
- iproute2

```
Linux cpt-ter-rs1 6.1.13-atomic #1 SMP PREEMPT_DYNAMIC Fri Feb 24 08:24:16 SAST 2023 x86_64
 GNU/Linux
root@cpt-ter-rs1 ~ # cat /etc/debian_version
11.6
root@cpt-ter-rs1 ~ # ethtool -i swp20
driver: mlxsw_spectrum
version: 1.0
firmware-version: 13.2010.4026
expansion-rom-version:
bus-info: 0000:01:00.0
supports-statistics: yes
supports-test: no
supports-eeprom-access: no
supports-register-dump: no
supports-priv-flags: no
root@cpt-ter-rs1 ~ # ethtool swp20
Settings for swp20:
        Supported ports: [ FIBRE ]
        Supported link modes:   1000baseKX/Full
                                10000baseKR/Full
                                40000baseCR4/Full
                                40000baseSR4/Full
                                40000baseLR4/Full
                                25000baseCR/Full
                                25000baseSR/Full
                                50000baseCR2/Full
                                100000baseSR4/Full
                                100000baseCR4/Full
                                100000baseLR4_ER4/Full
```

Why? 😎

- purist ❤️ debian
- most open, no lame NDAs
- small, low power
- pretty good port density
- peering traffic at ASIC speeds
- can do cool things with tc rules

…not really cheaper

Specs 🤓 SN2010

- 140k IPv4, 30k IPv6, 8k MAC (256k)
- 10 / 25 / 40 / 100 Gbps
- 57 Watt power
- 8G memory, 256G storage (DIY)
- 1.3 Bpps
- 16MB buffers
- 300ns latency

What's missing? 😕

- Deep buffers
- 2M routes
- yes, you have to filter HE routes

Questions? 😵‍💫

- Cumulus vs Debian
- Switchd vs Switchdev
- Sectrum1 vs Spectrum2
- All 10G ports
- Ops: Linux sysadmin vs ~Cisco config
- Upgrades