NYSERNet New York City Dark Fiber Network

Alan Crosswell
Columbia University
submitted to NYMAN 2002

August 29, 2002

Introduction

In September 2002, final contract negotiations are expected to be complete for the initial build out of a metropolitan area dark fiber network in New York City for about a dozen research and education institutions comprising about 35 sites. We expect the first fiber to be lit a year later. This report, written from the point of view of a customer of the NYSERNet NYC dark fiber network, summarizes the motivation for the network, planning process, and some of the technical design options. The network build is managed by the New York State Education and Research Network, Inc. (NYSERNet) of which Columbia University is a founding member.

Motivation

For many years Columbia and our peers have been pushing up against the limits of available affordable local loop bandwidth for commodity Internet, Internet2 and private network connectivity among our multiple campuses and single-building locations in New York City. For Columbia, these loops consists of two 155 Mbps OC-3 SONET circuits for commodity and Internet2 access, three 45 Mbps DS-3 private circuits, private microwave links to our Health Sciences campus with aggregated bandwidth of 245 Mbps, and a dozen T1s to miscellaneous small sites. Our (and Cornell's) affiliated hospital, NewYork-Presbyterian, has a significantly larger leased ATM infrastructure at DS-3 and OC-3 rates interconnecting about a dozen buildings. We were separately and collectively paying a lot for bandwidth in Manhattan.

About three years ago, dark fiber vendors began courting us, offering attractive pricing along the lines of half what we were paying the incumbent telcos for circuits. We saw dark fiber as just more of what we already do within our multi-block campuses and even less of a technical challenge than dealing with leased telco circuits. We were interested in dark fiber for both Internet/Internet2 access and private intra-institutional connections. Of course these vendors rarely had facilities built up to northern Manhattan having instead focused on skimming the Wall Street cream.

After a few conversations with vendors, our NYSERNet Board Members urged NYSERNet to take on the job of negotiating bulk pricing as they have historically done for Internet access and local loop contracts. NYSERNet agreed.

NYSERNet

The New York State Education and Research Network, Inc.[1] was founded by a number of NYS R&E institutions including Columbia in the mid-1980's and served as the NSFnet regional for New York State.

NYSERNet has evolved[2] over the years but still has a core mission of helping members get high-quality economical (often subsidized) Internet access. NYSERNet is also the operator of the New York State Internet2[3] gigapop which peers with Abilene in NYC and Buffalo as well as CA*net3, the Canadian R&E network. Finally, NYSERNet is now also the Internet2 Sponsored Educational Grants Program (SEGP) coordinator for K-20 networking in the state.

The NYSERNet New York City dark fiber project is managed by Dr. Ben Chi of NYSERNet with support from NYSERNet engineering, legal and financial staff, several consultants and staff of several NYSERNet member institutions[4] who have participated as a subcommittee of the NYSERNet Engineering Working Group.

Other Dark Fiber Projects

There are a number of completed or in progress dark fiber builds in the R&E community covering small cities, metro areas, states, regions, provinces, etc. We have tried to learn as much as we can from all of them, especially SURA, CENIC, and Canarie. One of the key early advisers to the project was Robert Proulx, consulting engineer for Quebec and Ontario dark fiber build-outs.

Build or Lease?

One of the key pieces of advice Mr. Proulx gave us was that even if we intend not to build our own network we should find out what it would cost to do so if for no other reason than to be able to negotiate with potential lessors. We also learned of the condominium build concept in which multiple partners share the costs of a build as well as trading strands among several partners to fill in gaps.

To this end, we first generated a list of potential participants. This included current NYSERNet members and a fair number of "cold calls" to R&E network managers in the City. Armed with that list we hired Alan Hahn, P.E. as a consultant to help us determine feasibility and rough costs. Mr. Hahn had in the past designed and managed several private conduit builds for both Columbia and NYU. He worked with our list of potential participant sites in Manhattan and Empire City Subway[5] to do a duct study and to estimate costs for the various components of a build: construction of laterals from ECS manholes; leasing, rod and rope of ECS ducts; fiber pull and splicing.

With these numbers in hand, we saw that with our current expenditures for leased circuits and financing for a 10-year term, we could afford the network.

Generating the RFP

Now the hard detail work began. NYSERNet engaged Ray LaChance and Rao Karanam to assist in developing a detailed list of sites, fiber technical requirements and colocation facility requirements. At this point the EWG subcommittee had completed its work. NYSERNet and their consultants met with a number of potential partners for construction and/or lease of fiber, colocation facilities, and operations. A final list of participants was drawn up based on final budget estimates and a request for proposals was issued. Six bidders responded, about evenly divided between those with significant installed fiber and those offering to build to suit.

Technical and financial review committees consisting of NYSERNet staff, the consultants, and customers independently reviewed the technical and financial aspects of the responses. Once the selections were made by each committee, they met jointly to come up with a finalist and a couple of backups. NYSERNet is now in contract negotiation with the finalist which will be installing a build-to-suit network.

Fiber Network Requirements

The fiber network requirements can be separated into physical topology and fiber features. Since we will be putting significant services on this fiber both for intra-institutional and Internet (and for some members telephony and video routing) access, the topology has to be survivable. This resulted in a multiple ring topology maintaining a minimum distance of two blocks between arcs of the ring and with diverse ring entrances to buildings and the two colocation facilities. Furthermore, laterals were specified to be as short as possible from the backbone ring.

One of the issues that developed as we learned more about building fiber networks was trying to future-proof our investment in fiber. Of the several responders, those that had installed fiber generally use Corning SMF-28. We anticipate running 40 Gbps networks in the near term potentially using coarse and/or dense wavelength division multiplexing. Furthermore, optical networking research performed by our faculty might need access to lambdas or dedicated strands. We solicited advice from other R&E fiber network operators, vendors, and our faculty with specialization in optical networks. The developing consensus view seems to be leaning toward installing hybrid cable containing both a low water peak fiber such as Lucent/OFS Allwave and NZDSF such as Truewave or LEAF. Detailed choice of fiber is still up in the air with some debate on the relative merits of Allwave vs. Corning's SMF-28e which is claimed to be roughly equivalent by some – a claim which is disputed by others.

Colocation Facility Requirements

One of the major issues for NYSERNet and it's members has been the cost of the colocation facility at 60 Hudson Street. Even "jumpers" between floors of the building incur enormous local loop fees. The new colocation facility is meant to be similar to those provided by other R&E consortia such as at the MAX and Pacific Northwest Gigapops. The colo must provide minimal-cost carrier-neutral meet-me facilities for multiple providers to offer service to NYSERNet members and for interconnection of R&E networks (such as the many European networks that land in NYC as well as Canarie and Abilene). The "usual" requirements for a robust colo were also specified including redundant HVAC, power, generator backup, etc. Each NYSERNet customer will have a full rack for their own equipment to be used to interconnect with service providers. What we hope will be ample additional rack space for future services has been reserved.

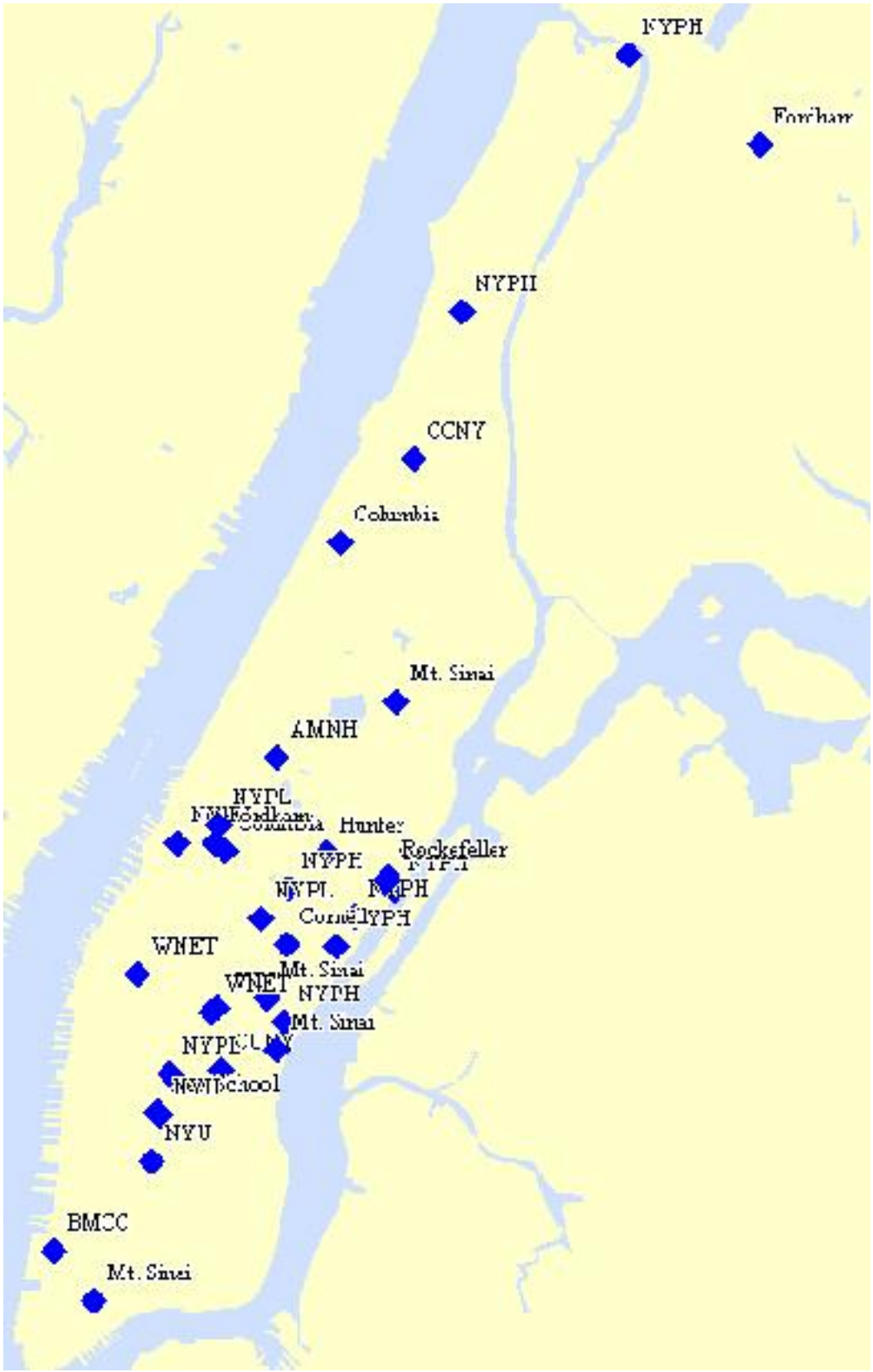
Finally, a requirement of many NYSERNet members is a second, or backup, colocation facility should the primary colo have a catastrophic failure. This second colo is required to be a significant distance away from the primary facility. Columbia will be contracting for primary and backup Internet service at these two colos.

We had initially explored locating one or both of these colocation facilities at NYSERNet member institution campuses, assuming that there would be all that now-unused 1960's computer center space available. But, after some research, discovered, not surprisingly, that nobody had available space. For instance, 75% of Columbia's machine room space is now offices.

Phase 1 Participants

- American Museum of Natural History
- City University of New York
- Columbia University – NewYork-Presbyterian Hospital
- Cornell University Medical College

- Fordham University
- Mount Sinai-NYU Health and School of Medicine
- New School University
- New York Public Library
- New York University
- Rockefeller University
- Channel13/WNET


NYPH
Fordham
NYPH
CCNY
Columbia
Mt. Sinai
AMNH
NYPL
Hunter
Rockefeller
NYPH
WNET
Mt. Sinai
WNET
NYPH
Mt. Sinai
NYPH
BMCC
Mt. Sinai

Notes

[1] http://www.nysernet.orghttp://www.nysernet.org

[2] http://www.nysernet.org/prod/nysernet/history.htmlhttp://www.nysernet.org/prod/nysernet/history.html

[3] http://www.internet2.eduhttp://www.internet2.edu

[4] Columbia, NYU, NY Public Library, American Museum of Natural History

[5] ECS has nothing to do with the NYC subway. It is the underground communications conduit network that was first established by New York City in the late 1800's when the City government decreed that all communications cables must be moved underground. While ECS is now a subsidiary of Verizon (the City sold it during the 1970's fiscal crisis) it is still run as an equal-access service open and required to be used by all City communications franchisees. All low voltage phone and CATV copper and fiber is run through ECS ducts.