Build vs. Buy: The NREN Network Connectivity Dilemma

Presented by Brian Savory
Business Development Manager, Optelian

UbuntuNet Connect 2012
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Brian Savory’s Bio

• Professional Experience
  ➢ Business Development Manager, Optelian
  ➢ Fibre based transport networks and wireless
  ➢ Built, operated and maintained private fibre optic networks

• Research & Education (R&E) Experience
  – Internet2 Involvement
    • Network Architecture, Operations & Policy Program Advisory Group
    • Program Committee
  – Southern Light Rail (SLR) - R&E Regional Optical Network (RON) in the Southeast, US – Internet2 Connector / commodity Internet provider
    • President & Executive Director
    • University of Alabama System RON connects campuses and NASA Marshall Space Flight Center to Atlanta
  – IEEAF / USAID / RENU Project in Uganda
    • Worked with Ed Fantegrossi / Don Riley
    • Learned many lessons about deploying R&E fibre optic networks in Africa

• Education
  ➢ BSEE, Georgia Institute of Technology
  ➢ MBA, Georgia State University
Abstract

• **Purpose** – to provide emerging NRENs with information on how to evaluate business case parameters and practical experience findings involved in making a decision on migrating from using carrier based bandwidth services to building, operating and maintaining a private fiber network.

• **Design** – to provide information that has been developed from personal professional experience as well as data gathered from being part of the research and education community for over ten years, both as a member and as a vendor serving the community.

• **Findings** – It is my intention to provide emerging NRENs with a beginner’s cookbook for developing a high bandwidth private fiber network for research and education.

• **Value** – This paper should provide emerging NRENs with a “lessons learned” document to refer to when implementing a private fiber network.
Build vs. Buy: The NREN Network Connectivity Dilemma

Presentation Outline

- Bio
- Background
  - R&E Build their own fiber networks
  - Methodology
- Build vs. Buy
  - Case study
  - Business case analysis
- R&E Networks
  - Leaning from other R&E optical network implementations
- Models
  - For acquiring dark fiber
  - R&E business models
  - Network design criteria
- Implementation Plan
  - Step-by-step implementation plan for what is required to build, operate and maintain a fibre network
- Conclusion
Background
“C’mon baby, light my fiber” – *US R&E Community Builds Their Own Fiber Networks*

- Parallel between current African developing NRENs and US Regional Optical Networks (RONs) 10-15 years ago
  - Limited bandwidth at market based price
  - Opportunity to build fiber network and acquire virtually unlimited bandwidth on a marginal cost basis
- Georgia’s PeachNet - previously leased bandwidth from AT&T and now owns & operates its own fiber network
- Merit Network
- MOREnet
- University of Alabama System (UAS) - previously leased bandwidth from ITC Deltacom and now owns & operates its own fiber network
Methodology

• How data was collected from research & education, university community and industry players
  – Personal relationships
  – Participation in the Research & Education community
  – Business experiences
  – Internet research
Build vs. Buy

A Business Case Analysis
Case Study: Data Center Interconnect

- Network Application – Data Center Interconnect
  - Diverse Fiber Routes
    - 2x 60Km Strands
    - 2x 40 Km Strands
  - Load-Balanced Router/Switch Interconnect
  - Total Initial Bandwidth 38 Gbps
    - 3x10GE (over 60Km span)
    - 8x1GE (over 40Km span)

- Components of Dark Fiber Growth
  - Addition of 10Gbps Channel – Typical Turn-up Time – ½ day
  - System Capacity – 400 Gbps (40 x 10Gbps)

Nine Month Payback!
Case Study: Cash Flow – Static Network Model

- Growth Assumptions
  - Most Conservative Model
  - Static Network Growth

<table>
<thead>
<tr>
<th>Network Capacity</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
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<tbody>
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<th>Leased Line OPEX</th>
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Leased Line Assumptions

- 40Km to 60Km
- Leased Line Cost
  - Monthly
  - Annual
  - GE: $1,600, $19,200
  - 10GE: $8,000, $96,000

Nine Month Payback!
Case Study - DWDM ROI Summary

- **Static Network Growth – no Bandwidth increase over 5 years**

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  DWDM ROI
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<th>Annual Savings</th>
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  DWDM Payback Period (Months)
  | 9                |

  DWDM 5 Year Savings
  | $1,303,734        |

- **Modest Network Growth – add 8xGE and 1x10GE in Year 3**

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  DWDM Payback Period (Months)
  | 9                |

  DWDM 5 Year Savings
  | $2,006,845        |

Leased Line Assumptions

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<thead>
<tr>
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<th>40Km to 60Km</th>
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Learning from Research & Education (R&E)
Regional Optical Networks (RONs)
Research & Education Optical Networks

- Funding sources & business models
- Initial funding & operational cost recovery
  - Stanford University
  - PeachNET
  - Merit Network
  - Missouri Research & Education Network (MOREnet)
  - University of Alabama System (UAS)
Stanford University

Commodity Internet & Internet2

Main Campus - Jenkins

PAIX Facility

Commodity Internet & Internet2
PeachNet – University System of Georgia
University System of Georgia (USG)

- USG, ITS acquired fiber assets by leasing 1,900 route miles of fiber in 2004 to connect 26 of the 35 USG institutions, as well as additional USG sites.
- The demand for bandwidth continues to rise as USG institutions continually increase their use of technology through online courses, new research connections, web-based tools, and GALILEO services.
- By leasing the fiber directly, USG Information Technology Services (ITS) is able to move PeachNet services away from commercial telecommunications services. The result is additional bandwidth and levels of redundancies that were previously cost prohibitive.
Merit Network – REACH-3MC

Click a city to zoom in on a map area.

October 31, 2012
Merit Network – REACH-3MC

• REACH-3MC will build 2,287 miles of open-access, advanced fiber-optic network through rural and underserved communities across Michigan's Lower and Upper Peninsulas.
• REACH-3MC is funded by two grants from the Broadband Technology Opportunities Program (BTOP) as part of the American Recovery and Reinvestment Act of 2009 (ARRA), commonly referenced as the Stimulus Package.
• REACH-3MC features robust public-private collaboration. Merit Network is working with over 140 community anchor institutions that will receive fiber-optic laterals.
• Merit also has engaged three providers from the commercial sector, who are Sub-recipients on REACH-3MC and will offer services to homes, businesses and local ISPs in the project service area.
Merit’s Family of Services

**Merit Professional Learning**
- Merit Licensing Service
- Merit Professional Services
- Merit Town Hall and Services Events

**Merit Cloud Media**
- Merit List Manager
- MeritMail Collaboration Suite
- Merit Michigan ID
- Merit RADb - The Routing Assets Database
- MeritVoice
- Merit WebConnect

**Merit Cloud Storage**
- Merit Colocation
- Merit Virtual Data Centers
- Merit VirtualDesktops
- Merit Web Contingency

**Merit Connectivity**
- Merit Domain Name Services
- Merit Multicast Services
- Merit Network Time Protocol (NTP) Services
- Merit Transport Service
- Merit VPN
Missouri Research & Education Network (MOREnet)
MOREnet

Business Continuity / Disaster Recovery
• Colocation
• Network Backup
• Network Storage
• SecondWeb Hosting Service
• Virtual Servers

Connectivity Management
• Black Hole DNS
• Domain Name System
• E-rate Assistance
• E-mail Virus and Spam Filtering
• Good Net Neighbor Phase 1 & 2
• Internet Connection
• Internet Content Filtering
• Internet2
• Microsoft EES Consortium Pricing
• MyMOREnet
• Network Consulting as a Professional Service
• SSL Certificates
• Virtual Servers
• Wireless Assessment Surveys

Communications and Collaboration
• Discussion Lists
• E-mail Archiving
• E-mail Hosting
• E-mail Virus and Spam Filtering
• Google Apps for Missouri
• Learning Management System (LMS)
• Live Video Streaming – Originating
• Live Video Streaming – Viewing
• Remote Conference Management
• Mobile Videoconferencing
• Videoconferencing
• Web Hosting

Community Cloud
• E-mail Archiving
• E-mail Hosting
• Learning Management System (LMS) Hosting
• Network Backup
• Network Storage
• SecondWeb Hosting Service
• Virtual Servers
• Web Hosting
University of Alabama System (UAS)

Interconnecting of University of Alabama System campuses and NASA Marshall Space Flight Center to Internet2 and commodity Internet in Atlanta
University of Alabama System (UAS)

• Costs
  – National Aeronautics and Space Administration (NASA) Research & Engineering Network (NREN) and Marshall Space Flight Center (MSFC) in Huntsville, AL, paid for the fiber.
  – UAS paid for the optronics
  – Both NASA and UAS pay for the operational support for the network.

• Utilization
  – The network will provide MSFC with 10Gbit/s connectivity to NASA’s other facilities nationally
  – The network will also provide The University of Alabama System with more affordable commodity Internet connectivity & Internet2 access
  – The University of Alabama System fiber network will link their campuses in Tuscaloosa, Birmingham and Huntsville, AL,
  – For the scientific community, the network supports DR/BC high-quality, digital-video applications for telemedicine services and distance learning

• Southern Light Rail designed the UAS RON network, acquired the equipment and provided project management and operational support.
Models
Models for Acquiring Dark Fiber

• Acquire from carrier or electric utility
  – Lease fiber (MRC)
  – Indefeasible right-of-use (IRU) – fixed term fiber use agreement (NRC + MRC)

• Trade
  – Barter wavelengths for fiber
  – i.e. Uganda Telecom Ltd. (UTL) was to receive one 10Gig wave in return for use of fiber from Entebbe to Kampala

• Partner
  – One partner procures the fiber
  – Another partner procures the optical equipment
  – Both parties share the cost of operating and maintaining (O&M)
R&E Business Models

• Business considerations
  – Government
  – Regulatory
  – University politics

• Initial funding
  – Grants
  – Internal funding

• Sustainability models
  – Membership / utilization fees
  – Develop member services
  – Drive applications to the network
  – Teaching and learning opportunities
    • MAGPI
    • D-2-D
Network Design Considerations

• Initial Planning
  – Business concerns
  – Network Startup Resource Center (NSRC)
  – Vendor sponsored workshops and webinars

• Fiber Network
  – Diverse entry
  – Diverse fiber path
    • Path Protection Module
  – Optical Link Monitor

• Equipment
  – Small rack footprint
  – Low power consumption (solar)
  – Passives (temperature hardened) at edge and for short-haul links

• Ongoing operation
  – Network management
  – In-country spares and local service partner
  – Vendor maintenance agreement
  – Training – vendor provided, both technical and operations
Implementation Plan - 1

• Project Management
• Procure fiber
  – Characterize fiber (OTDR, optical loss, dispersion, etc.)
• Network design
  – Design optical network
  – Applications and network integration
  – Rack layout
• Procure optical equipment
• Contract issues
• Manufacturing
  – Equipment & spares
  – Staging & system test
• Shipping & Delivery (global logistics - customs)
• Customer Checklist
  – Site preparation check list (access, power, fiber jumpers)
Implementation Plan - 2

• Deployment
  – Installation
    • Site access planning
    • Rack & stack
    • Set levels and commission equipment
  – Coordinate with local service partner

• Post-Installation Testing
  – Perform tests at all sites (i.e. OSNR, Res. Sensitivity, Latency)
  – 24 hour BER test

• Training
• Documentation
• Maintenance
  – Remote tech support
  – Spare management
  – Repair & return
  – On-site engineer

• NOC services
Conclusion
Recommendations

• Determine if it make sense from a business and bandwidth perspective to deploy DWDM
• Learn from / collaborate with other members of the research & education community
• Prepare detailed plans based upon other’s experiences
  – Dark fibre acquisition plan
  – Business plan
  – Network design plan
  – Implementation plan
• Allow me to introduce my friends in the US to my new friends in Africa
Contact Information

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m: +1 404-512-9907 e: brian.savory@optelian.com

www.optelian.com
Optical Transport for Reach Extension

Reach Out and Touch Someone

Thank you

Asante