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So What Does $7.2 Billion Buy You in Broadband?

PAGE 4

IN THIS ISSUE

Fiber to the User As a Public Utility

By Tim Nulty

The Burlington Telecom initiative was developed on the basis of a set of principles, which in my view, are fundamental to any similar public undertaking:

- "Broadband" communication is the "electronic road system of the 21st century, essential for full participation in the economy and society.
- Universal optical Fiber-to-the-user (FTTU)[1] is the foundation of that electronic road system.
- Universal FTTU is economically viable to any premise that currently has a copper telephone wire. The idea that fiber is "uneconomic" in rural and other "hard to serve" areas is misguided;
- Universal FTTU is a natural monopoly—which means public oversight (via ownership, regulation or both) is essential to ensure adequate provision without monopoly abuse.

These principles lead to the conclusion that universal FTTU is a "public utility" and, regardless of formal ownership, should be built and managed as such. The key policies governing it should be:

- **Universality:** everyone should have access to it at affordable rates—no exceptions;
- **Open access,** (i.e. "common carriage"): as a "public road" system, it must be available to all on non-discriminatory terms;
- **"Future Proof":** The universal "electronic road system" is both essential and expensive. Thus, the resulting network(s) must last a long time and be capable of efficient, economic upgrades as needs increase.
- **Financial self sufficiency:** While, in theory, it is justifiable to build a universal basic public service with taxpayer funds, both tradition and political reality in the United States require that universal fiber networks be self-supporting from the revenues generated by users. This is eminently feasible.

Burlington Telecom (BT) Experience

Burlington decided to build a universal FTTH network in the late '90s when there were few examples to follow. It spent several years before deciding, in 2001, on a workable plan. That plan involved building a fiber wide area network (WAN) for the city Government. The WAN began

operation in mid-2002, providing internet, voice and internal gigabit connectivity between 37 city and school facilities for less than the cost of the external services it replaced—making it "profitable" from the moment it went into full operation. With that experience behind it, Burlington decided to build a universal FTTU network serving all residents and businesses in the city. By that time several other towns had similar projects running, so BT was able to learn from them. Bristol, VA and Reedsburg, WI were particularly helpful.

Burlington chose the "phased approach" because there was so little experience elsewhere from which to learn. Now, however, there are many examples of municipal FTTU networks and the formula for success is becoming clear. Nevertheless, the "phased" approach may still be useful where political authorities wish to move cautiously, or are otherwise constrained.

Burlington financed its FTTU network with a privately placed "Municipal Capital Lease, subject to appropriation." This is similar to a revenue bond except that the lender retains ownership of the asset and can take possession in the event of a default. Financing was closed in November 2004, ground broken in May 2005 and the first customers were connected in February 2006. BT became "operationally cash-flow positive" in September 2007 with 2000 customers. It is scheduled to become overall cash-flow positive (i.e. "profitable") when it reaches 5000 customers sometime in early 2009. To go from initial financing to profitability in less than 5 years is an exceptional performance for a heavily capital-intensive enterprise, whether private or public.

Problems experienced by BT:

Problems prior to start up:

- **Incumbent opposition to licensing:** The incumbent cable company, Adelphia, strongly opposed award of a cable license to BT. This necessitated a lengthy regulatory process which delayed the project for almost a year and which cost BT in direct fees and delayed income an estimated $4 million. This had a measureable adverse effect on the economic performance of the project.
- **Cable content contracts:** Because BT decided to be an all-IPTV, it was unable to take advantage of existing contracts through associations such as NCTC. Instead, BT was forced to negotiate its own contracts directly with the content providers—a difficult and time-consuming effort.

Problems after start-up:

- **Billing and related software:** When BT began, integrated software covering billing, customer care, trouble monitoring, work orders, and inventory for triple-play FTTU networks was still rudimentary. BT's initial contractor failed to perform and BT had to cancel the contract, negotiate a settlement, "fork-lift" the software out of BT, choose another company and install the new software—all while continuing to connect and service customers. Obviously, this was a very difficult experience! *Fortunately, there are now a number of good platforms available, so new muni FTTH networks can avoid this experience.*
- Inside wiring: BT originally intended to utilize existing inside wiring to save cost and time. However, this led to multiple difficulties since most existing inside wiring has imperfections that are exposed by the demands of a modern FTTU network. After BT abandoned the original policy and began installing its own inside wiring, it experienced a dramatic decline in troubles and big increase in customer perception of network and service quality. The policy now is that BT will wire to the existing phone interface, to one PC and to one TV for free. Additional wiring is offered at $45/hour. Customers have been happy with this policy and it has resulted in far fewer installs having to be revisited—a large cost savings.
- **IPTV "middle ware:"** As with billing software, the software that manages the IPTV signal from the point it is received by the satellite dish through to the TV was still in early development stages when BT began offering service. BT's first choice failed to perform and had to be replaced at substantial cost in terms of delay, lost revenue, etc. As with other software, *IPTV middleware providers have improved significantly since BT began. New Muni FTTH networks should be able to avoid this problem.*
- **Corporate Structure:** BT is a department of the Burlington City Government—just like Parks or Zoning. Public ownership of basic FTTU infrastructure is perfectly viable but organizing it as a conventional city department is not recommended. The constraints of municipal human resources practices, contracting rules, budgeting, administrative practices and daily interference of city officials are inappropriate for a dynamic telecom operation offering hundreds of services under rapidly changing technical and market conditions. Far better would be a publicly-owned corporation charged with operating in a competitive commercial manner subject to certain social-service conditions (e.g. universality, open access, specified "lifeline" options, etc) and controlled by an appointed and professional Board of Directors.

Major strengths of the BT effort:

- **Strong community and political support:** The importance of this cannot be

[1] "Fiber-to-the-Home (FTTH), "Fiber-to-the-Premise" (FTTP) and "Fiber-to-the-User (FTTU) are considered functional equivalents in this document.

overstated. BT has enjoyed strong consistent community support over a sustained period. Undertaking a municipal FTTU network would be difficult without such political and community backing.

- **State political environment:** Vermont is relatively inhospitable to the sort of big-corporation pressure tactics that are so corrosive in other places. While incumbents opposed the BT effort, the degree of political traction they were able to get in Vermont was significantly less than they have achieved in other states. Municipal FTTU projects (like Lafayette, LA) that have faced—and survived—much more severe opposition than BT had both our sympathy and our admiration. *Legislation to prohibit this sort of sabotage should be on the agenda for the new Congress and Administration, as well as at State level where feasible.*

East Central Vermont Community Fiber[2]: Cloning BT in rural Vermont:

Although the basics of the model are transferable, the rest of Vermont presents issues not confronted in Burlington. In particular: a) low density of customers; and b) towns too small to undertake an FTTU project on their own.

East Central Vermont Community Fiber (ECFiber) network is a consortium of 22 towns that will obtain the financing, own the network, control the money and overall policy. Day-to-day construction and operation will be performed under contract by ValleyNet, an established local non-profit telecom company. The ECFiber territory covers approximately 900 square miles, 52,000 people and 1600 miles of inhabited roads. Total potential customers (residential, business, and institutional) are about 23,000, giving an average density of about 13.5 customers per mile of road. About 40% of the population lives in three towns of 10,000, 7,000 and 5,000 each. The rest of the population lives in rural areas with densities as low as 4 or 5 per mile. Outside plant is aerial. To build the network, cable will be attached to approximately 42,000 poles. Conventional wisdom is that FTTU is not viable under such circumstances. However, some 15 to 20% of all Americans live in these sorts of areas—approximately 45 million people. That is roughly the equivalent of a country the size of Spain or Italy. If ECFiber is successful, it will create a model for how to bring state-of-the-art FTTU to this large group of Americans—something for which they currently have little hope or prospect.

Between November 2007 and October 2008, a detailed project was put together that addressed both the organizational/structural and engineering/economic issues. The project is now complete and ready to go ("shovel ready" in the latest argot).

Public Utility Policy: Although not required to do so by law, the member towns have decided that ECFiber network will rigorously adhere to the principles spelled out at the beginning of this paper. e.g., universality, non-discriminatory open access, financial self-sufficiency and "future proof" technological foundation.

Economics: The actual financial plan is confidential. However, I can say that ECFiber is projected to become profitable in its 5th, 6th or 7th year after initial funding (depending on the interest rate) and that the long run return to its owners, the 22 member towns, are sufficient to make a significant contribution to municipal budgets. Costs and revenues have been vetted by independent experts not chosen by ECFiber.

Community support: The rapid advance of so complex and ground-breaking a project was made possible by a high level of grass-roots activism among the citizens of the towns involved. The project has also been able to draw on an array of experts, many of whom have contributed their time on a pro bono basis because of their strong belief in the path-breaking importance of this project for millions of Americans. The result of this collective effort was that, on November 1, 2008, exactly one year after the effort was initiated, a Public Offering of Certificates of Participation in a Municipal Capital Lease of $101 million was ready for presentation to the markets. Legal and regulatory requirements were addressed, the network is engineered, costed and anchored by a "hard-money" fixed-price construction contract with the pre-eminent design/build firm in the FTTH space, management was identified and committed, and over 4200 customers had pre-registered. Unfortunately this public offering has been temporarily suspended as a result of the collapse of credit markets.

Details of the ECF project

Structure: ECFiber was organized as an "Interlocal Contract" (ILC) under Vermont law. The contract spells out an organization which "looks and feels" like a jointly owned municipal corporation. However, it is not, in law, a "body corporate and politic." A formal municipal corporation (called a "Municipal Utility District" in Vermont) would be a superior vehicle, but requires a lengthy legislative process that the ECFiber towns did not want to undertake initially but which is now proceeding in the wake of the delay in financing.

ECFiber's member towns did not wish to take on the responsibility for day-to-day operation of such a complex and technologically challenging enterprise. Instead, ECFiber contracted with an established local non-profit ISP/telecom company, ValleyNet. The Design/Build/Operate contract (DBO) between ECFiber and

[2] "East Central Vermont Community Fiber Net"

Individual FAPs can provide basic emergency services for "their" customers in the event of catastrophic failure of the whole network. This architecture is extremely robust, redundant, easy to upgrade and facilitates co-location, common-carriage, etc.

ValleyNet is a key legal document underlying the project and its public offering for finance. Under the DBO, ValleyNet will build and operate the network and all employees will work for VN. ECFiber will control policy and will hold all the money. In effect, the towns are the shareholders. They each appoint a representative (and alternate) to the Governing Board which controls policy, and has elected an Executive Committee of 7 who meet regularly and effectively serve as the Board of Directors. Operations are conducted by ValleyNet. All proceeds of both the initial financing and, later, customer revenue, will come to bank accounts held and controlled by ECFiber and administered by the Trustee, a respected regional bank.

Technical Overview of the ECF network

Fiber network: The prime engineering goal is to build a fiber infrastructure that will last for the rest of the century and that can accommodate any electronic technology easily. To do this, we have designed a "modified home-run" architecture, i.e., every premise has its own fiber which terminates directly in a satellite "hub" or Fiber Aggregation Point (FAP). This is not unlike the traditional copper telephone network. These satellite hubs are strategically placed to minimize cost and to ensure that all customers are within the specified reach of the access lasers (typically 20-30 km). A maximum of about 3500 customers can be accommodated in a FAP. FAPs are heated, powered, lighted buildings. Fiber counts are calculated to provide at least 20% overage—and more in areas where population growth is anticipated. All electronics are placed in the FAPs—no outside cabinets or similar structures are employed. This is a major factor for maintenance and for migration to other technologies. The ECF network has 13 FAPs, one of which is in the main Network Operations Center. The FAPs are connected to each other and to the main Hub by a carrier-grade 10Gig-E backhaul network. Individual FAPs can provide basic emergency services for "their" customers in the event of catastrophic failure of the whole network. This architecture is extremely robust, redundant, easy to upgrade and facilitates co-location, common-carriage, etc.

Access technology: The initial access technology will be 2.4/1/2 Gigabits G-PON. However, the fiber architecture described above will facilitate upgrading to later versions of G-PON, to wave division multiplex, to active technology—or to any other technology not yet conceived that may arise during the next century. The fiber distribution network we are planning has virtually infinite capacity.

Triple Play retail services: ECFiber will provide standard telephone serrvice, VOIP, a full line of video programming and internet connectivity far superior to that available on any other technology, and it will charge less than customers currently pay for much inferior service. Further, because the capacity of its network is so enormous and so cheap[3] and it is a community owned public utility, the scope for all sorts of innovative uses—in education, health, arts, local government, local sports, local advertising, etc.—is far beyond anything that has ever been available. Unlike most traditional cable TV companies which consider public access to be an onerous burden and resist them with varying degrees of ferocity, community networks like BT and ECFiber consider this to be a major part of their core raison d'être and go out of their way to assist providers of public and community services.

Point-to-Point services: The network can provide dedicated point-to-point connectivity at any speed a customer wants—up to (and, eventually beyond) Terabits per second.

Data Storage/Backup: There is significant demand for data storage/backup especially for disaster recovery capability. Since a company can be connected to a link of any speed they wish, it is feasible to be able to back up an entire day's work (say, at a law firm, architectural firm, medical clinic, etc) in seconds….and to retrieve all backed up data in similar times. Because, the ECFiber network will be spread over a very large area, back-up can be located far from the primary office—a basic requirement for disaster recovery.

Wholesale services. ECFiber will permit any service provider to use its transport network—even those that compete with its own retail services—on a non-discriminatory basis. The forms this might take are varied: e.g. rental of video channels, rental of a full G-PON "pipe" into a customer, back-haul for a wireless system, etc. In all cases, ECFiber will seek to price the

[3] ECFiber will have the capacity to offer 100,000 full HD channels of video on day one of operations. It expects to be able to sell channels for as little as $100/month for commercial purposes—and to give them away free for any public-interest purpose.

wholesale service at a full-cost "public utility" basis—and to ensure that its own use of that service is charged in the same way. It will maintain its books in such a fashion as to enable such pricing to be established and verified.

In conclusion:

- Universal FTTU is the pre-eminent public utility infrastructure of the next 100 years. Nothing else is as good and nothing else is good enough. "Broadband" policy is really "fiber" policy.
- Universal FTTU is economically viable everywhere that we have a copper telephone wire today….which is very close to 100% of the population. There is no reason and no excuse for "making do" with anything less.
- Universal FTTU is a natural monopoly….possibly the most perfect and complete natural monopoly ever invented. Since it is also essential for modern life, it should be provided as a public utility and regulated as such. ■

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