Jisc

Deploying 400Gbit/s on the Janet network

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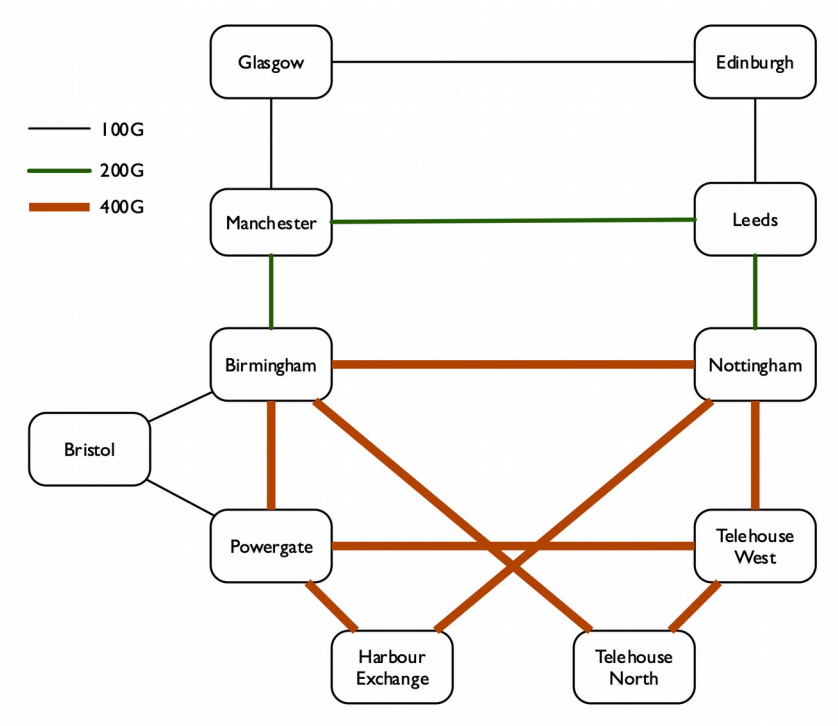
What is Janet?

- National network for research and education
- Connects Higher and Further Education sites
- High speed connections to GÉANT, which connects all European R&E networks
  - …and on to other global NRENs
- ”Everyday” use, students on their phones connected to wifi, through to large data flows from, e.g., the Large Hadron Collider, Bioinformatics, etc
- The question that everybody asks:
  - Jisc is the company
  - Janet is the network
  - Neither are acronyms any longer

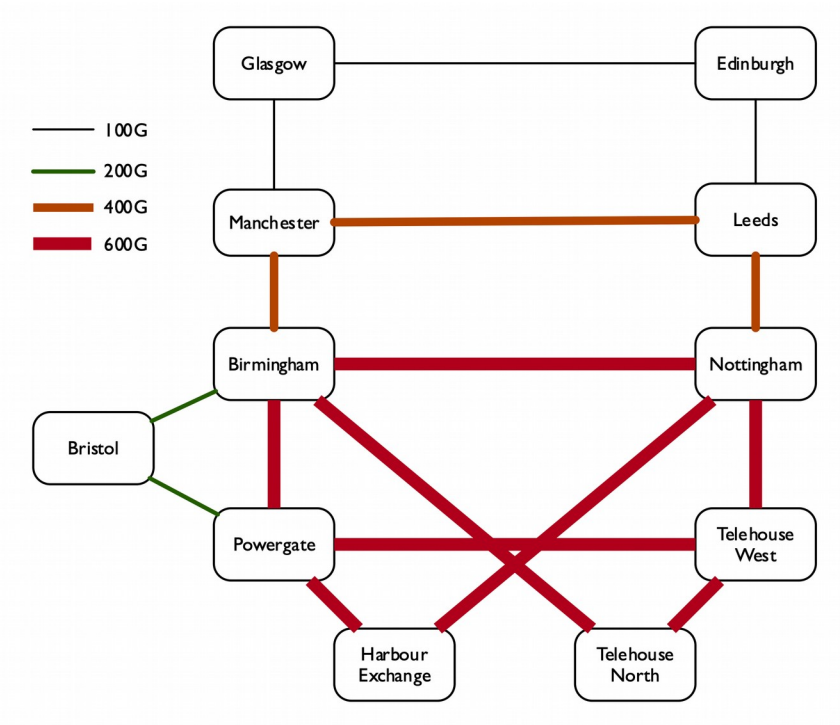
What is Janet?

- Leased fibre from SSET
- Ciena 6500 transmission equipment managed in-house
- Predominantly Juniper routing base
  - MX2010
  - MX960
- Current network has been in service since 2013
- Fibre contract until 2028
- Previously regional aggregation networks managed autonomously
- Now all managed in-house
  - Process of rolling out new aggregation architecture to them all at the moment
  - Except Wales and Kent, which have all-sector public service aggregation networks

The Janet network – before.



The Janet network – the plan.

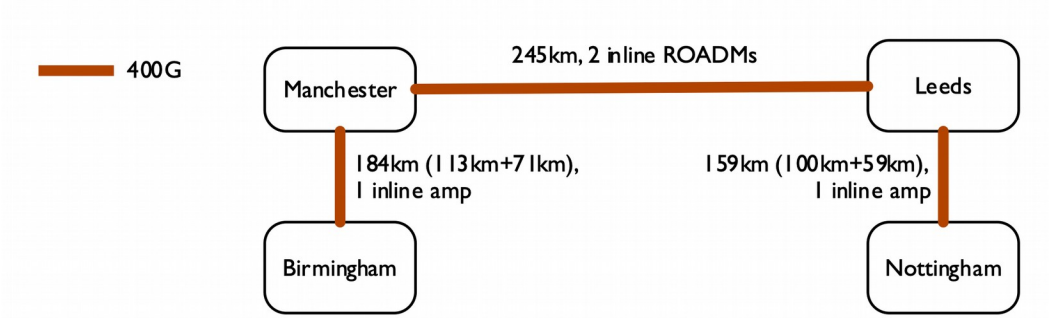


Why did we want/need 400G?

- Ever-increasing capacity demands
  - Incoming IP traffic to Janet from GEANT, peering, and transit is > 600Gbit/s
- More efficient spectrum usage
- Save on chassis space!
  - 4x100G client plus 400G line in single slot, saves 3 slots compared to OTR (one slot per 100G), saves 7 slots (half a chassis) compared to OCI+OCLD (two slots per 100G).
  - Flexgrid 9:1 WSS are two slots, older fixed grid 9:1 WSS occupied 3

Where should we deploy 400G?

- You might have thought where we wanted 600G
  - Busiest parts of the network
  - Lots of disruption to migrate from fixed grid to flexgrid.
  - Some routes too long to run Wavelogic Ai cards at 400G in 75GHz.
    - Other Wavelogic cards are available…
- Birmingham – Manchester – Leeds – Nottingham
  - Require 400G capacity
  - Replace existing 100G cards and re-deploy for South upgrade from 400G to 600G.



Will it work?

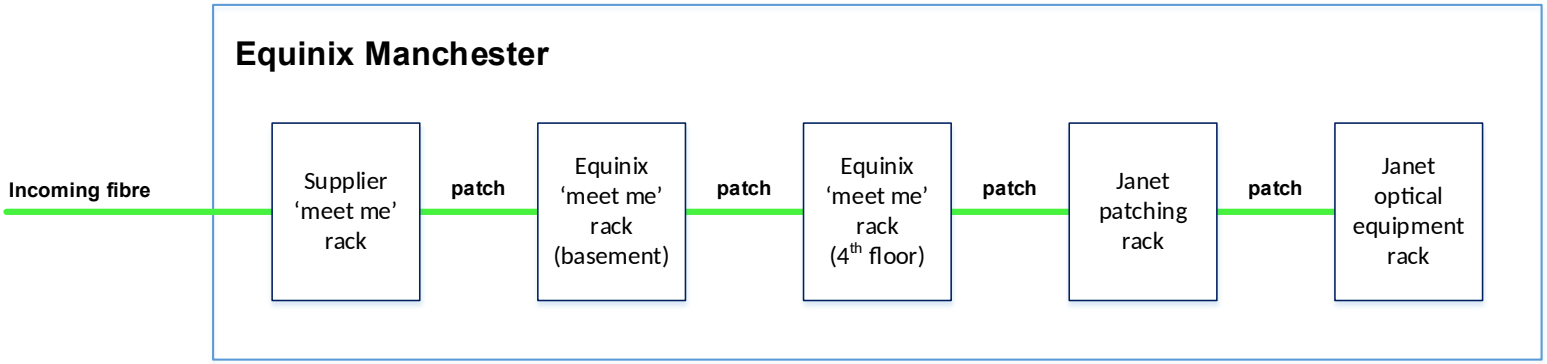
- 100G transmission uses DP-QPSK encoding
  - Two polarisations, quadrature phase shifting
- Wavelogic Ai chipset adjusts encoding depending on OSNR
  - The better the OSNR, the more capacity
  - Proprietary modulation formats based on QPSK/8QAM/16QAM/32QAM/64QAM
- Step 1: Know what we've got
  - Original OTDR results now six years old
  - Take backbone fibres out of service to re-measure

OSNR: Why and how?

- Change from EDFA-based amplifiers to Raman
  - Strict loss requirements in the first 20km of fibre
  - Raman amplifiers include OTDR to check fibre is in spec before enabling
- Modelling on the planned spans
  - Good to go on Birmingham to Manchester and Nottingham to Leeds (& vice versa)
  - Manchester to Leeds: -0.42dB
  - Leeds to Manchester: -0.09dB
  - Anything below -0.3dB is out of spec
  - Conservative stance is that we can only do 300G between Leeds and Manchester

How does the fibre get from the road to the rack?

- Equinix MA1

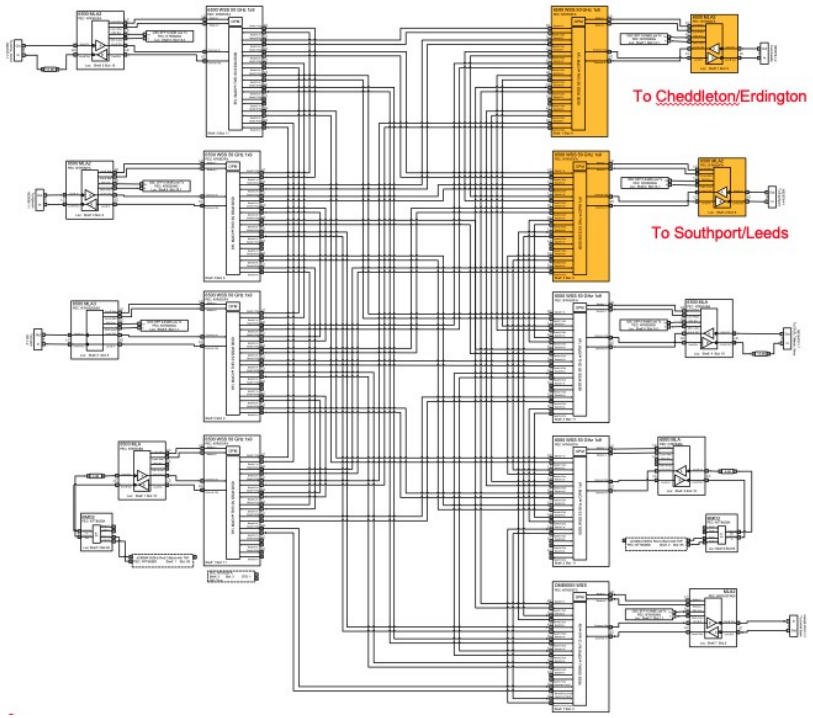


- Just splice the thing…
  - Spot the deliberate mistake in the diagram…

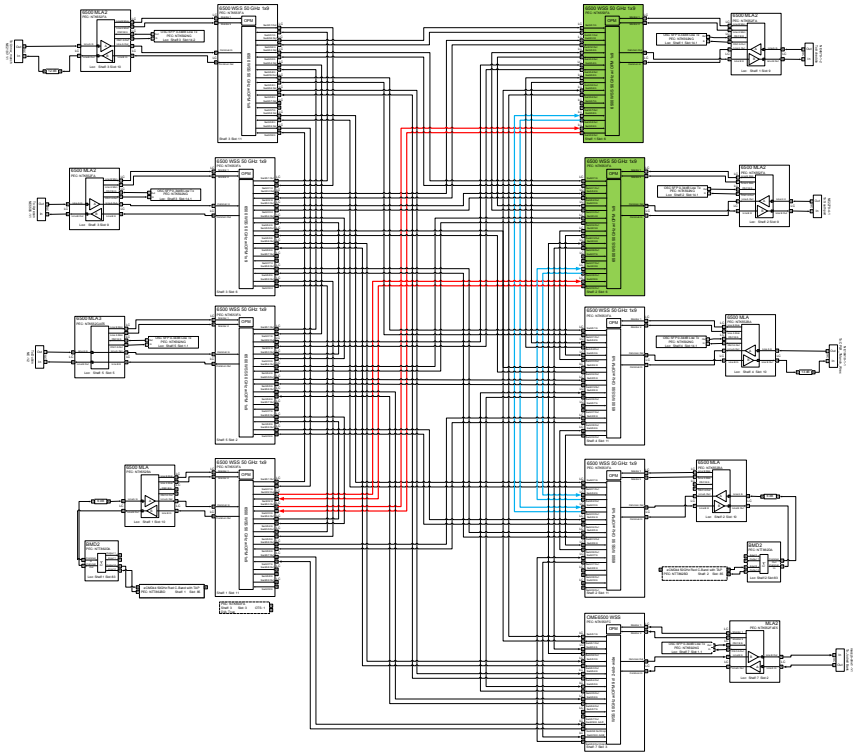
Flexgrid and colourless add/drop

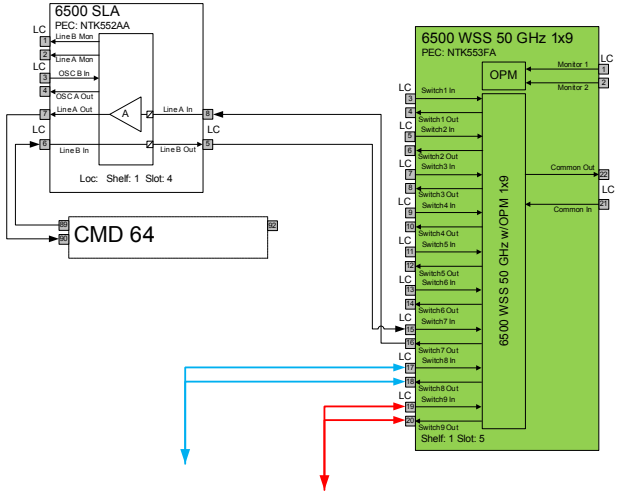
- Existing WSSs all 50GHz fixed grid with wavelength-specific add/drop mux/demux (CMD44)
- 400Gbit/s uses 56Gbaud in 75GHz
- ‘Simple’ matter of replacing fixed-grid WSSs with flex-grid and introducing colourless add/drop.

Flexgrid conversion



Not quite colourless



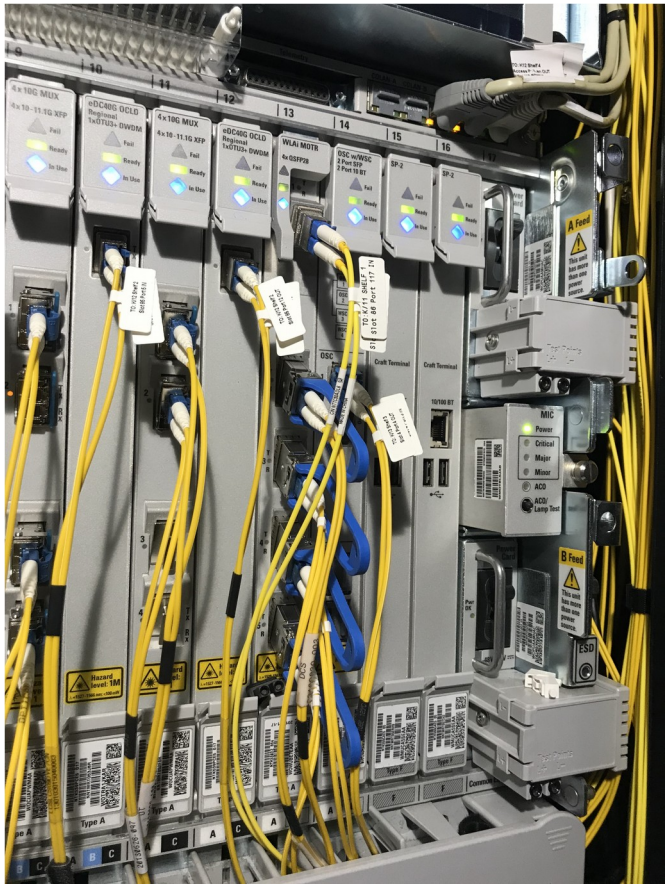


If only it was that easy…

- Network-wide software upgrade beforehand
  - Not just one, but two: 10.2 -> 11.2 -> 12.1
  - OneControl
- Change in licensing approach for 12.1
  - License alarms after upgrade
  - Deploy external license server
- Different power calculations between releases of software
  - Existing services entered a “waiting for power” state after upgrade

It was all worth it in the end…

- Initially provisioned Manchester – Leeds with 3x100G clients
  - Wavelength came up at 400G
  - Able to add fourth service and run it at 400G



Where next?

- Migrating the rest of the network to flexgrid
  - Just completed
- Deploying true colourless add/drop
  - Next up
- Newer cards for the longer spans
- 400GE clients
  - A whole other talk… on QSFP56-DD, etc

Questions?