

Lit Fiber Update

VELCO Operating Committee October 2011



Project Update

Fiber Optic Backbone Lit Fiber

Acronyms/Definitions

Synchronous optical networking (SONET) – standardized multiplexing protocols that transfer multiple digital bit streams over optical fiber

Dense wave division multiplexing (DWDM) – a technology which multiplexes a number of optical carrier signals onto a single optical fiber using different wavelengths. This technology enables bidirectional communications over one strand of fiber

Reconfigurable optical add-drop multiplexing (ROADM) – is a form of optical add-drop multiplexing that adds the ability to remotely switch traffic from a DWDM system at the wavelength layer

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Background Information

- The VELCO fiber optic system supports the reliability needs of the transmission system, dark fiber commercial traffic, and data traffic for the state's distribution utilities
- The existing system consists of an approximately 2.5 GB capacity OC-48 SONET system utilizing Ciena/Nortel equipment
- This system was installed in 2001
- Fiber optic equipment technology is a rapidly changing due to innovation in the capacity of the equipment which effectively doubles every 12-14 months
- Planning for electronics equipment upgrades at VELCO began during the summer of 2009

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Development Timeline

- Summer/Fall 2009 conceptual system development to support data transport
 - Complementary to the current OC-48 System
 - Assumed standardized DU electronics
 - Cyber security requirements uncertain
 - Vermont “Snowman System”: 3 rings with high traffic middle ring
 - Approximately 10 GB capacity SONET OC-192 based system (Ciena 6500 chassis without electronics) with 4 DWDM ROADMs at the core ring
 - Placeholder estimate of \$15 Million (included both VELCO and DU electronics)
 - DU input assumed limited to data transport load only, based upon Plexus and VELCO analysis

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Development Timeline (continued)

- 2010
 - Award of eEnergy Vermont Grant
 - Attachment Agreements developed for fiber
 - Development of DU system requirements and ownership issue
 - Telecom Sub Committee of Operating Committee formed at VELCO Board's direction
 - Executive Committee provided guidance on cost allocation to the Operating Committee



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Development Timeline (continued)

- 2011
 - Developed common network architecture
 - Retained IBM to assist with development of network architecture
 - Telecom Subcommittee agreed to support diversity in end equipment (example J-mux, rugged.com)
 - Capacity requirements refined (example: growth from 1-T1 to 7-T1 capacity at substations)
OC-192 system envision in 2009 cannot support this traffic
 - Consolidated backhaul provided by VELCO core (addresses islanding)
 - **Ciena confirmed that current OC-48 platform will be discontinued in 2016**
 - Interoperability tests completed on a variety of end equipment
 - Switched to DWDM Technology from SONET
 - Carrier Ethernet solution is determined to be CIP compliant (addresses cyber security issues)
 - Operating Committee provides direction on DU electronic ownership
 - Original scope of work for the proposed network received July 2011

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Results:

Changes from the conceptual system provide significantly more capacity, meet security requirements, and support a diversity of applications and end equipment.

- **System Description:**

- Based upon the Ciena 6500 Platform
- DWDM based (capacity is up to 4400 GB vs 2.5 GB for the existing system)
carrier class network migration possible
- 27 Nodes, 7 designed with ROADM and the additional 20 can be upgraded to ROADM
- The ROADM network provides more reliability than standard SONET
- Carrier Ethernet Network addresses IP based solution and is CIP compliant
- Addresses “end of manufacturer’s life” issue

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Conclusion:

- The original assumptions used to develop the conceptual proved to be obsolete and flawed
- The proposed system meets the needs developed jointly by the DU's and VELCO
- The budget figures included with this presentation do not include DU electronics
- VELCO and the DUs are examining the options for DU electronics, current estimates of costs vary depending upon the host DU's standard equipment
- We request approval of the attached budget so that the pricing for the equipment can be assured (pricing expires November 18, 2011) and the project can support the state's smart grid deployment schedule

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Projected Budget Core DWDM Network

Activity	Projected Cost
Substation Make Ready	\$ 1,766,600.00
DWDM Equipment	\$ 6,639,129.00
Equipment Installation and Testing	\$ 1,892,871.00
Engineering, Procurement, Management	\$ 3,785,775.00
Ciena Support/NOC Services	\$ 906,610.00
Network Operations Center/Asset Tracking	\$ 200,000.00
Escalation/Capital Interest	\$ 1,083,687.00
Subtotal	\$ 16,274,672.00
Contingency @ 20%	\$ 3,254,934.00
Total	\$ 19,529,606.00

Note 1: Assumes work at 40 substations

Note 2: Pricing for electronics expires on 11/18/2011

Note 3: Project schedule shows completion by June 2013