



# Upgrading to STM-256

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JANET(UK)



# What is JANET?

- UK's National Research and Education Network (NREN)
- Connects educational establishments to each other, the Internet, and other R&E networks around the world
- Serves schools, colleges, universities and research facilities
- Potential userbase of 18 million

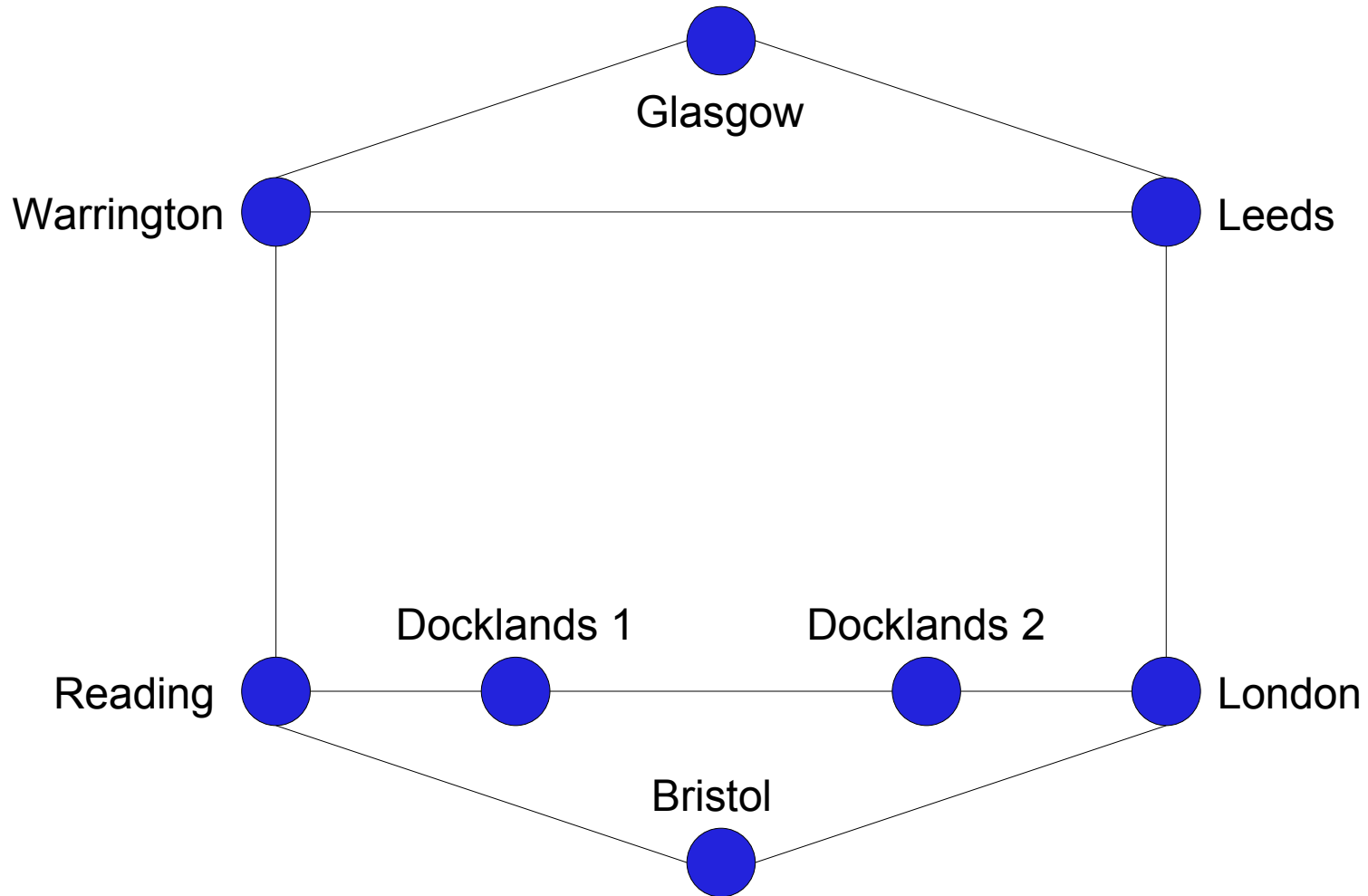


# What is JANET?

- Backbone and regional networks (RNs)
  - Sites connect to RNs
  - RNs connect to backbone through two diverse fibre routes
- Two PoPs in London Docklands with most of the external connections (transit, peering)
- This talk concentrates on the backbone



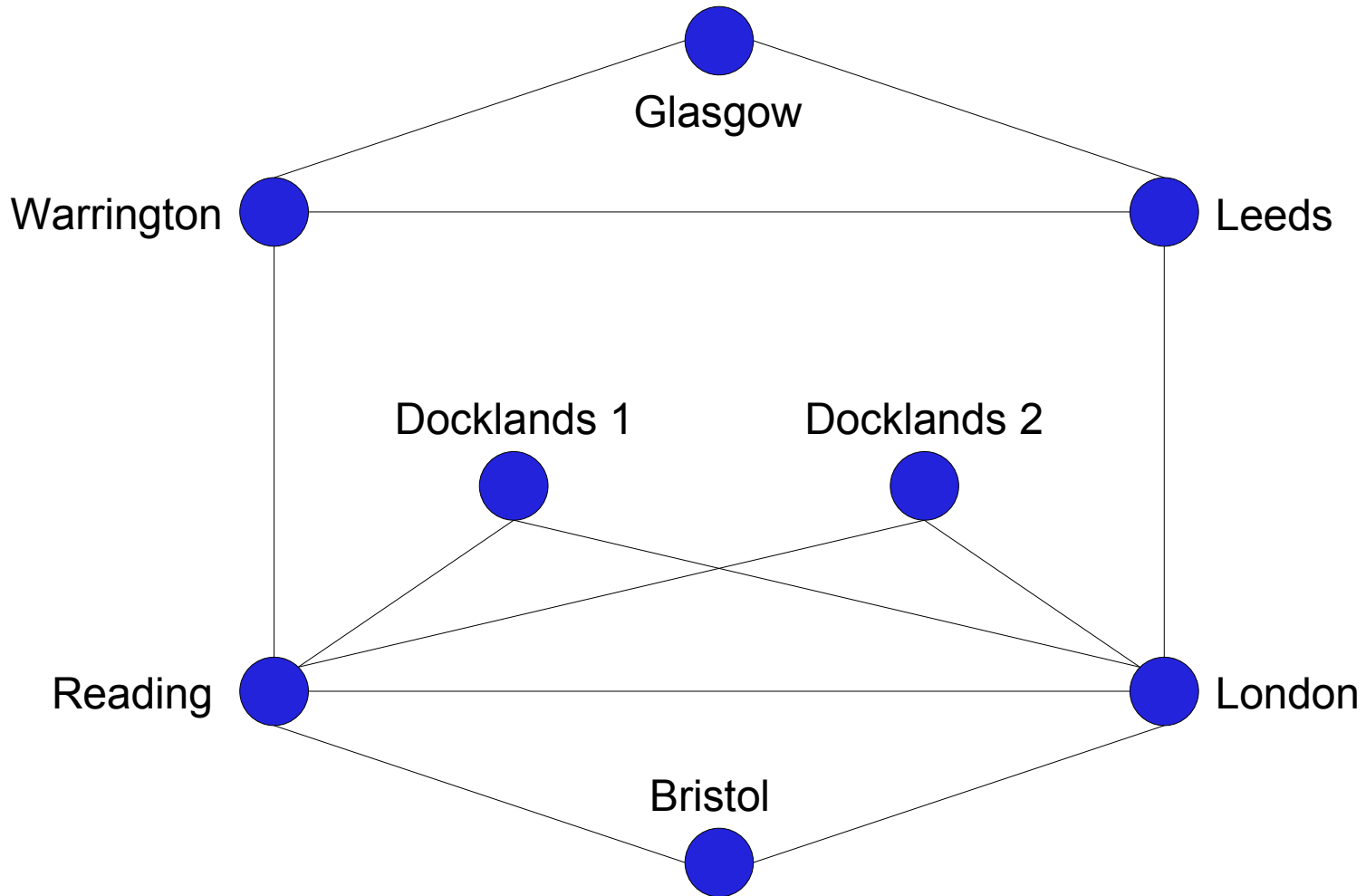
# JANET (Fibre)



# JANET (Fibre)



# JANET (Circuits)





# What is JANET?

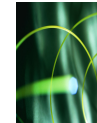
- Dedicated optical equipment
  - Ciena CoreStream Regional & CN4200
- Dedicated fibre
- Optical layer managed by Verizon Business
  - We have read-only access to OnCentre
- Most circuits are SDH
  - We like alarms, diagnostics and error counters provided by SDH

# What is JANET?



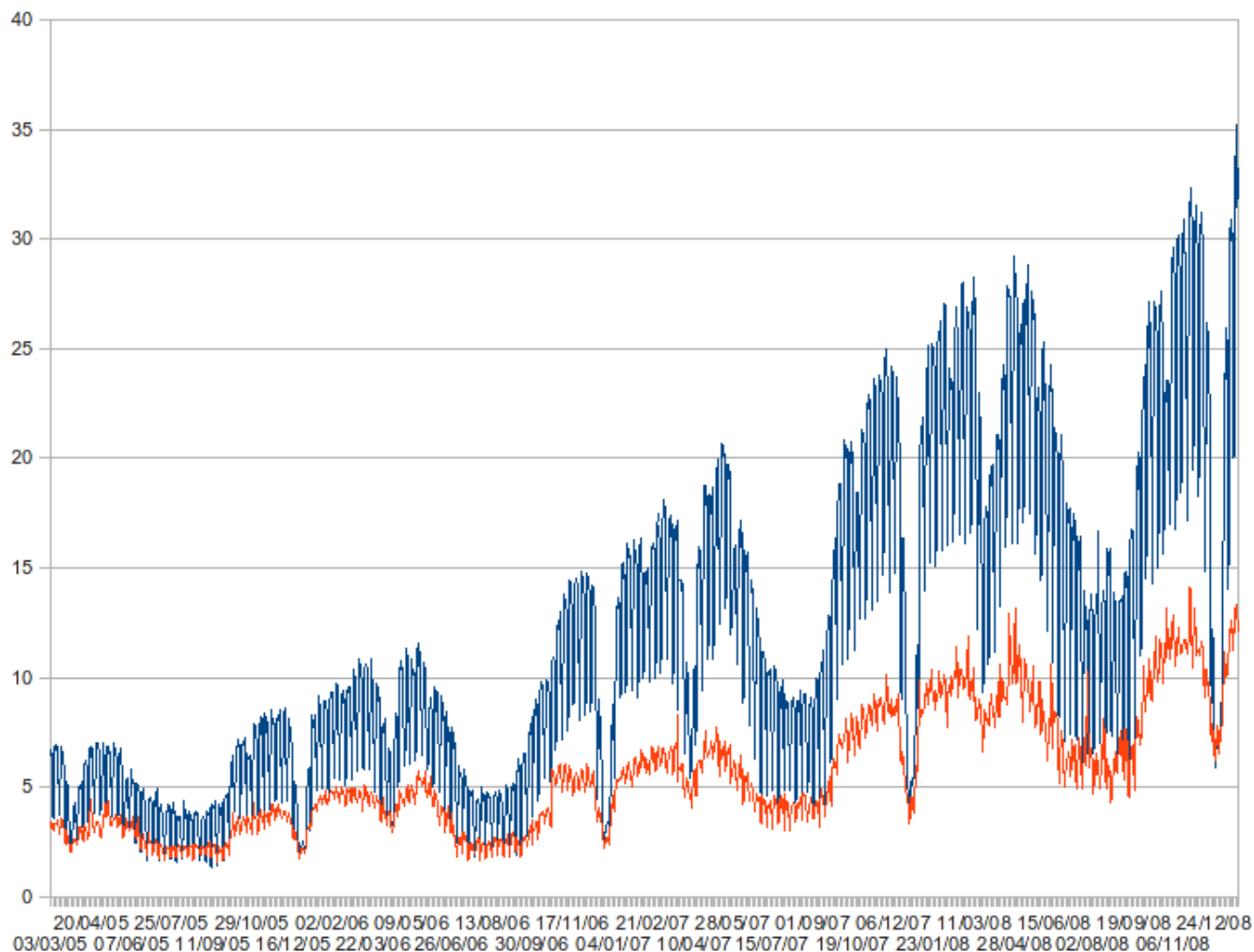
- Juniper T series routers
  - Quite a few Ciscos too
- IP layer managed in-house





# Why increase speed?

External  
Traffic (Gbps)



# What were the options?



- Trunk multiple links
- Faster circuits



# Why choose STM-256?

- Client (router) side:
  - We like simplicity
    - Prefer one link to multiple
  - Some of the scientists generate large flows
    - May overload a particular link in a bundle



# Why choose STM-256?

- Line (optical) side:
  - Don't want to squander wavelengths that researchers may need
- As an R&E network, we're expected to be on the 'leading edge.'
  - Within reasonable constraints
  - Whilst still keeping a stable network, of course.



# Equipment specification

- Ciena cards made by Stratalight
- First generation card
  - PMD tolerance: 2.1ps DGD
  - Duobinary encoding
- Second generation card
  - PMD tolerance: 2.5ps DGD
    - 8ps with compensation
  - DPSK encoding



# Fibre characteristics

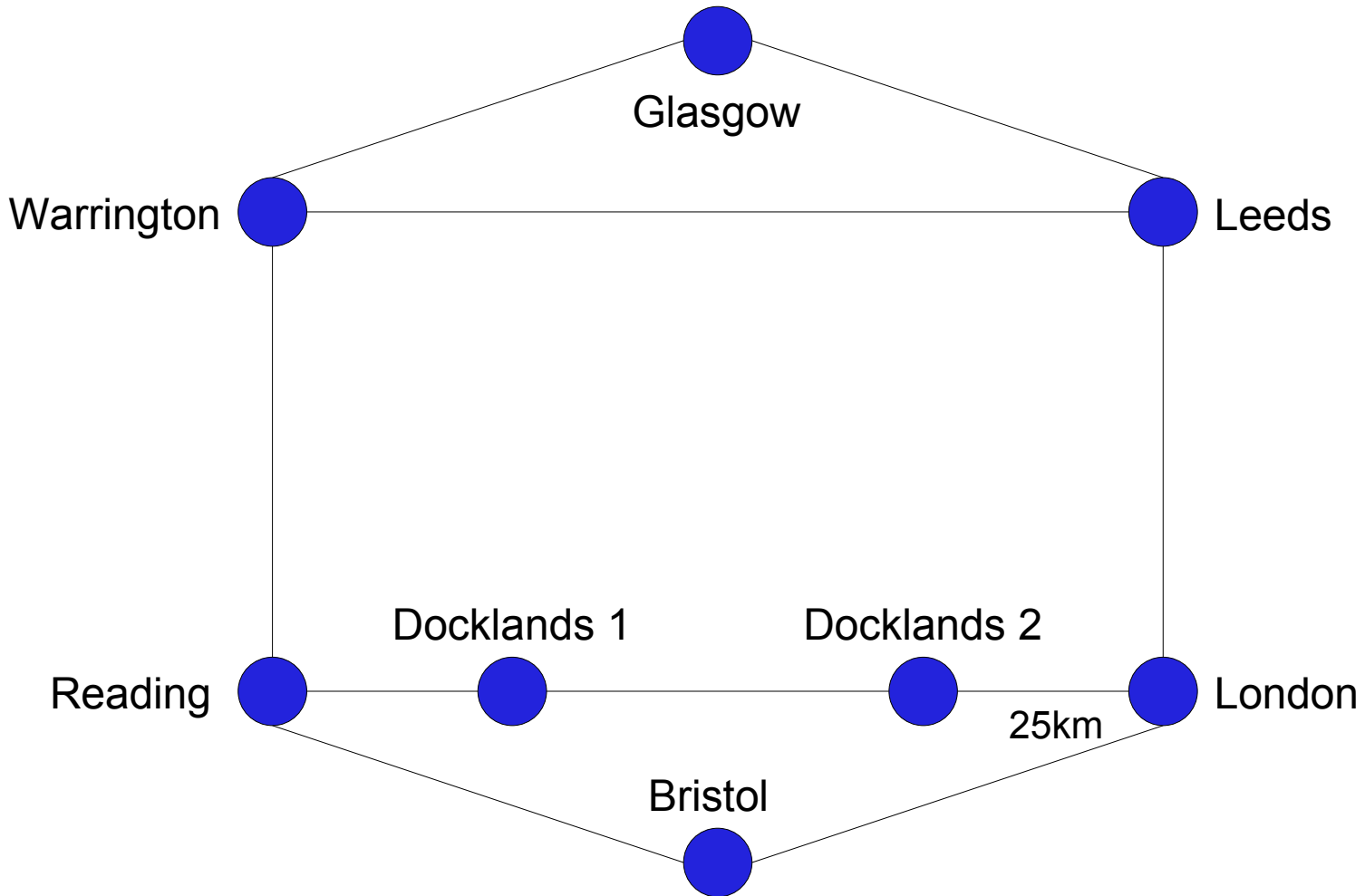
		A to B	B to A
	Length (km)	DGD (ps)	DGD (ps)
London – Telehouse	25.10	1.44	0.47
London – Telecity	28.30	1.45	0.49
Reading – Telehouse	116.50	0.75	1.64
Reading – Telecity	113.30	0.74	1.64
London – Leeds	379.68	15.46	13.66
Reading – Warrington	322.85	10.01	11.52
Warrington – Leeds	107.00	0.15	1.31
London – Bristol	252.94	2.03	1.89
Bristol – Reading	150.00	1.10	0.84

# Step 1: Trial



- Split into trial and two phases.
  - Trial: Telehouse to London

# Trial







# Trial: June 2007

- Started with a separate fibre in same bundle as primary route (~25km)
- Ciena 1<sup>st</sup> generation cards
- Loaned Juniper interfaces
- Logistics more complicated than technology.

# Trial



- One month later, wavelength multiplexed onto backbone fibre
- No problems.

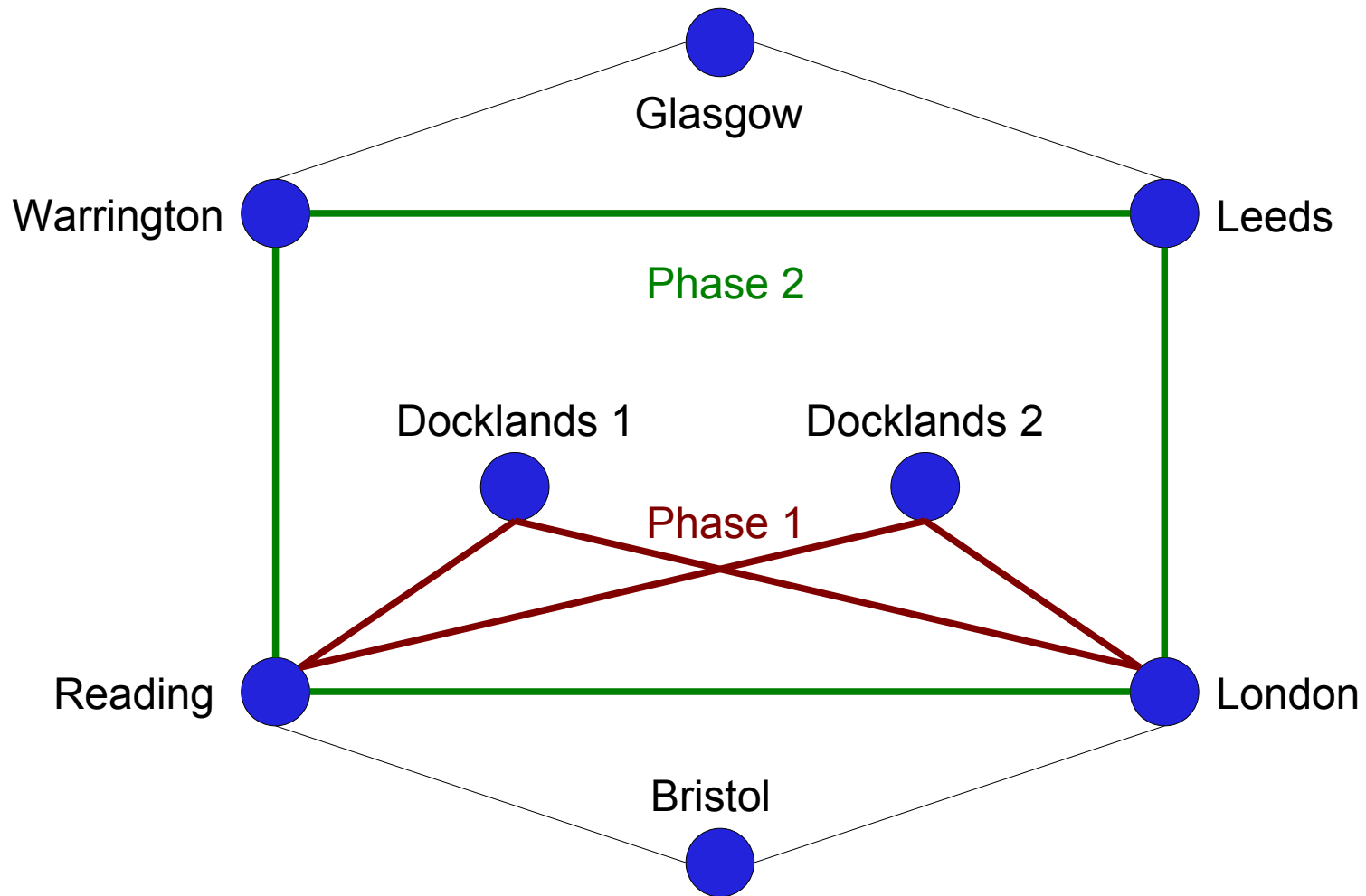


## Step 2: Production

- Phase 1: Docklands (Telehouse and Telecity) into London and Reading
  - All could be done with the Ciena equipment
- Phase 2: London and Reading north to Leeds and Warrington
  - Needed to find an alternative solution



# Production





# Phase 1: June 2008

- 2<sup>nd</sup> Generation Ciena cards
  - Became available 1Q08
- Required software upgrades to existing Ciena shelves to work with new management software
  - Not always so smooth
- September 2008



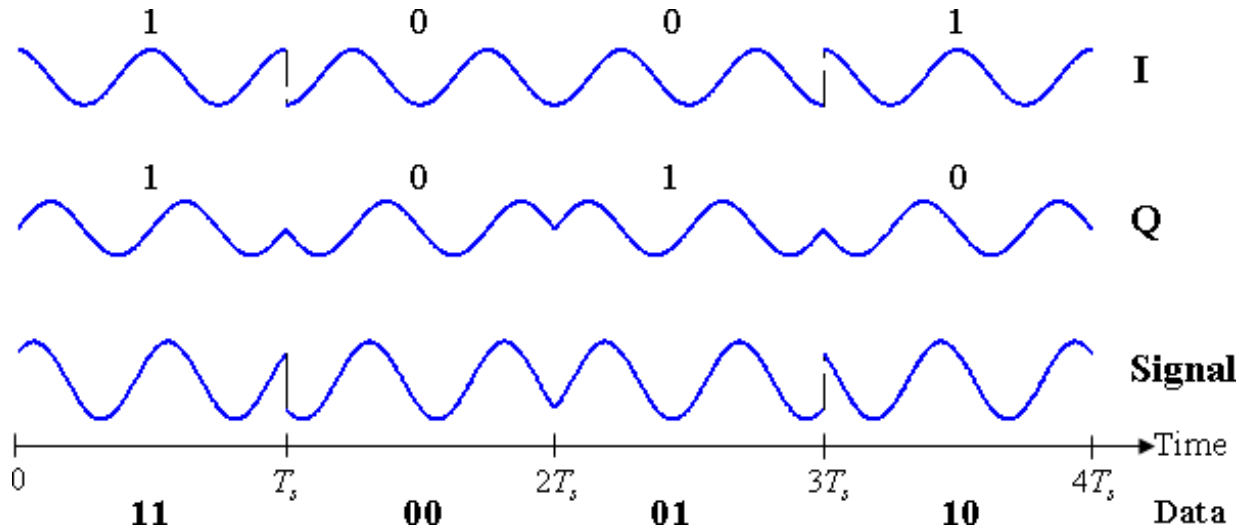
# Phase 2: Nov 2008

- Outside specification for Ciena cards
  - Even with external dispersion compensation
- Alternative solution: Nortel
  - Uses Polarisation Multiplexing Differential Quadrature Phase Shift Keying (POLMUX-DQPSK)
- Carried as 'alien wavelength' on CoreStreams



# POLMUX-DQPSK

## Quadrature Phase Shift Keying



2 bits per symbol,  $\sim 1\text{bit/s/Hz}$

Diagram by wikipedia:User:Splash



# POLMUX-DQPSK

- Two DQPSK signals sent down the fibre at the same frequency with different polarisations
- 2 x 2 bits per symbol = 4 bits per symbol
  - ~2 bit/s/Hz
- Can carry 100Gbit/s signals (112Gbit/s for ODU-4) within neighbouring 50GHz ITU grid channels





# Phase 2

- Additional optical equipment at four core points of presence
  - Expensive
    - “Not our problem,” we'd had 40Gbit/s in our contract.
  - New management systems
  - New management procedures
- December 2008



# Problems

- Card failure shortly after commissioning
  - Backed off to 4-hour spares replacement
  - ...only no card in stock
    - ...or in the country
      - ...or in the continent
  - Had to be sourced from manufacturing
  - Best part of two weeks



# Problems

- Still had STM-64 circuit to back it up
  - Just in case there were teething problems
  - Still had sufficient capacity
- Took several more weeks until sparing was completed
  - Followed up contractually



# Problems

- Mainly logistical rather than technical
  - Weekly phone conferences for six months

# Routing kit



- So far, only talked about circuits
- What about the routers at either end?



# Routing kit

- Started off with Juniper T-640s
  - Eight chassis slots
  - 40Gbit/s per slot
- Some routers would have four STM-256 circuits
  - Half the chassis just for core links
- Upgrade to T-1600s!



# Routing kit

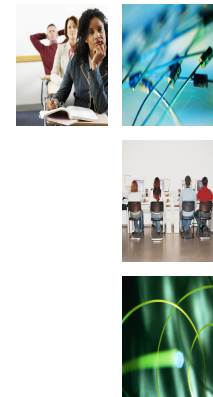
- T-640 to T-1600 is an “in-service” upgrade
  - Needs an extra DC feed per PEM
  - Telehousing providers worried about power and cooling
  - Power rating increased from 6.5kW to 9.1kW
- Lots of talking to convince providers we wouldn't be running at maximum power draw
  - Actual draw ~3kW



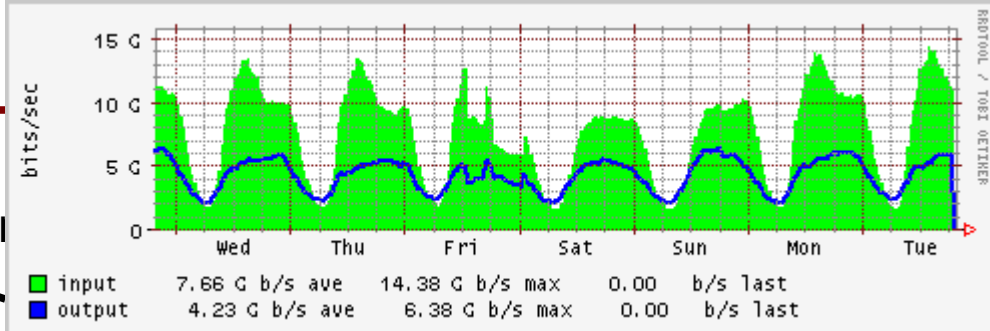
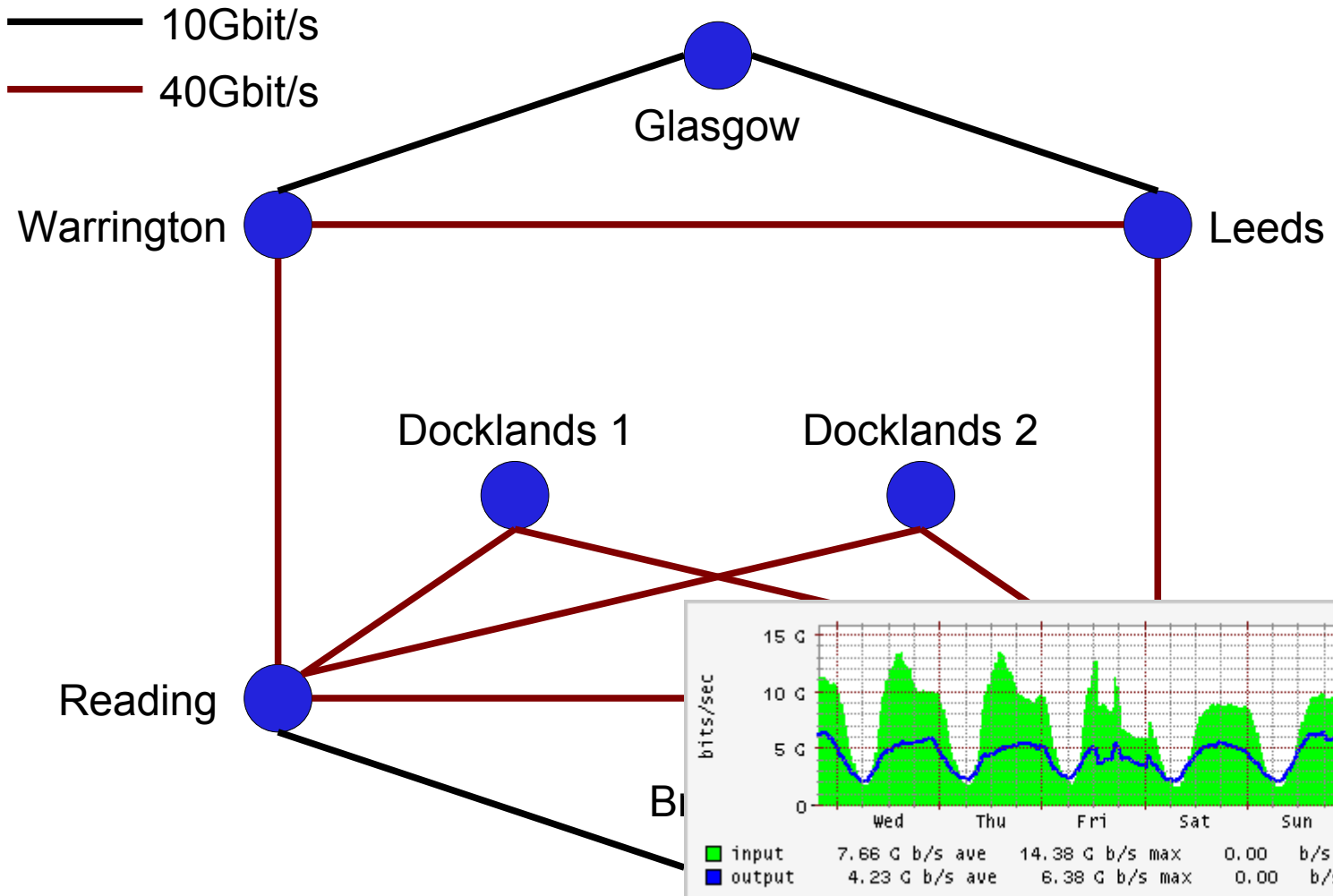
# Routing kit

- First time links were brought up, interface card needed to be taken offline and brought online again to work
  - Not happened since
    - Even after circuit outage
    - Until earlier this week after some reprovisioning work...
- Otherwise, not much to report
  - Generally it “just worked.”

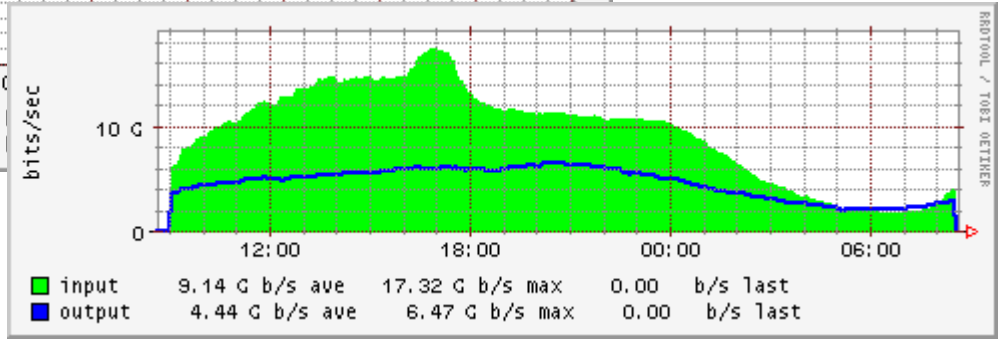
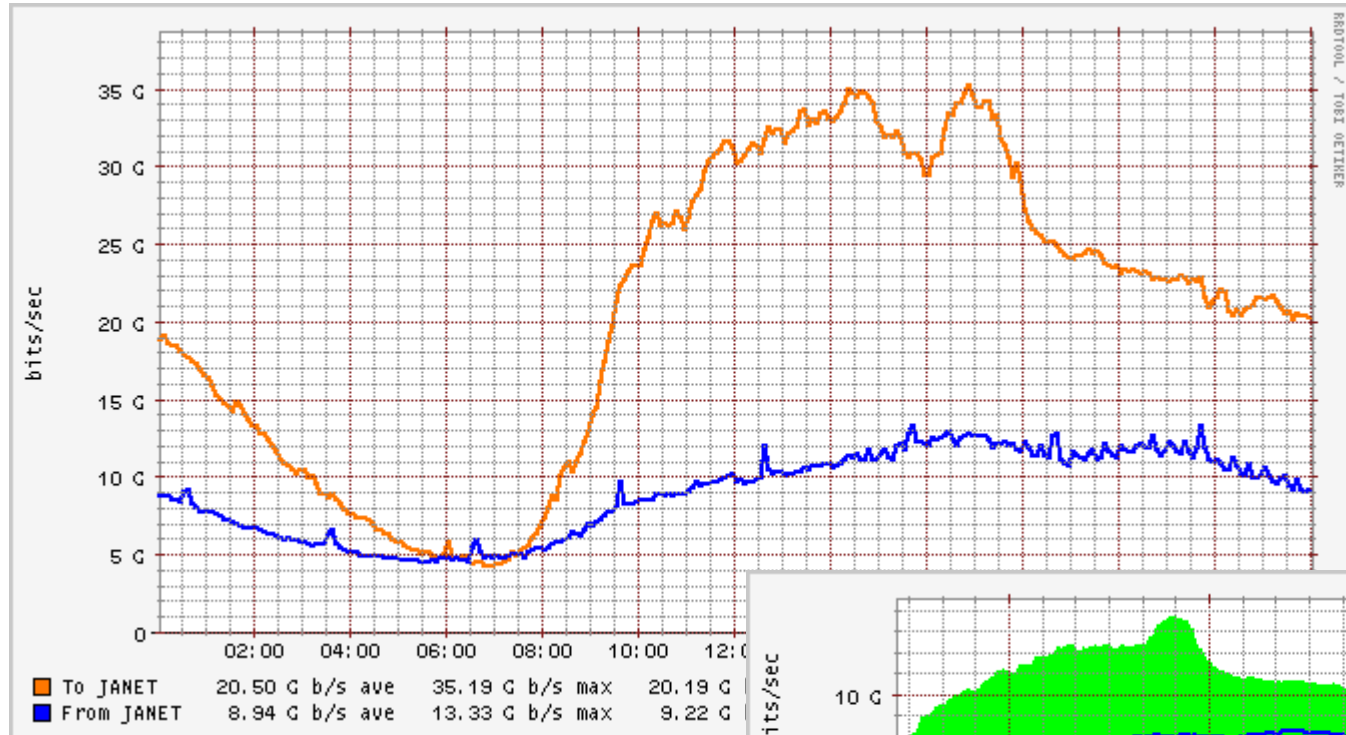
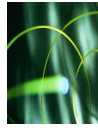




# What do we have now?



# US Inauguration





# Should you go 40G?

- I can't tell you that, but...
- 40G has very strict fibre requirements
  - Aim is for 100G requirements to be closer to 10G requirements
  - 'Coherent detection' will help things further



# Should you go 40G?

- 40G SDH prices haven't dropped significantly
  - Some large deployments in 2008 may help
    - Maybe not, these have mainly been 'line side' deployments, multiplexing 1GE/2.5G/10G circuits onto 40G wavelength
- SDH reaching the end of its life
- 'Carrier Ethernet' the way forward



# Should you go 40G?

- 100G standardisation marches on
  - We've started looking at it for technology trials soon
    - Line side available before client side
    - Considering deployment in 2011-2012
  - But... will your chassis route/switch 100G/slot?
- 40G is here now



# Credits

- Verizon Business worked very hard with us to make this happen
- Ciena
- Nortel
- Alcatel-Lucent and Juniper



# Questions?