JANET Lightpath – Core Infrastructure Replacement

D Tinkler
JANET Network Operations Centre

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Lightpath Definition

• Lightpath from JANET institution to another JANET institution / International Partner
• Three Components
  • JANET Institution to JANET Regional Network Entry Point (RNEP)
  • Core, JANET RNEP to JANET RNEP/International gateway
  • JANET RNEP/International Gateway to JANET Institution/International Partner

Lightpath Core Options

• JANET(UK) Managed Infrastructure
  – Available at 1 RNEP only at present
  – Speeds from 100 Mbps to multiple Gbps
  – Faster provisioning Speed
• JANET Infrastructure
  – Provided under Verizon Contract
  – Used for all 10Gbps Lightpaths
  – Available at Both RNEPs
  – Provide 1Gbps or 10Gbps

Reasons for Change

• Issues with original core infrastructure
• Ethernet technology developments
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Original Lightpath Core Infrastructure
- 10Gbps SDH
- Equipment at RNEPs 1GE/STM-16 interfaces
- Installed 2004

Infrastructure Issues
- High cost
- Complex provisioning
- Separate management system
  - Lightpath usage statistics not easily available
  - No lightpath requirement for SDH circuits
- Coming up to 5 years old
  - Some regional equipment end-of-life

Design - Scope
- Provide lightpaths to all RNs
  - 1 nominated RNEP per RN
  - Initially RNs with existing lightpaths
- Use JANET(UK) managed Infrastructure whenever possible
- Consider extension to other RNEPs
  - Based on lightpath demand

Infrastructure Design
- Scope
- Design Principles
- Topology
  - Key Design Principles
  - Topology Selection
- Provisioning Technology
  - Key Design Principles
  - Technology Selection

Ethernet Developments
- Ethernet Technologies
  - Carrier Ethernet/Metro Ethernet development
- Pilot Project in Regional Network
  - SDH equipment replaced by Ethernet switches
  - Vlan provisioning
- Benefits
  - Significant cost advantages
  - Network management integration
    - OpenView
    - Netsight

Design - Principles
- Speed: 100Mbps to multiple Gbps
- Provisioning
  - Paths follow a specified Route
  - Guaranteed bandwidth
  - Integrate with RN provisioning
  - Fast provisioning speed
- Service availability
  - 99.5% (based on JANET infrastructure)
  - Path resilience - institution to institution (2 Lightpaths)
  - Initially no core resilience
- Use existing NMS Tools
  - Openview
  - Netsight
Infrastructure Design

- Topology Design
  - Key design principles
  - Initial topology
  - Future topology
- Provisioning Technology
  - Key design principles
  - Candidates
    - Carrier Ethernet
    - Ethernet over MPLS
  - Summary/Selection

Design - Topology

- Key Design Principles
  - Resilience
    - Retain existing circuits & ring topology
    - Support connection to RN nominated RNEP
  - Equipment at all JANET Core Pops
  - Integrate with RN provisioning technologies
    - 10GE circuit to RNEP
    - RNO to provide equipment at RNEP
    - Lightpaths identified by VLANS

Current Lightpath Core Topology
- Uses Existing Circuits
- Supports existing lightpaths

Future Lightpath Core Topology
- Extend to All RNs
- Enhance core capacity to meet demand

Provisioning Technology - Key Design Principles
- Paths that follow a specified route
- Guaranteed bandwidth
- Transparent to customer traffic
- Integrate with RN provisioning
- Standards based and widely adopted technologies.

Technology Options
- Ethernet over MPLS RFC 4448
  - Traffic Engineering Extension using RSVP RFC 3209
- Carrier Ethernet
  - PBB – Traffic Engineering (PBB-TE) 802.1 Qay
  - Provider Backbone Bridging (PBB) 802.1 ah
  - Provider Bridging (PB) 802.1 ad
- IP Tunnels
- Ethernet
Technology Comparison

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Project Implementation

- **Core equipment**
  - Procurement on Call-Off Contracts
  - Juniper MX960 Ethernet Routers
    - Delivered Dec '08
- **Regional Network equipment**
  - Specified by RNs
  - Funded by JANET(UK)
- **Core installation and configuration**
  - Install - Dec '08 / Jan '09
  - Configuration – Jan '09/Feb '09

Lightpath Migration

- 9th March
  - Core/Regional links changed from SDH to 10GE
  - Core/regional links connected to new core equipment
- 10th March
  - Regional Networks connected and configured equipment
- 11th March
  - 20 of 23 Lightpaths in Service
- Thanks for Successful Transition 😊

Upgrading to STM-256

Rob Evans
JANET(UK)
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.

Deployment

- Existing optical network was Ciena
  - However, Ciena’s 40G shelf couldn’t handle some of the JANET fibre
- 40G Deployment split into two phases
  - Docklands to London and Reading
    - Ciena
  - London and Reading north to Leeds and Warrington
    - Nortel

Production

- Glasgow
- Leeds
- Warrington
- Reading
- Bristol
- London

Docklands 1

Docklands 2

Phase 1

Phase 2
Phase 1: June 2008

- 2nd 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 Quadrature Phase Shift Keying (POLMUX-QPSK)
  - Can fit >100Gbit/s onto a wavelength in 50GHz grid spacing
- Carried as 'alien wavelength' on CoreStreams

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

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 in London 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
What do we have now?

- 10Gbit/s
- 40Gbit/s

Dockslands 1
Dockslands 2

Leeds
Glasgow
Warrington
Reading

US Inauguration

Where next?

- 40G SDH is still expensive
  - Some large deployments in 2008
    - Mainly line-side, multiplexing 10G signals onto a 40G wavelength.
- SDH development is stopping
- "Carrier Ethernet" the transmission technology of the future
  - Or maybe straight IPoWDM?
  - Transponder-less systems?

Where next?

- 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
- 100G Fibre requirements less strict than 40G
- Routers that support > 100Gbit/s per slot are very rare.

Credits

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

A final note.

- No IPv6 talk this year
  - Nobody is happier about this than I am!
- The usual reminder
  - Don't wait for CS researchers to ask for it.
  - Start looking on IPv6 deployment as an infrastructure upgrade
    - Thickwire – FDDI – Gigabit Ethernet...
- Free pool of IPv4 addresses continues to run down
Questions?