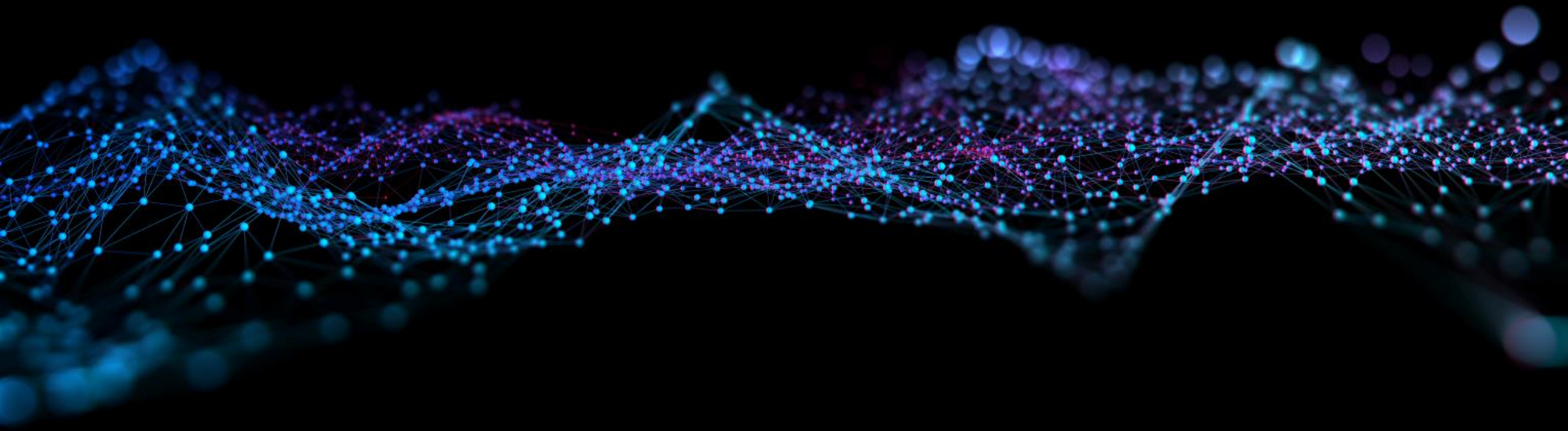
Building a regional service provider network using SDN (for fun)



By @nz_liam

Why/How? A number of favourable factors… making market entry possible to smaller players

- Chorus bond requirements have come down, (previously $50k now approx. $10k)
- Chorus UFB Tail Extensions
  - Total of 33 UFB Areas, 24 Chorus (70%)
  - Previously an interconnect was required in each UFB area, (plus exchange space, equipment, backhaul etc)
  - With tail extensions only 3 Interconnects are required for the North Island
    - Auckland
    - Hamilton
    - Wellington
- Cheap Backhaul
  - Chorus Launched CRT, bringing 10G DWDM P2P links down to ~$4k / month ($0.40 per mbit).
  - This lowered national backhaul costs substantially from the previous cost of about $5 per mbit.

What are the requirements, and where does SDN come in?

- Lower cost structures in acquiring tails help, but its not enough.
  - You still need exchange space, hardware and software… exchange space was easy we brought it off 2Degrees.
- Hardware is the tricky (and fun) part…
  - Vendor gear is expensive and often low density.
  - We wanted;
    - Small footprint (1RU)
    - High Port Density (16 x 10G)
    - 48VDC Power (for Exchanges)
    - Converged infrastructure, (Switch, Router, BRAS, RADIUS, DNS etc)
    - Cost Effective (Cheap)

Building your own SDN appliance… (and what is SDN actually?)

- To meet our requirements (footprint, density, cost) we decided to build our own SDN appliance.
- What is SDN, does anyone actually know?
  - For me it's the combination of virtualised networking in the form of virtual routers, virtual switching, and associated virtualised applications (RADIUS, DNS etc) on converged hardware.
  - Traditional vendors (Juniper / Cisco) do a bad job of producing virtual routing software for converged hardware
    - Generally only support old OS versions
    - Require specific hardware (network cards)
    - Require specific driver patches
    - Net result – you're replacing dedicated vendor hardware with dedicated SDN hardware for a single vendor…

Our SDN Environment – Hardware

- Finding virtualisation hardware for Exchanges is hard, 48VDC is a PITA
- We actually modded some CCR's to get up services up and running quickly for a customer

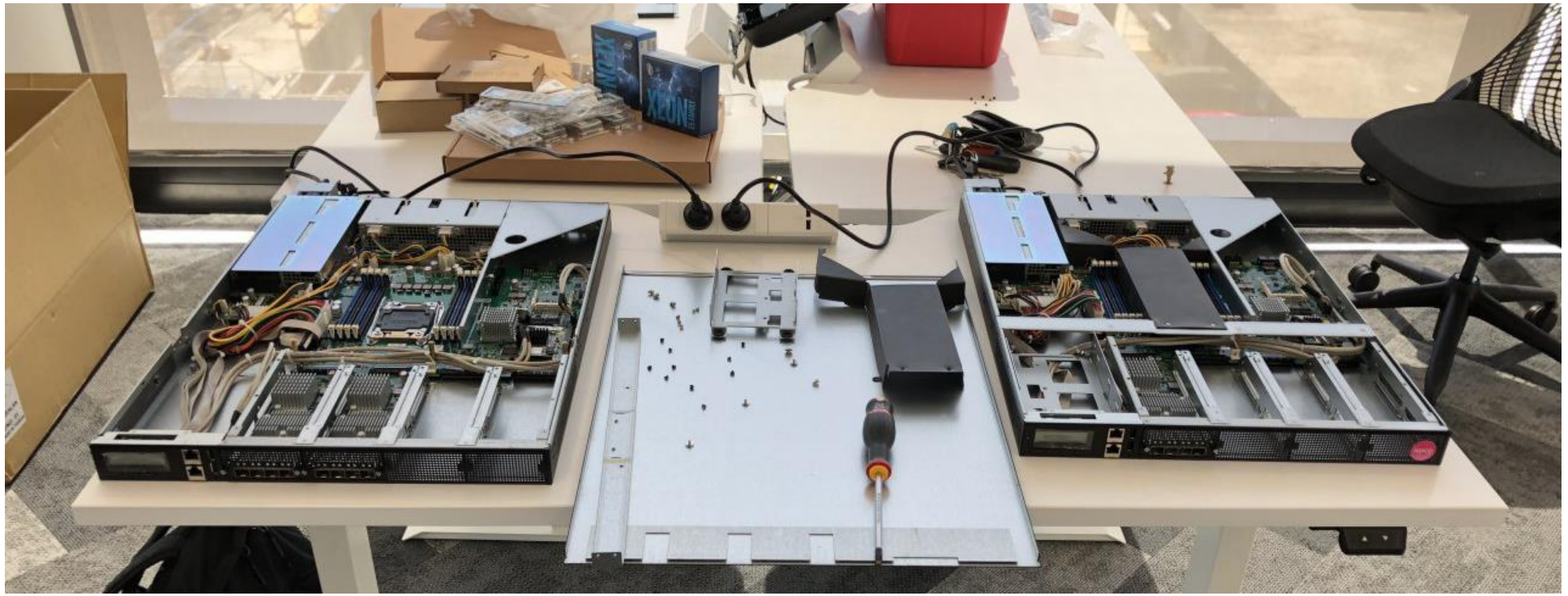
Mikrotik CCR1016 with Dual 48VDC Conversion in Napier Exchange

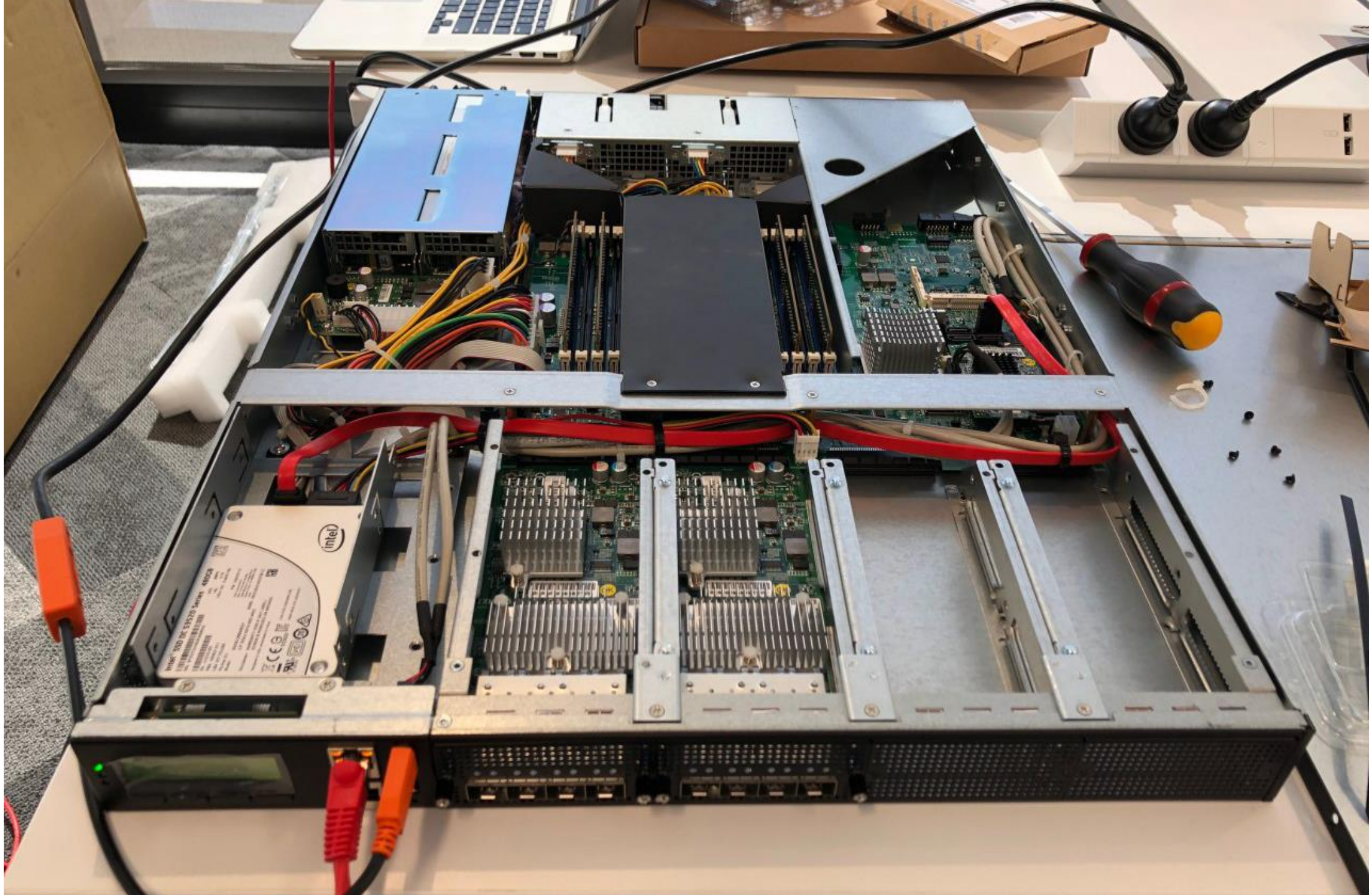
Our SDN Environment – Hardware

- We found a great Taiwanese OEM – Lanner
- NCA-5510 Appliance
  - 48VDC Power Option
  - 1RU
  - Up to 4 Network Modules, with 4 x 10G
  - Intel Xeon E5 Support – Max 95W TDP
  - Up to 256GB ECC DDR4 RAM
  - Dual 2.5” SSD
  - IPMI (OOB)

Our SDN Environment – Hardware

- Our Build, Intel Xeon E5-2640 v4 (10 Core @ 2.40GHz), 64GB ECC DDR4, 480GB Intel SSD, 4-16x Intel 10G Nic, Price tag approx. $7K




intel

Our SDN Environment - Software

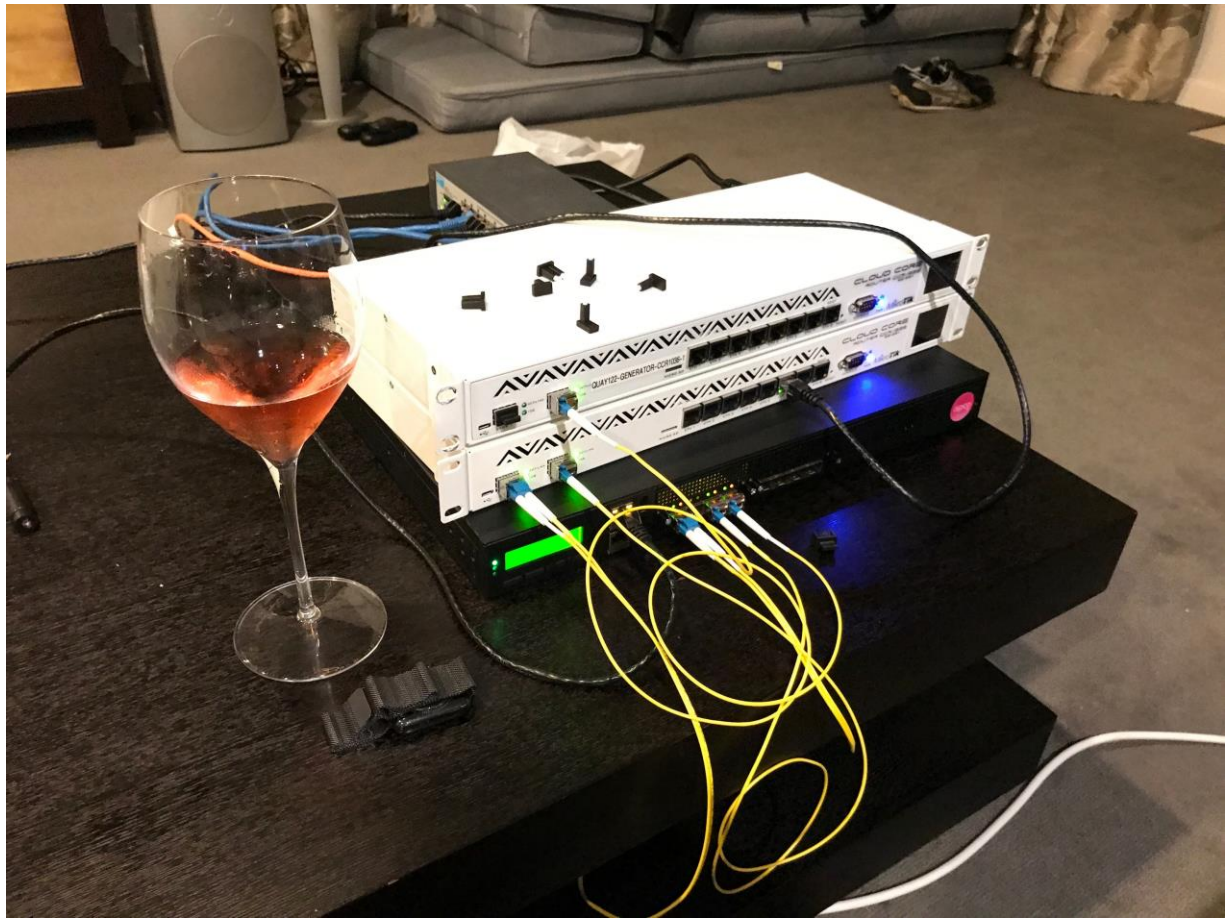
- Proxmox VE 5 (KVM, QUEMU)
  - Linux hypervisor in an easy use out of the box package
  - Has commercial support
  - Runs Debian – easy to modify the HV environment
- Open vSwitch
  - OVS is Awesome (queue rant)
    - NIC’s become switch ports, (access ports, trunk ports, QinQ ports etc)
    - Multiple virtual switches
    - Links between vSwitches
- For Routing - Mikrotik CHR…

Mikrotik CHR

- It runs on everything, (vmware, KVM, it just works)
  - No specific requirements, you can actually run CHR on converged hardware
- Fulfils our base requirements
  - VLANs (w/ QinQinQ Support)
  - OSPF
  - Bridging
  - MPLS / VPLS
  - BRAS
- Affordable

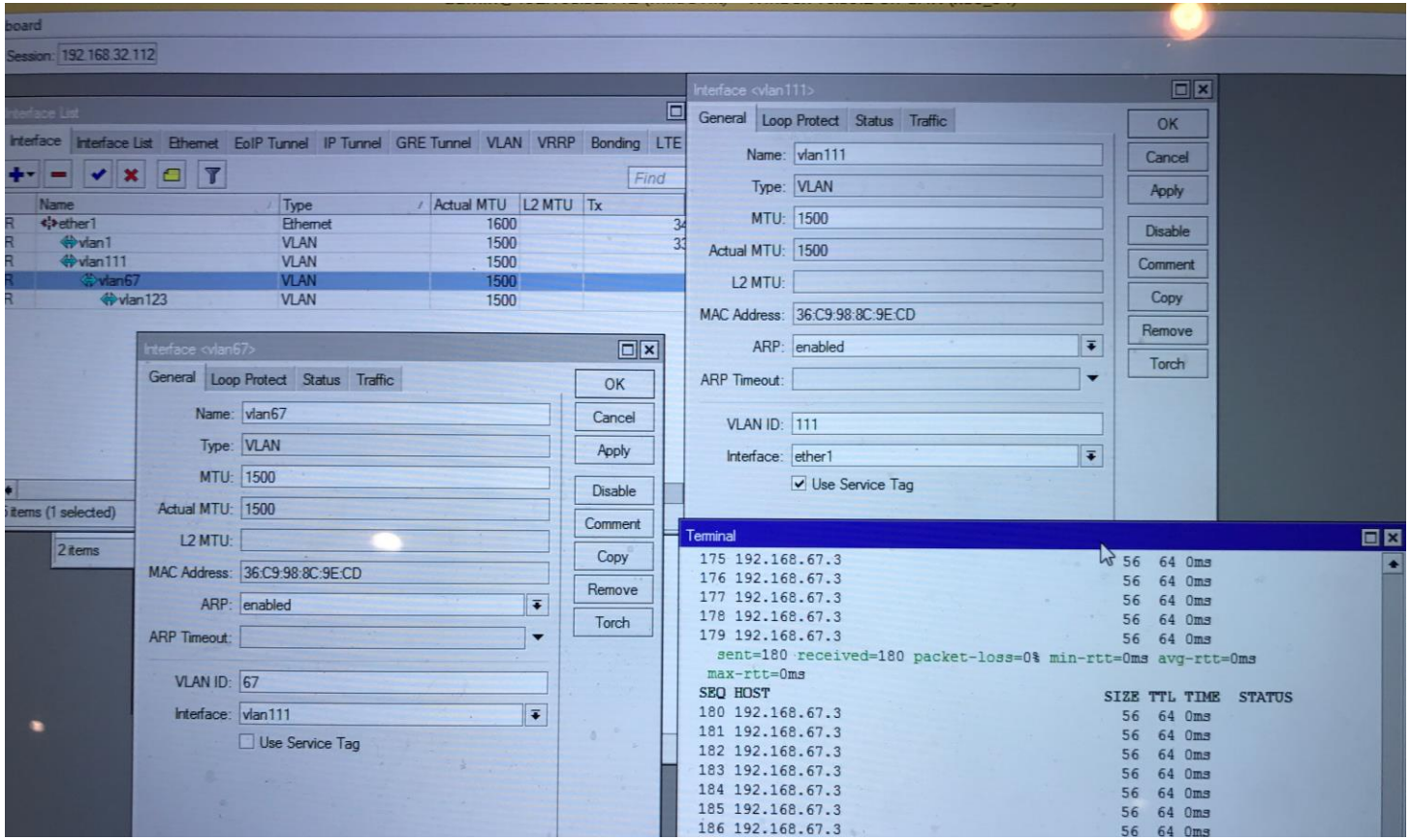
Some testing…

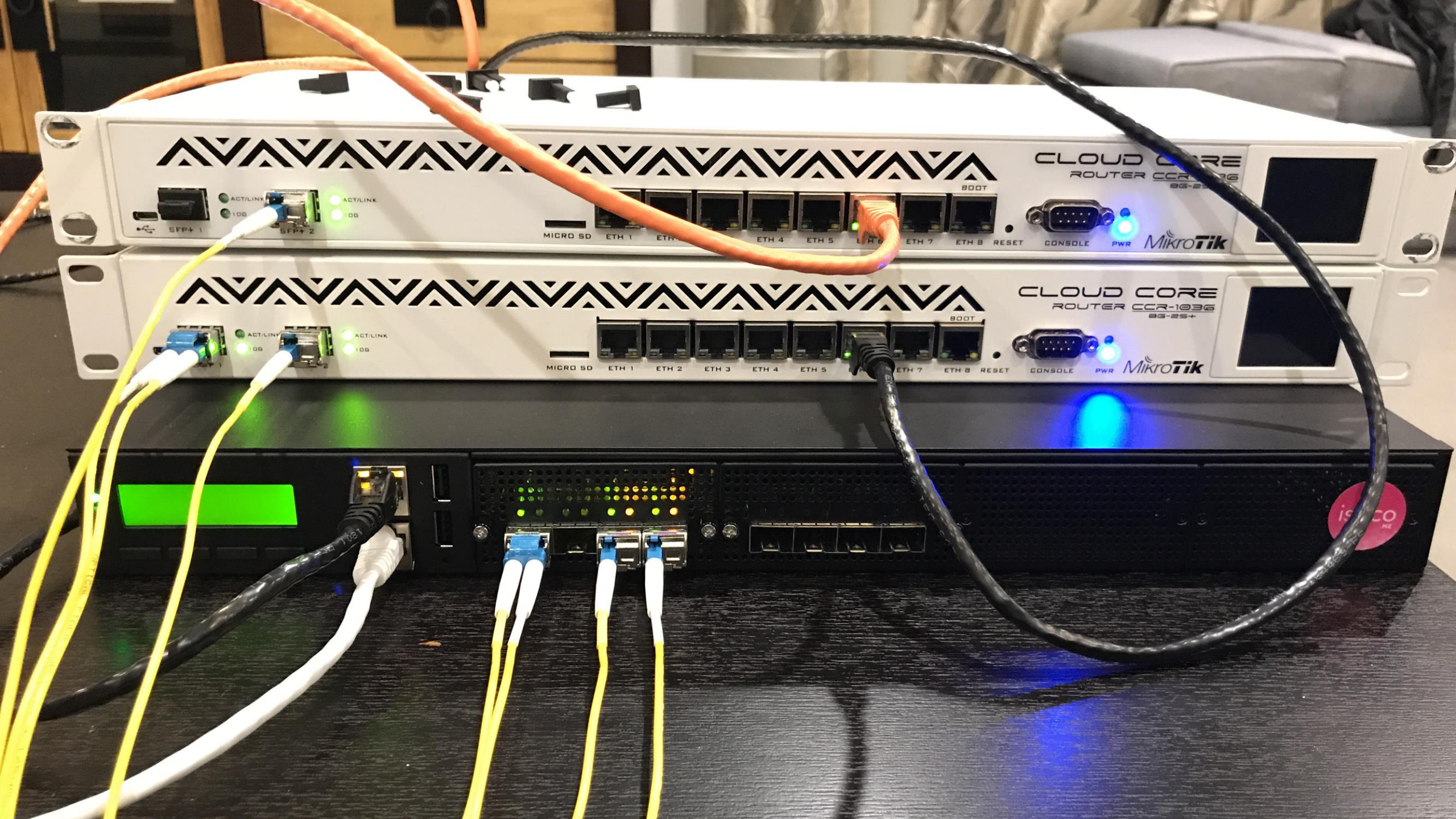
- Coffee Table ✔
- Wine ✔
- Hardware ✔
- Hypervisor (PVE) ✔
- OVS from source?
- Does QinQ work?
- What's performance like?



Some testing…

- Optics work
- OVS Works
- 1G VPLS uses 10% of 1 CPU Core
- QinQ works
- Great Success!




CLOUD CORE
ROUTER CCR-1036
8G-2S+
MikroTik
CLOUD CORE
ROUTER CCR-1036
8G-2S+
MikroTik

Exchange & Handover time!

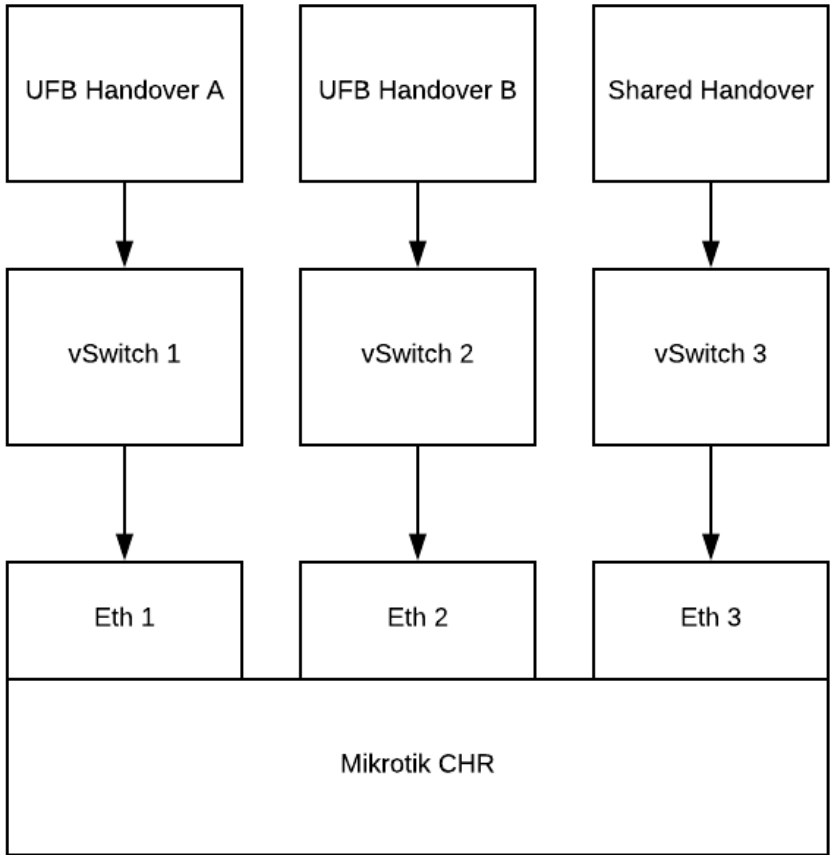
- Chorus is complicated…
- So many portals… (each with different logins)
  - Wireline
  - Portal (Fibre)
  - Checkmate
  - SSP (Self Service Portal)
  - SP (Service Provider Portal)
  - Gateway (Service Performance Manager)
  - Legacy Portal
  - CCM (Maps)

Exchange & Handover time!

- Some challenges
  - MDR had no more 10G Handover Ports… Handover & DFAS from Mt Eden
  - 1G BiDi optics don’t work well in 10G cards, (even in un unsupported mode)
    - We ordered a 1G Shared Handover (ADSL / VDSL)
    - FedEx in a 1G Network Card to resolve
  - It crashed… (networking stopped passing traffic)
    - Hard to diagnose stuff when everything is broken
    - Suspect a Virtio Driver / Kernel / vSwitch Issue
    - Updated vSwitch, Kernels and Virtual routers, problem solved
  - EUBA & WVS is a pain, particularly EUBA with PPPoA

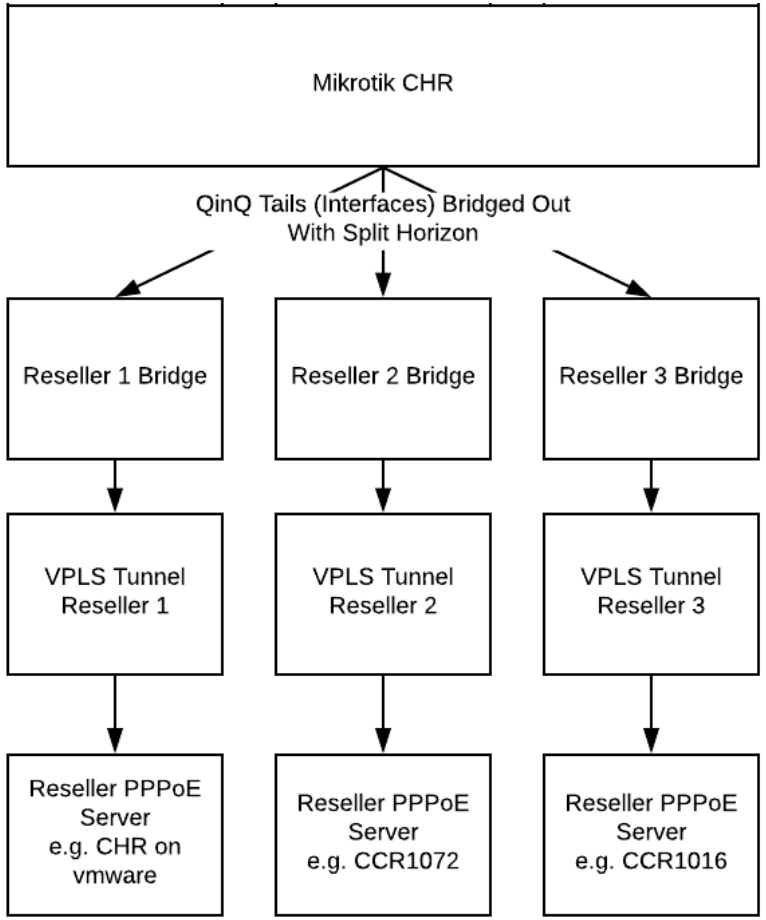
Dealing with QinQ Handovers

- Each customer tail comes as QinQ (or QinQinQ)
- OVS QinQ doesn't use the right ethertype (0x88a8 not 0x8100)
- Separate each handover (OVS port) into a new vSwitch for collision avoidance



Dealing with QinQ Handovers – Part 2

- QinQ Means you have a S-VID (Outer Tag) and C-VID (Inner Tag) for each circuit (tail)
- Connect each tail C-VID to a bridge for the specific reseller
- Use split horizon bridging to prevent tails talking to each other & STP
- We VPLS each resellers bridge back to Datacenter for PPPoE Termination on their specific BRAS



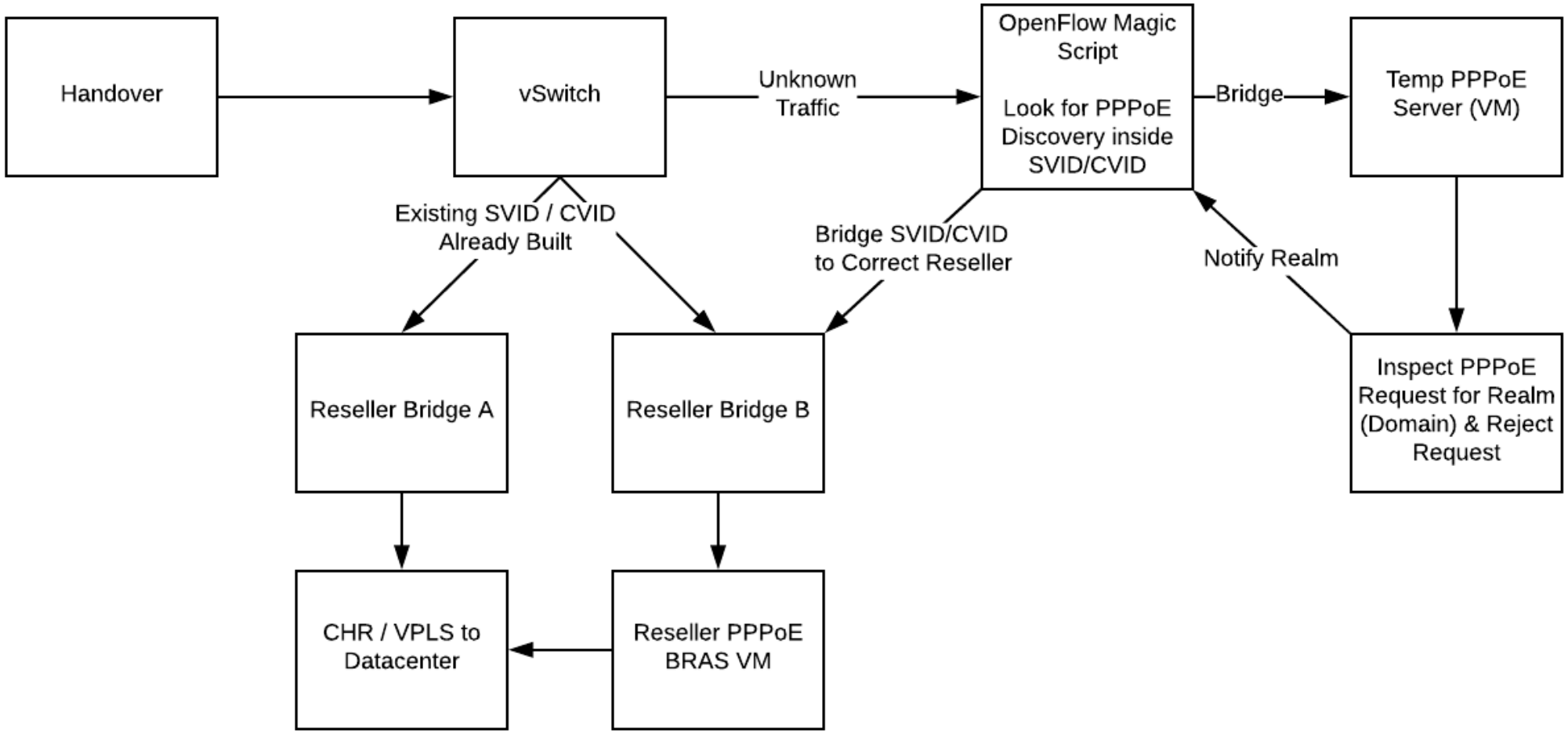
Challenges with our design

- Each customer circuit has to be built manually
  - S-VID Interface, C-VID Interface, Bridge Port…
- UFB is Easy SVID / CVID's are sequential
- EUBA / VVS (ADSL/VDSL) SVID / CVID's are NOT sequential
  - Different S-VID for each Exchange, random C-VIDs based on line card position
  - Line cards explode… CVID's change…
- EUBA is even worse
  - Using PPPoE / VLAN 10 you get the assigned C-VID by Chorus
  - Using PPPoA you get the assigned C-VID + 1600
  - Most shitty modems use PPPoA, but we also use PPPoE when bridging…

Future design improvements

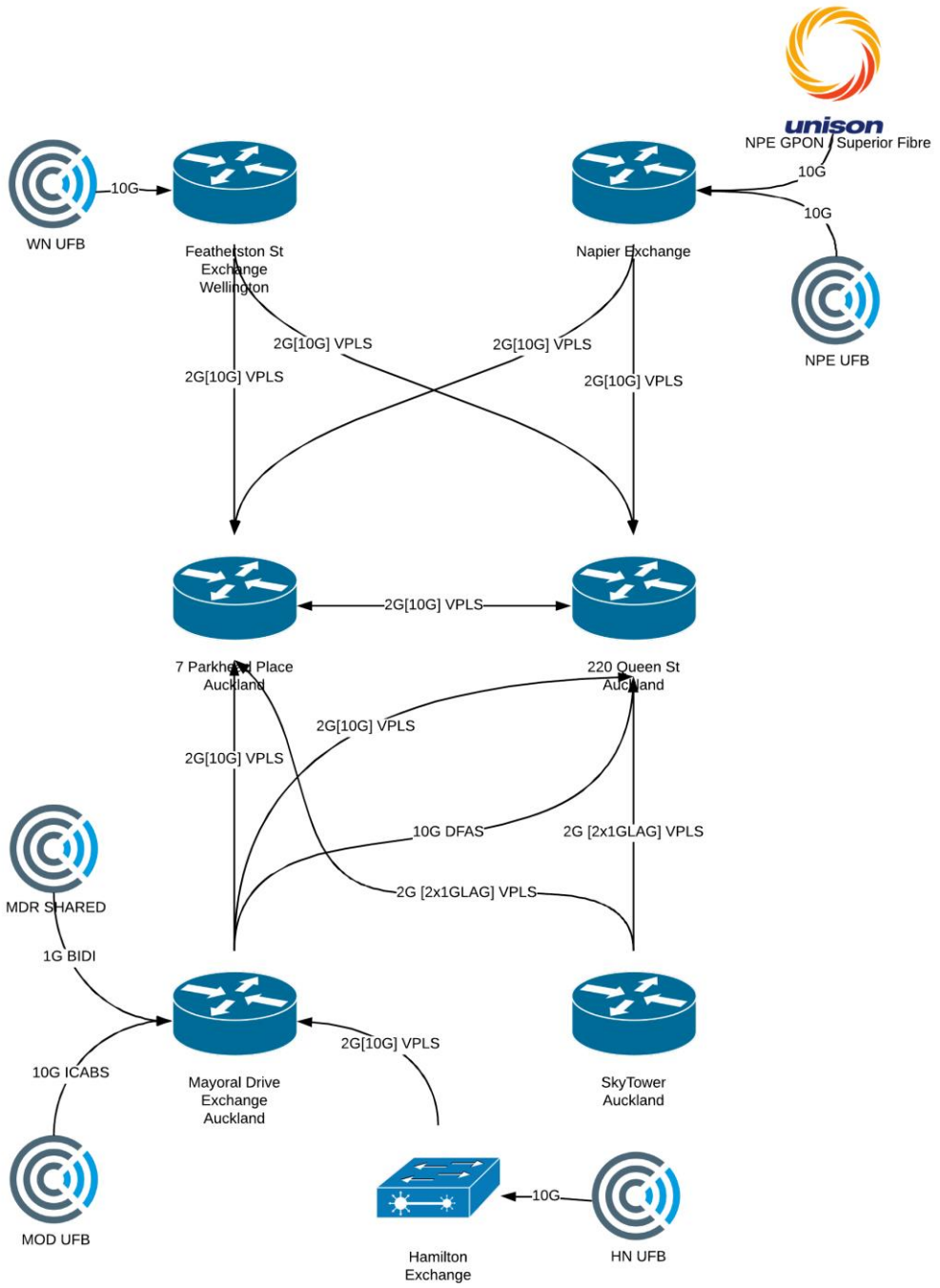
- More performance using Open vSwitch w/ DPDK (and proper benchmarking)
- Custom Build of OVS with 0x8100 QinQ ethertype
- Making the front LCD do something (tell jokes)
- Hosted infrastructure for resellers
  - BYO Handover
  - Use our hardware / virtualisation platform / backhaul
- Dynamic VLAN Creation
  - NZNOG + Beer + WAND = Something Cool is Coming

Dynamic VLAN Creation



juniper
EX3300
MAXUM WLG-PVE-1
MAXUM-NPE-CCR1016-
Core Router
Resources
Storage: 78.1 MiB
CPU: 1 %
Memory: 1486.0 MiB
Serial Console
48vdc
MAXUM-NPE-PVE-1
ispco

The End Product

- Chorus Handovers
  - Auckland
  - Hamilton
  - Napier
  - Wellington
- Unison Handover
  - Napier
- Datacenter POP's
  - 220 Queen Street
  - SkyTower
  - Vocus Albany

Questions? @nz_liam on Twitter