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Experience Mapping US Regional Optical Networks

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Some slides that peaked my interest

Leading & Emerging *Regional Optical Networks*

- Alabama
- Arkansas
- California (CALREN)
- Colorado (FRGP/BRAN)
- Connecticut (Conn. Education Network)
- Florida (Florida LambdaRail)
- Georgia (Southern Light Rail)
- Indiana (I-LIGHT)
- Illinois (I-WIRE)
- Louisiana (LONI)
- Maryland, D.C. & northern Virginia (MAX)
- Michigan (MiLR)
- Minnesota
- New England region (NEREN)
- New York (NYSERNet, Cornell)
- North Carolina (NC LambdaRail)
- Ohio (Third Frontier Network)
- Oklahoma (OneNet)
- Oregon
- Pacific Northwest (Lariat – NIH BRIN, PNNL)
- Rhode Island (OSHEAN)
- SURA Crossroads (southeastern U.S.)
- Tennessee (OneTN)
- Texas (LEARN)
- Virginia (MATP)
- Wyoming

Dark fiber: gauging community-wide progress

- Aggregate dark fiber assets acquired by U.S. R&E optical initiatives (segment-miles)
  - CENIC (for CalREN & NLR) 6,200
  - FiberCo (via Level 3 for NLR & RONs) 5,660
  - SURA (via AT&T) 6,000
    - Plus 2,000 route-miles for research
  - NLR Phase 2 4,000
  - OARnet 1,600
  - ORNL (via Qwest) 900
  - NEREN 670
  - Other projects (IN,IL,MI,OR, …) 2,200+
- ***Total (conservative estimate) 27,230+***
  - Over 55% of these assets are now outside NLR
    - NLR will hold ~11,250 route-miles

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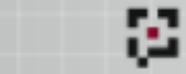
Opportunistic Coordination

- FiberCo & SURA offering access to fiber from a common carrier
- National Lambda Rail & Abilene motivating build outs to common aggregation points
- Service providers (commodity Internet) access in carrier hotels

- Result: Gravity seems to be pulling us to reasonable aggregation points (starting to look like railroad maps of the last century)



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The Quilt

- Bandwidth purchasing club
- Knowledge exchange (equipment, techniques, vendors, etc.)
- Working on sharing of expensive test equipment
- Regular meetings to exchange information

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Sum of the Parts

- Regional networks now measured in thousands of miles of fiber
- New networks now asset-based (i.e., facility-based)
- Cost of bandwidth dropping to zero, but not cost of connectivity
- How can patches of connectivity become a larger network?

No good overview

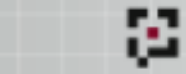
- Lots of slides and maps of regional networks, however no single map
- No agreement on what a single map would contain
- There's a reason maps with lines are called political maps
- If I was going to make a map I needed cover

The Quilt provides cover

- Approached the Quilt at their March 2005 meeting with the idea of making a map
- Informal consensus suggested that the map would be a good thing
- Followed up on subsequent Quilt conference call to get more specific guidance on map content and distribution
- Concerns expressed about impact of map on service providers (and their lobbying efforts)

Facilities-based Networks

- What does this mean?
- Fiber owned? Fiber-base service? Wavelength service?
- Current definition: network that will support alien wavelengths



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The Data

- Choose city-to-city segments
- Identified by city, state
- Translated to Lat/Long
- Currently held in Excel spreadsheet
- Maintained by me via e-mails

The Map

- Credit to David Ripley
- Once translated into lat/long, scatter plot
- Resulting excel chart stretched over spherical projection of North America
- A big of by-hand cleaning up needed

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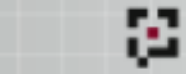
Network Cartographer

- Not really my day job
- Ideally data should be maintained by network owner
- A “virtual cartographer” employed to make maps on demand
- Trying not to reinvent the wheel, looked for existing distributed database (eureka! DNS)



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Conscripting DNS

- DNS is a well known and widely implemented distributed database
- Used for many things besides domain name-to-IP address associations
- Decide to register “network-map.net”

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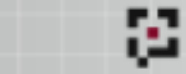
If DNS is your hammer, everything is a FQDN

- Data structure had to be searchable (not always easy with DNS's limited lookup ability)
- Database had to be distributable on DNS-friendly boundaries
- Records had to be simple (humans will maintain this in most cases)



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Caution: this isn't going to be pretty

Here's the idea

network-map.net	"US-UK-NL-CA"
us.network-map.net	"IN-OH-FL"
oh.us.network-map.net	"TFN"
tfn.oh.us.network-map.net	"records=26"
000001.tfn.oh.us.network-map.net	"Link=Columbus, OH - Cincinnati, OH"
000001.tfn.oh.us.network-map.net	"Link Status=Existing"

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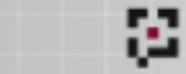
Careful not to misunderestimate the issues

- Is having a virtual cartographer ready to make maps on-demand a good thing?
- How many would be willing to maintain their own zone files?
- What's the best way to formalize this effort?



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What my lab can contribute

- Version 1.0 of the virtual cartographer
- Hosting of network-map.net
- Populating zone files for the existing US RONs

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Where to go from here?