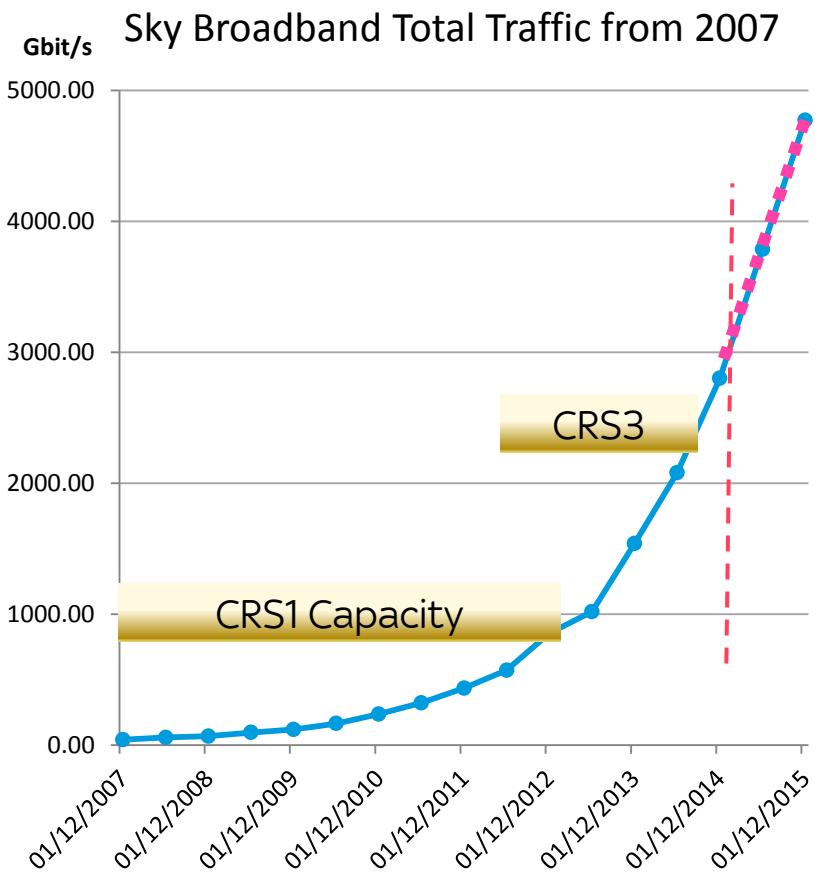
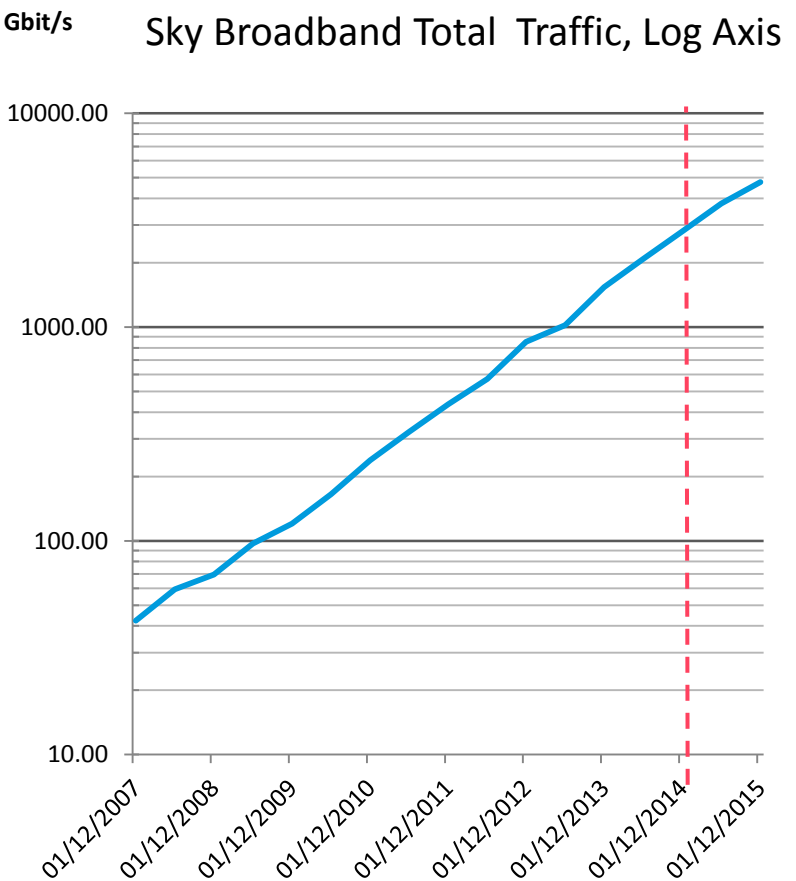
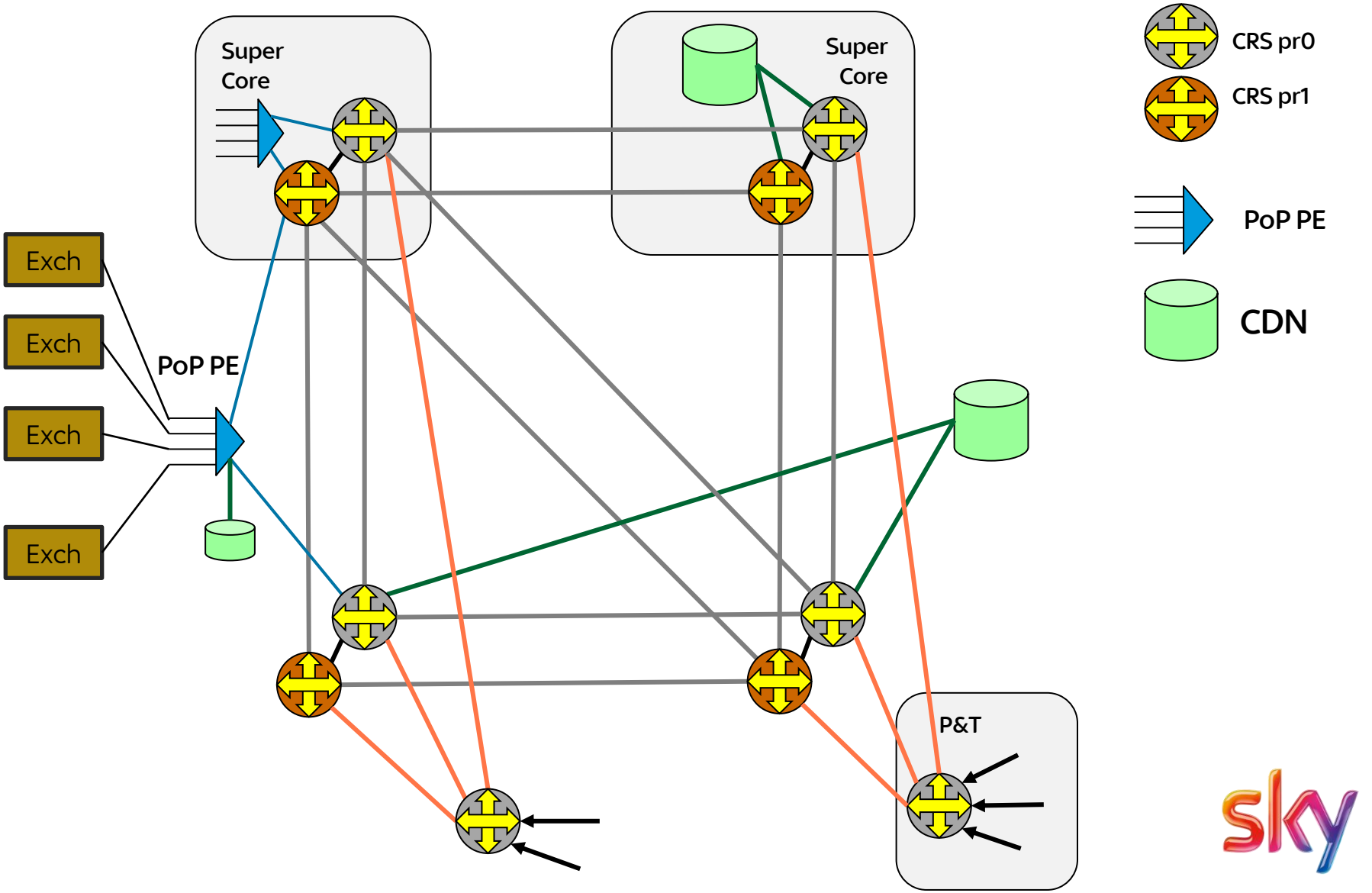

Sky NG Core Network
Keeping ahead of the Data Wave
Tim Rossiter – Sky Network Services
Storm Surfers
sky 3D

Historical Traffic Growth over 7 Years





Sky Network Structure (Simplified)



Resilience and Provisioning Policy

Resilience

- Dual Rings
- Dual feed to each PoP
- 2 or 3 Entry points to each Super-Core site
- Dual P&T sites
- Multiple CDN (1:N)

Dimensioning

- Serve peak traffic in the event of a single major failure
  - Major failure includes loss of one entire site or fibre (up to 80 layer 3 paths)
- Biggest P-Router capacity =~ Total traffic served
  - Worst Case Failure
  - Partial Slot usage
  - Range of P-Router sizes

Core Router Evolution

2005 Initial Build Cisco CRS1

- 16 Slots, 40Gb per slot => 640 Gb per chassis
- Traffic 50G
- Multi-Chassis capable

2011 Introduced Cisco CRS3

- Single Chassis strategy
- 16 Slots, 140Gb per slot => 2240 Gb per chassis
- Traffic ~350G

2013 - RFI for New core router

- Start of 2014, Largest CRS3 Node nearing Capacity

Properties of NCS6000 and ASR9K

ASR9922 for Peering and Transit

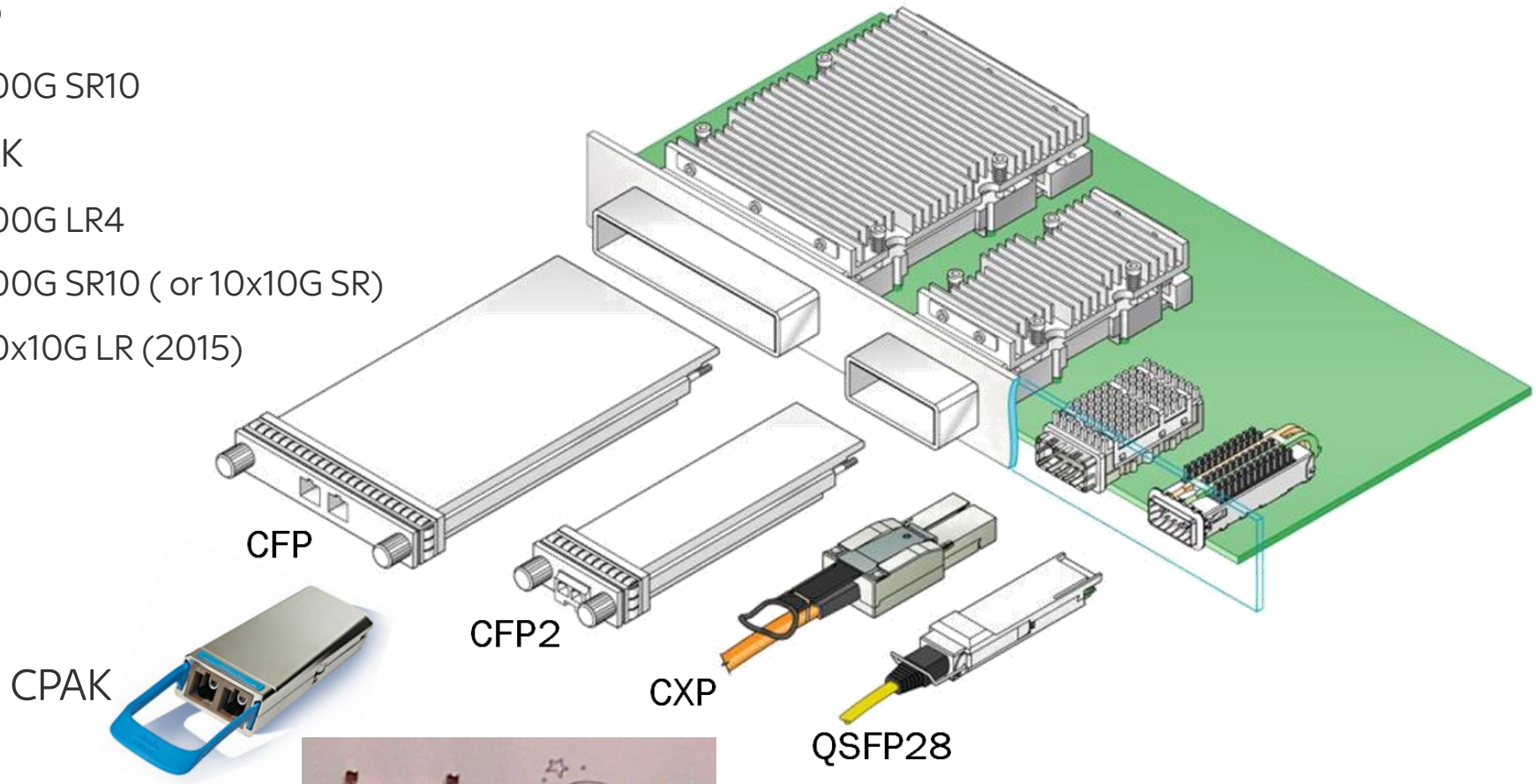
- Already available in 2014, 20 Slots
- Currently: 36x10G or 2 x 100G CFP (7.2Tb node)
- 2015 : increase to 8 x 100G per slot (16 Tb node)

NCS6000 for Super-Core

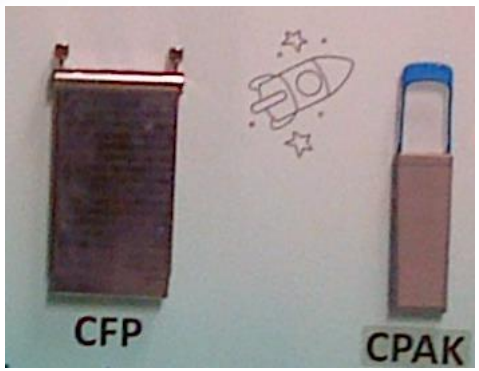
- 2014 H2 Product
- 8 Slots, 1Tb per slot => 8 Tb node
- 10 x 100G ports per slot or 10 x (10 x 10G)
- Alternative 60 x 10G SFP+ Card
- Roadmap 2+ Tb per slot => 16+ Tb node
- Simple Multi-chassis
- *Sky first (and only) UK user*

100G Optics – CFP, CXP & CPAK

- CXP
  - 100G SR10
- CPAK
  - 100G LR4
  - 100G SR10 (or 10x10G SR)
  - 10x10G LR (2015)



Roughly to scale

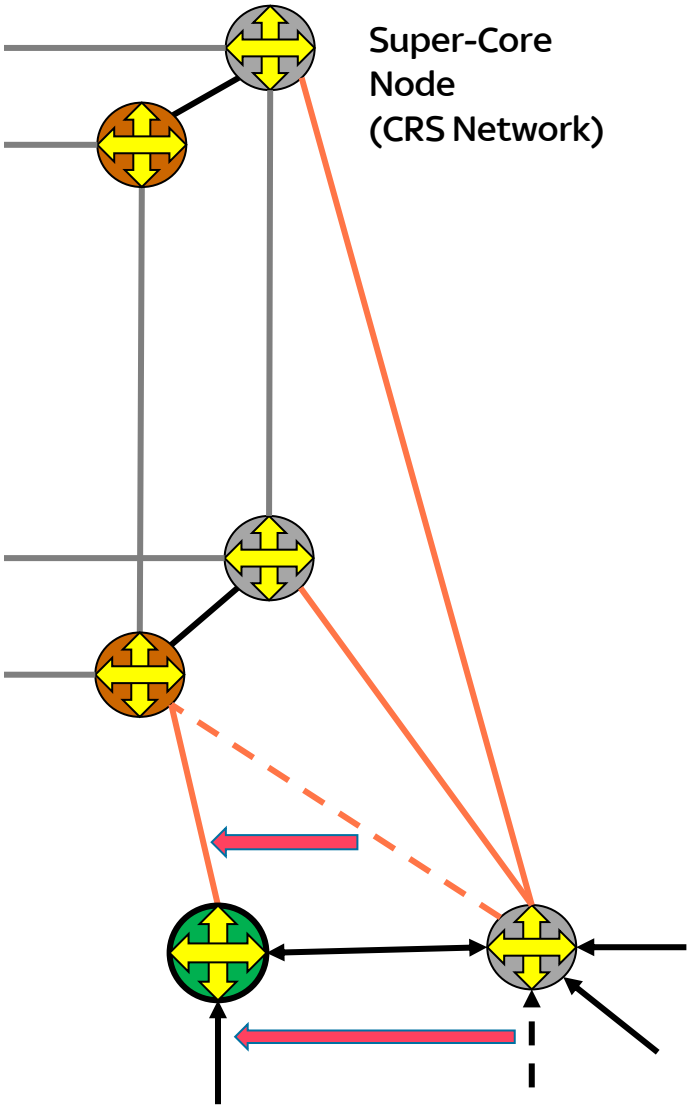


Diversity Constraints - 8 slot vs 16 slot

- **CRS Rules – Segregated Connection Classes per Slot**
  - Local connections , Remote PE, Remote Super Core connections etc.
- Required many slots with small initial usage per slot
- Easy to accommodate with 16 slots & Card capacity 40G or 140G

- **NCS6000**
- 8 slots with very large slot capacity
- Simple slot class segregation impossible, wasteful
- Re-formulated slot diversity whilst preserving network availability
- 3 – 4 slots max per node

P&T Migration – First Step (Early 2014)



- P&T First to Exhaust, early 2014
- ASR9K chosen for new P&T

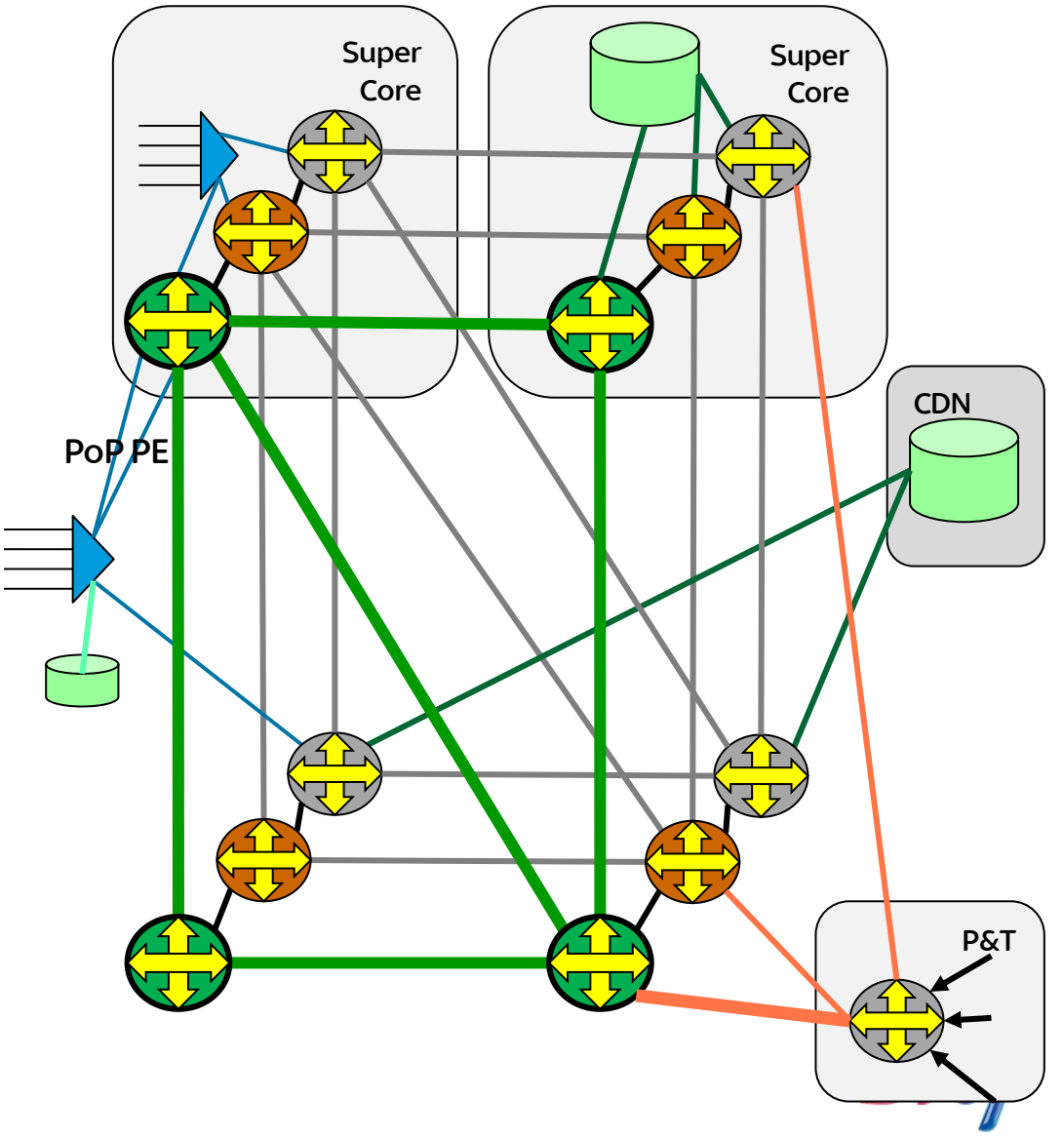
- Overlay P&T not possible owing to cap on 10G transmission and core router ports
- Multi-step migration of external and internal connections
- Each step capacity & failure modelled to ensure no overloads

Migration of Core Routers - Step 1,2,3

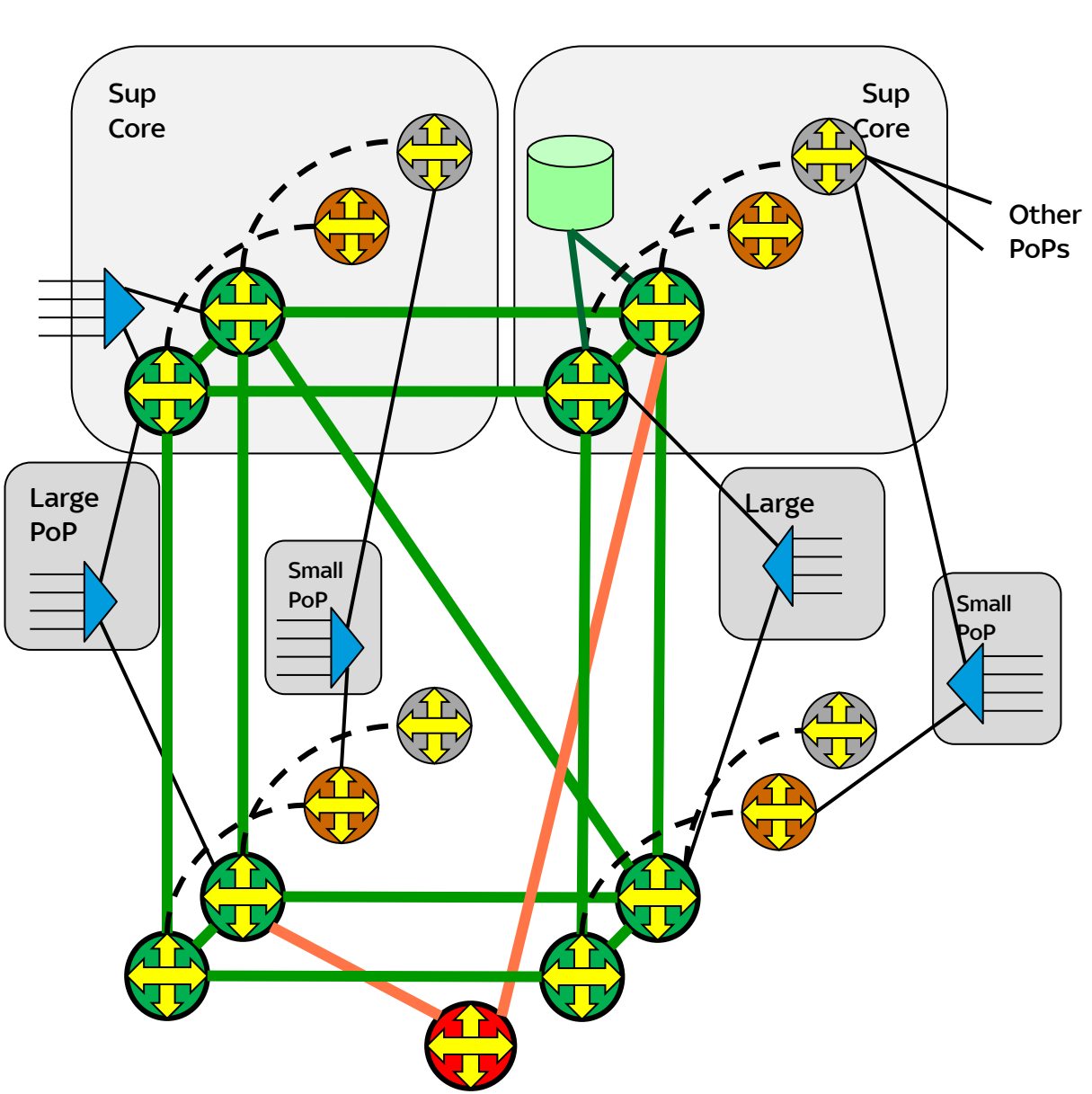
- CRS rings close to capacity (for worst case failure)

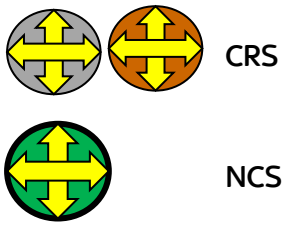
- Procedure
  1. Overlay first CRS Ring with NCS New super-core links N x 100G
  2. Triple connection of some sources
  3. Migrate some sources and PoP PE
- Model multiple route complexity

- PoP PE still N x 10G
- 10 x 10G LR CPAK not available
- Temporary 60 x 10G SFP+ cards
- Limit 60 x 10G card usage



Penultimate Stage, CRS as distribution node



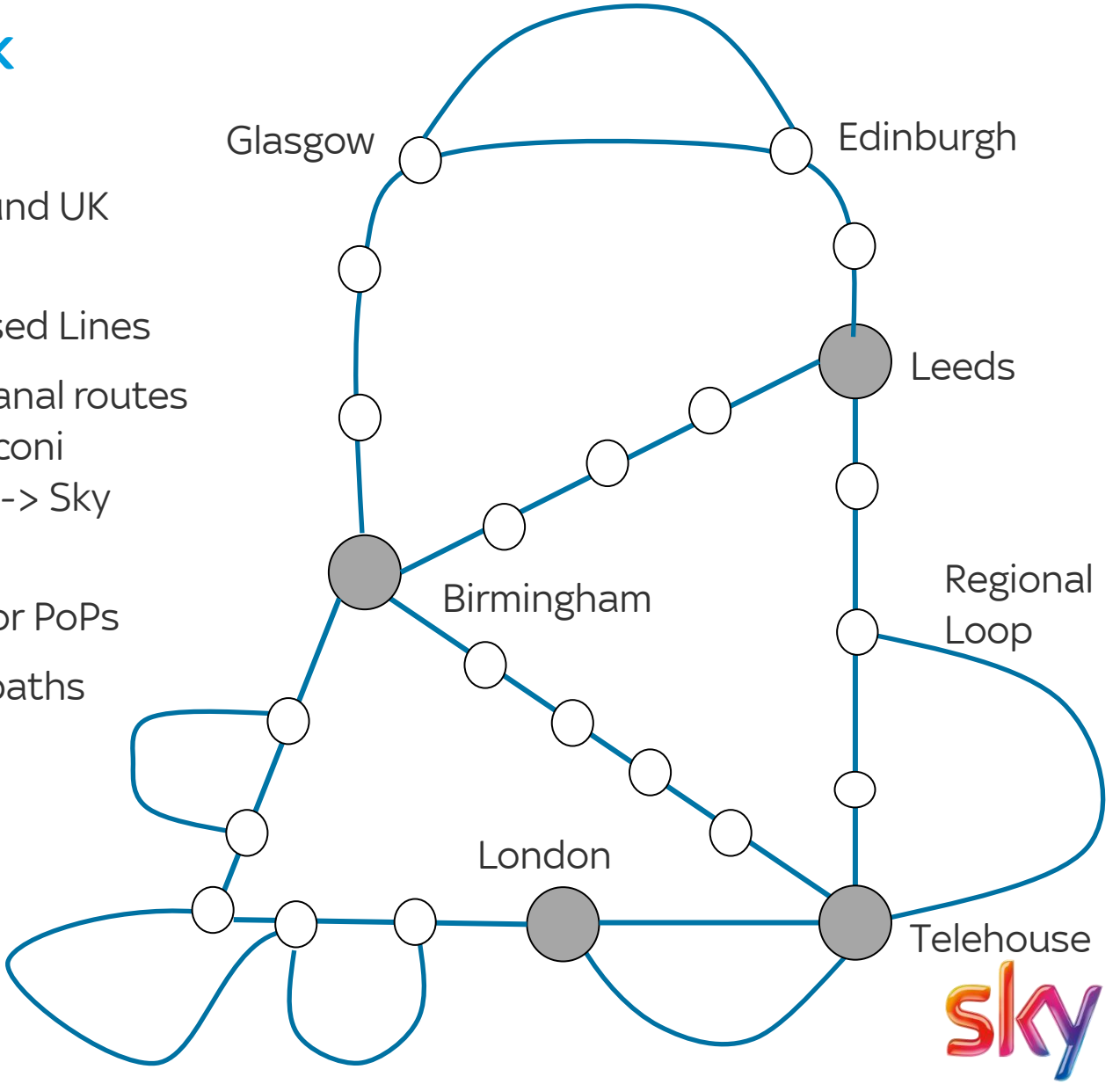


- 2014 Q2-Q4 - Migrated >50% traffic to NCS6000, parallel operation
- End 2014, Remaining PoP stay on CRS,
- CRS Re-purposed as Aggregation node
- 2015, Remaining PoP will move to NCS

Optical Network

- ~7000km Fibre paths round UK
- Mainly Own Fibre
  + Some Fibre Swaps, Leased Lines
- Much of Network along Canal routes
  British Waterways + Marconi
  -> Ipsaris -> Easynet -> Sky

- Core links: 5-10 x OADM for PoPs
- Regional Loops off main paths
- Almost no regeneration

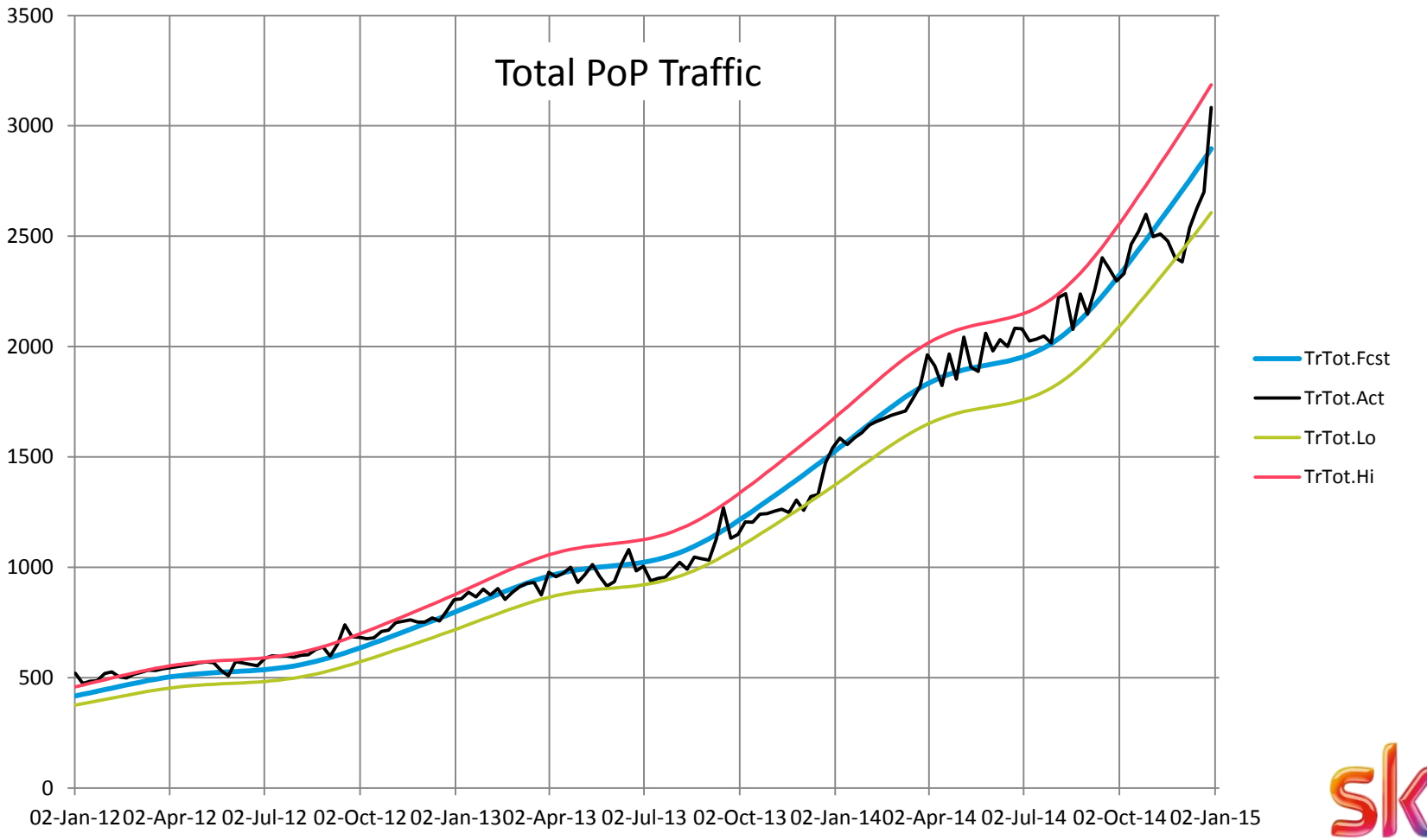


Optical 100G & Eliminating Regeneration

- 88 wavelength per fibre, Alcatel System
- Core links with OADM for PoPs en route.
- 2011
  - Nearing 10G λ Exhaust
  - Introduced 100G λ with 10 x 10G presentation
  - Minor OADM Upgrade - New power monitor for 100G
- Mid 2014: Direct 100G connections between new NCS core routers
- End 2014: All super-core connections on 100G
- Added second fibre
- 'Express' links – Pure 100G, No DCM
  - 100G Dual-Pol coherent & Electronic DCM => Improved optical performance
  - Eliminate all regeneration
  - Additional capacity
- Using 2 x 100G Transceiver. 50GHz Grid, 16 QAM

Planning Process

Initial Data - Traffic forecast



Planning Process

Initial Data

- Traffic forecast => Point to Point Demand
- Network Structure Database => Sites, Nodes, Links
- Optical path map => Layer 3 -> Layer 1 mapping
  - Shared Risk Groups, Regen count

Network Modelling - Cariden MATE planning tool

- Simple, fast, good interface to other processes/data
- Multiple failure scenarios (Failure: Node, Site, Circuit, SRLG)
- Added external framework for changing networks

Post Processing – Configuration, Cost, Power

- Optical Link Capacity requirements
- Full Nodal configuration (BoM) generated automatically
- Compare forecasts against committed plans in database

Operational Issues and Observations

Testing - Full testing of two new products for several months

ASR9K Deployment

- Mature product - No Issues

NCS6000 Deployment

- Built 100G supercore network, connect new nodes
- Initially - One PoP, One leg ~ July 2014
- Rapid migration of remaining large PoPs by Mid Dec 2014.
- In service Software upgrades
- Few minor software issues, resolved. (expected with new product)

Acknowlegements...

Rapid, well executed program through 2014

Made Possible by Great Team within Sky Networks

- Network Architecture & Planning - Forecast, Modelling, Migration Planning
- Network Development – Testing, Verification, Product Advice
- Network Implementation - Configuration, Installation
- Optical Team - 100G Optical Deployment & Migrations
- Network Operations - Many overnight migrations
- PMO - Complex Project Management, Juggling Resources
- Cisco - Early adopter support, Expedited delivery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