

# COHERENT MIGRATION OF LEGACY 1G AND 10G SERVICES

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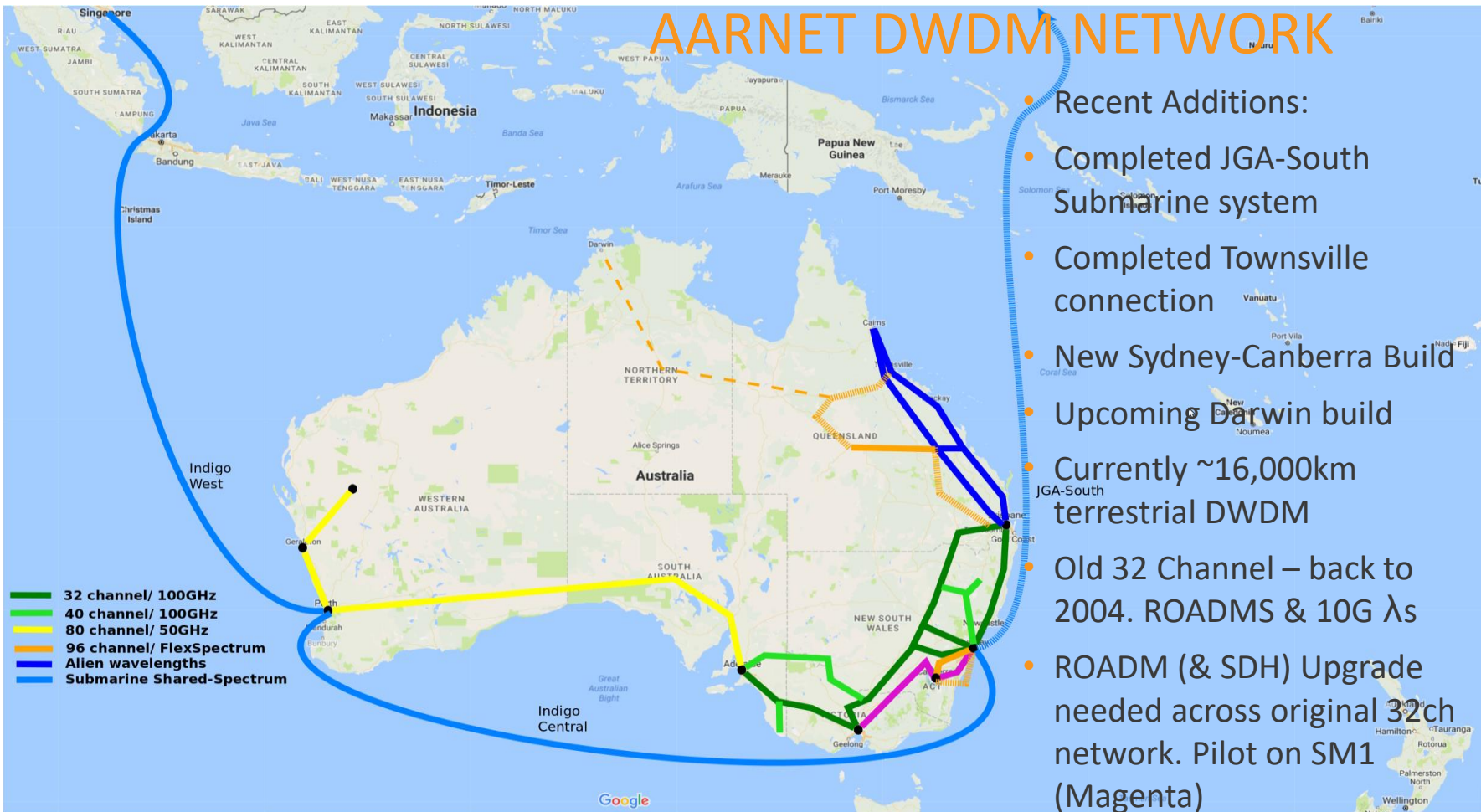
Proof of Concept for eventual SDH replacement  
Tim Rayner, - AARNet - April 2023

# AGENDA

## AARNet's Optical network

- Current & Future Optical Network Map
- Need to upgrade old 32ch 100GHz ROADMs & retire SDH
- Attempt 1: migration of 1G services to ME switch 10G wavelengths
- Attempt 2: migration to coherent - stalled by COVID
- Attempt 3: migration to switch platform with coherent 400G-QSFP-DD
- Addressing low Transmit power of 400ZRPlus QSFP-DDs

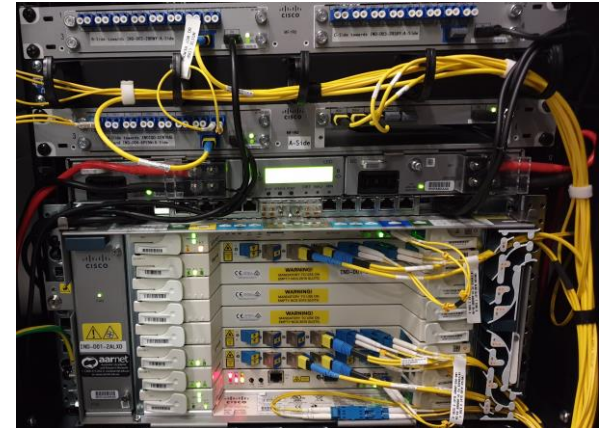
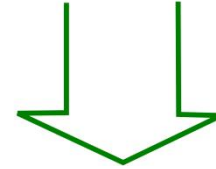
# AARNET DWDM NETWORK



- Recent Additions:
- Completed JGA-South Submarine system
- Completed Townsville connection
- New Sydney-Canberra Build
- Upcoming Darwin build
- Currently ~16,000km JGA-South terrestrial DWDM
- Old 32 Channel – back to 2004. ROADMS & 10G λs
- ROADM (& SDH) Upgrade needed across original 32ch network. Pilot on SM1 (Magenta)

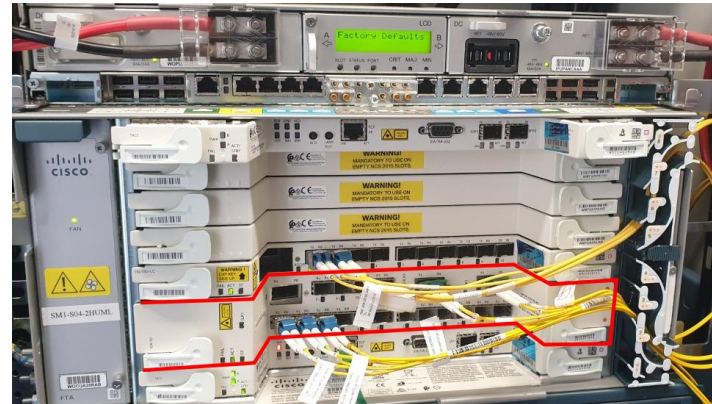
# ROADM UPGRADE STRATEGY

- Replace unsupported 32Ch 100GHz ROADM system
- 100GHz grid works with 60 – 72 Gbaud “leading edge” wavelengths, but we will want faster modulations soon. eg. 140 GBaud
- Remove Dispersion Compensation
- Requirement: retire non-coherent wavelengths needing Dispersion Compensation
- 10G Transponded services in regional sites & 1G services carried as SDH over 10G Transponded wavelengths.
- Our SDH retirement saga....



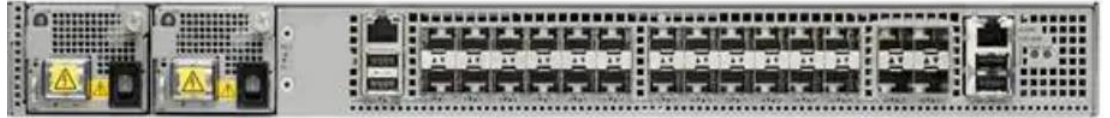
# ORIGINAL SDH EQUIPMENT

- Large footprint ~ 14RU
- Power consumption: ~ 400W + Transponders
- Client interfaces use GBICs – no DOM!
- Unsupported for ~ 5 years
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- Updated to “SDH on a Blade” - 2<sup>nd</sup> hand market.
- 2 x tuneable XFP trunk ports as Transponders
- SFP clients support DOM
- Compatible (mostly) – only 2 trunks rather than 4.
- Power consumption: 120W ? ~300W in Chassis



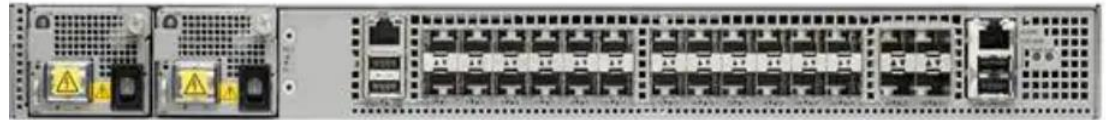
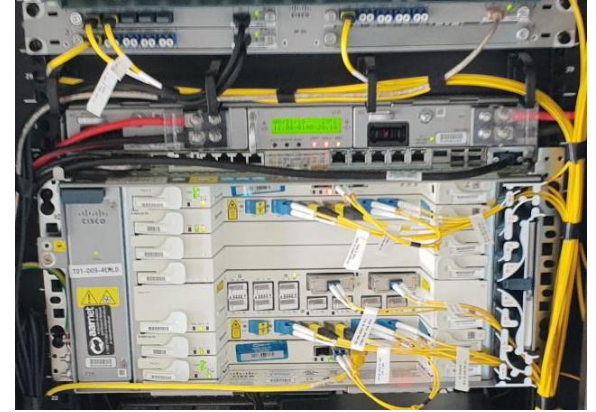
# FIRST ATTEMPT ~2016

- Selected Metro Ethernet switch vendor
- Power consumption: ~ 200W + Transponders
- Not trying to move to coherent wavelengths
- Lab testing revealed stability issues
- Back-tracked – old SDH equipment still performed reliably
- Continued to look for a better solution



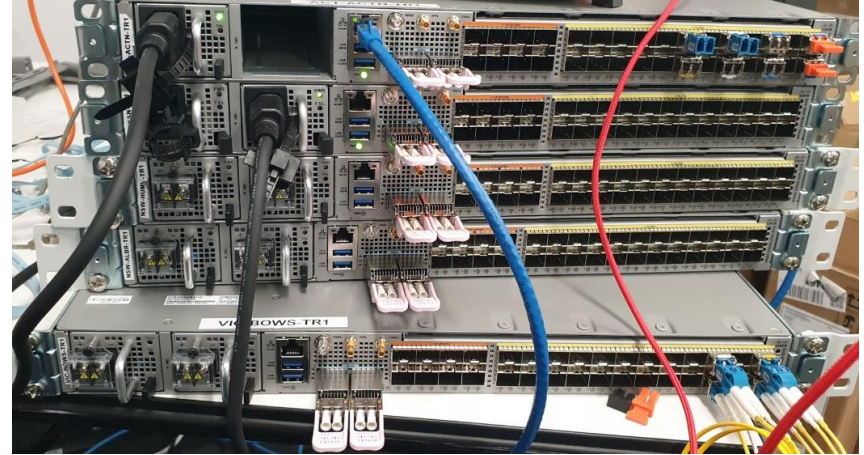
# SECOND ATTEMPT ~2020

- Retirement of non-coherent wavelengths & Dispersion Compensation
- Move 1G SDH services to a switch platform with 10G Trunks
- Use 200G Coherent CFP2 wavelengths to provide n x 10G services to transport 1G services & 10G customer services
- Use 10x10G cards (or switch ports) to convert grey 4x10G PSM QSFP+ services to coloured wavelengths for delivery to customer sites. eg. using multi-drop CWDM.
- Power consumption: 330W (400G-XP) + 140W (10x10G) + switch (>SDH)
- Upgrade Roll-outs were planned starting 2020, but delayed with COVID inconvenience
- Delay meant we decided to wait for coherent pluggables in a switch platform



# CISCO NCS540-LARGE

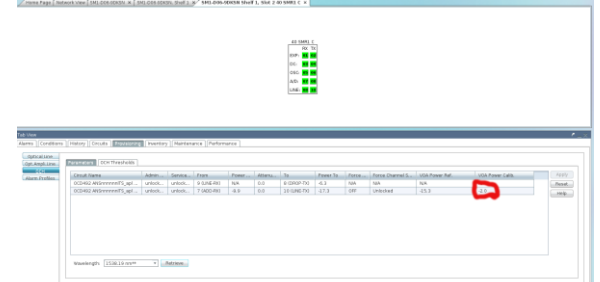
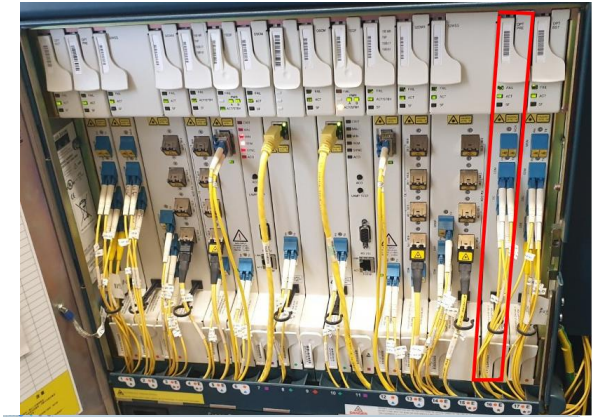
- 2 x QSFP-DD ports take 400G-ZRPlus Coherent Optics
- 8x50G, 24 x 1/10/25G
- 1RU, front power, < 300mm depth – ideal for regional field deployment
- High-density DC solutions often  $\geq 600$ mm deep, with no smaller options
- Power consumption: around 200W incl. 2 x QSFP-DD DCOs
- Cisco/Acacia 400-ZRPlus produce  $\sim -10$  dBm, but  $-5$ dBm @ 100G QPSK
- New “Bright” 400-ZRPlus will produce 0 dBm.
- Equipment deployed in Feb 2023, planning service configurations with architecture team – using Segment Routing
- Production Service migrations hopefully soon.





# COPING WITH LOW INPUT POWER

- Expect Flexspectrum ROADMs can cope @ -10 dBm, but use whole ROADM input degree (no splitter or wavelength panels possible)
- WSS32 ROADMs worked with -5 dBm power
- 40 Channel Single Module ROADMs use wavelength patch panel – additional ~5dB loss. Tweaks required @ -5 dBm, no chance at -10 dBm
- For our trial, we “worked around” the low input power by reducing trunk to 100Gbps QPSK with -5 dBm launch power. ++ also saves on licensing
- Other options:
  - EDFA Amplifier cards – large cost, power & footprint
  - Pluggable EDFAs – Licomm product tested – no switch support
  - Hopefully possible by working with Flexoptix & their “Flexbox”
- 0dBm 400ZRPlus part should be available mid-late 2023 – tested an early sample.
- Currently on order... We will delay further roll-outs until they are available



# CONCLUSIONS

- 400G-Zrplus DCO optics & compact switch platform solves migration issues
- Minimal power and footprint – less power and RU than original SDH
- Allows all non-coherent wavelengths to be retired whilst running old DWDM network
- Migration to new Flexspectrum network should be straightforward
- Low TX-Power posed challenges – worked around, but now waiting for new 0dBm product
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- Any Questions ???

