EXHIBIT
Staff 57

STATE OF VERMONT

PUBLIC SERVICE BOARD

Joint Petition of Verizon New England Inc.,	)	
d/b/a Verizon Vermont, Certain Affiliates	)	
Thereof, and FairPoint Communications,	)	
Inc. for approval of an asset transfer,	)	Docket No. 7270
acquisition of control by merger and	)	
associated transactions	)	

PREFILED REBUTTAL TESTIMONY OF DOUGLAS C. SICKER, PH.D.

ON BEHALF OF

FAIRPOINT COMMUNICATIONS, INC.

June 27, 2007

Summary: Dr. Sicker's testimony describes the appropriateness of Digital Subscriber Line (DSL) as an evolutionary technology path for the FairPoint Communications to serve the Verizon customer base upon acquisition of related assets in Maine, Vermont and New Hampshire. He discusses why DSL is the appropriate technology now and how it provides the base for future expansion as the needs for bandwidth grow. In addition, Dr. Sicker comments on FairPoint's broadband deployment plan, concluding that the plan is sound and reasonable and helps meet Vermont's broadband goals.

INTRODUCTION

Q1. Please state your name and business address.

A1. My name is Dr. Douglas C. Sicker. My business address is ECCR1B54, 430 UCB, Boulder, CO 80309-0430.

Q2. What is your position and by whom are you employed?

A2. I am the Director of the Interdisciplinary Telecommunications Labs and an Assistant Professor in the Department of Computer Science at the University of Colorado and am employed by the University of Colorado.

Q3. Please provide your educational background and professional experience.

A3. Prior to becoming a professor I was Director of Network Architecture at Level 3 Communications. And prior to this, I was Chief of the Network Technology Division at the Federal Communications Commission (FCC). I received my Ph.D. and M.S. in Telecommunications and my B.S. in Natural Sciences from the University of Pittsburgh.

Q4. On whose behalf are you testifying?

A4. I am testifying on behalf of FairPoint Communications, Inc. ("FairPoint").

Q5. What is the purpose of your testimony?

A5. The purpose of my testimony is to describe the appropriateness of Digital Subscriber Line (DSL) as an evolutionary technology path for FairPoint Communications to serve the Verizon customer base upon acquisition of related assets in Maine, Vermont and New Hampshire. I will testify as to why DSL is the appropriate technology now and how it provides the base for future expansion as the needs for bandwidth grow. Finally, I will comment on how FairPoint's broadband plan helps meet Vermont's broadband goals.

Q6. Have parties in this case raised questions about FairPoint's broadband plan?

A6. Yes. The Department of Public Service has a long-standing interest in broadband deployment and access. The Department is interested in FairPoint's plan for a broadband migration path that will provide not only broadband sufficient for today's need, but future requirements as well. The Department has also asked how FairPoint's plan will be superior to Verizon's existing broadband commitment in Vermont.

Q7. Please summarize your analysis.

A7. Based on my extensive experience as an academic and professional in the field of communications technology and my evaluation of information about both FairPoint's current broadband deployments and its initial plans for Northern New England, as well as interviews with FairPoint's internal subject matter experts, I conclude that DSL is a logical solution for Vermont (and is in fact the technology of choice), and that it provides a prudent migratory path toward even higher-rate data services such as Fiber To The Home ("FTTH"). I also conclude that the goal of increasing broadband deployment is not well-served by ordering a specific deployment with specific data rates, specific technology and specific timelines. To do so would fail to provide the flexibility that a carrier requires to evolve its network in response to consumer demands, financial factors and technology evolution.

Specifically concerning the FairPoint broadband deployment plan, I conclude that: (1) the FairPoint Communications' plan is sound given the economics of broadband deployment; (2) the plan is consistent with the technologies currently being deployed by other operators in the United States and abroad; (3) the plan is designed to ensure a significant and wide-spread build-out to large numbers of additional customers; (4) the plan will provide appropriate broadband capacity for current uses and the network can be evolved as needed to meet even higher-speed customer needs; and (5) the plan will position the infrastructure required to meet the needs of particular high-capacity customers.

Q8. Could you provide a simplified description of the Internet and explain how technologies like DSL and FTTH fit into the Internet?

A8. Technologies such as DSL and FTTH are part of the network system that is the Internet. It is important to understand how that system is designed in order to understand the value of different access technologies (technologies that provide end-users with access to the network). Just as putting racing tires on an old car won't make it go faster, the network's performance and an Internet user's experience are based on many parts. Modern telecommunications systems are moving to "network convergence," meaning that subscribers' voice, video and data network services are provided by a single common connection to the Internet.

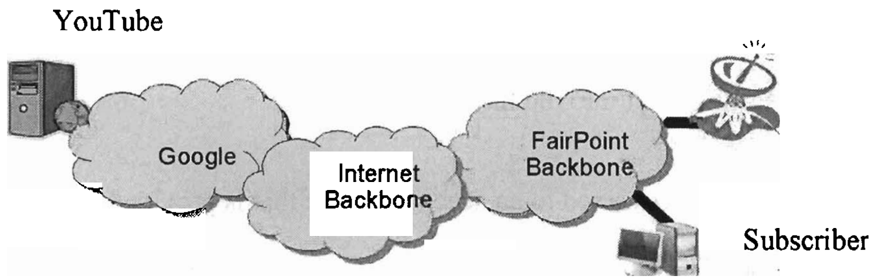
Q9. How does an access network fit into the Internet?

A9. The devices in a home are connected to an access network that is provided by a broadband network provider. That network provider also has a backbone network that connects all the different access devices and provides access to other networks. The Internet is a "network of networks," allowing different broadband providers to access the same content.

Q10. Could you give an example of how information might travel across this "network of networks" giving different access networks, including broadband providers, access to the same content?

A10. For example, the following diagram provides a schematic illustration of how subscribers to FairPoint's network might access content from YouTube.

Figure 1. From YouTube to Your Tube



The subscriber (represented by the PC and monitor) directly connects to the FairPoint network; that network connects, or peers, with other Internet backbones. In order to receive a video from YouTube, the data will flow from the computer located at a Google datacenter, through Google's internal networks, across the Internet backbone networks, through FairPoint's network and then to the subscriber's PC. Data travels through the network at the speed of the slowest link – since "backbone" networks combine traffic from many subscribers, those backbone networks must also be well designed.

Q11. Does all information necessarily travel across the full Internet?

A11. Not all data traverse the full Internet. For example, video services for a broadband network may originate at a regional satellite dish farm (see Figure 1) and then be distributed through a broadband provider's network to subscribers. The power of the Internet is that it allows various kinds of content (e.g., video or information) to be distributed from broadband provider networks or distant Internet providers, such as YouTube.

Q12. Please explain how the design of "backbone networks" can affect the performance and cost of broadband services?

A12. The design of the backbone networks can influence greatly the cost and performance of broadband services. Some Internet backbone networks arose by adapting existing telecommunication networks that were primarily designed for voice traffic. These networks use technology called Asynchronous Transfer Mode (ATM)[1] to establish "virtual circuits" through the telecommunications network. This technology approach was a direct outgrowth of the design of the local telecommunications networks in which telephones were connected by "circuits" to a central office. Once data enter a "circuit," the information doesn't exit until it reaches its endpoint, no matter how many "switches" it may traverse. Adapting these networks to transport Internet data involves adding "abstraction layers" that hide the "circuit like" nature of the network.

New network deployments use "IP networking," which uses Internet Protocol (IP) to move or route data. The main differences are that most "IP Networking" equipment moves larger "chunks" of data (leading to higher efficiency) and the path that data takes

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[1] From the NTIA glossary, "Asynchronous Transfer Mode (ATM): A high-speed multiplexing and switching method utilizing fixed-length cells of 53 octets to support multiple types of traffic. Note: ATM, specified in international standards, is asynchronous in the sense that cells carrying user data need not be periodic."

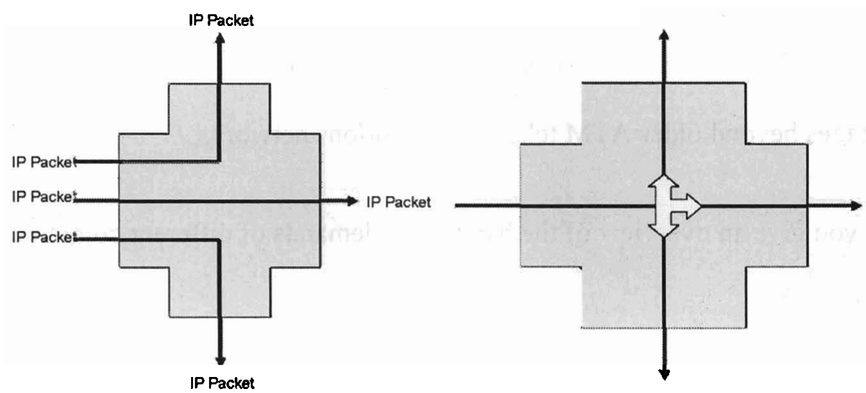
through the network is much more flexible than in ATM networks. It is easiest to understand this difference by way of analogy:

Railroads (ATM) and Freeways (IP)

Traditional ATM telecommunications networks are like railways, while IP networks are more like freeways. In a rail network, trains enter at specific points on the network and have uncontested rights-of-way to their destinations; however, it is difficult and expensive to add new "exits" to a rail line. Sometimes, it may even be necessary for a train to travel in one direction down a track, turn around at a rail yard and then traverse that same track in the opposite direction in order to reach a certain destination. By comparison, cars make "routing decisions" at each roadway intersection, and it is simple to add new intersections to serve new homes because of this design choice. It is also possible to design roadways, like Interstate highways, that are more efficient as a result of limiting the number of on ramps and exits.

The analogy falls short for one important kind of Internet traffic: IP multicast. Multicast data originates from a single location (such as a TV satellite) but is directed to multiple different receivers. Multicast mechanisms are the basis for delivering TV services efficiently over IP networks. In an IP network, the router and switches that make up the "intersections" of the highway are designed to duplicate multicast data directly, and shown in Figure 2.

Figure 2. Digital Railways and Digital Freeways - The Benefits of Native IP Multicast



Without multicast, three packets must traverse the backbone

Native IP switching needs only a single message to deliver multicast content

Source: Author's construct

ATM networks are at a disadvantage for multicast traffic. The switches that make up most of an ATM telecommunication network don't "see" the IP multicast data directly, and thus can't duplicate the traffic in the network. This requires more data to be sent through the network backbone, leading to yet more overhead – it is as if the train is carrying cars, but is unable to benefit from the advantages of cars.

The design of backbone networks is important and integral when planning `high-speed access networks. Modern "high speed" access networks allow throughput of 25-100 megabits per second (Mb/s) of downloadable data. If a thousand customers use a 100

Mb/s network at the same time, a typical OC-3 of 155 Mb/s used for backhaul would be exhausted. Therefore, it is imperative that carriers properly evolve both their backbone and access networks as they attempt to bring higher data speed products and service to their customers. As part of that network evolution it is important to keep in mind that the efficiency of IP backbone networks can provide significant performance benefits and cost advantages beyond older ATM telecommunications networks.

Q13. Could you give an overview of the bandwidth demands of different common applications?

A13. Yes. Most broadband providers are focused on the "triple play" of providing voice, video and data networking to subscribers. Of these services, voice uses the least amount of bandwidth (less than 100 kilobits per second (Kb/s)). The necessary bandwidth demands of data or Web networking are more difficult to quantify because "more is better," up to a point. If we have a gigabit access network, Web data will be received no faster than the web server can provide it. In most cases, 20-30 Mb/s is considered more than sufficient at the upper end for Web access.

Video data would appear to be the most demanding kind of traffic. Industry reports advocating the deployment of high-speed fiber networks point out that uncompressed video consumes tens of megabytes of bandwidth. The bandwidth available in cable networks largely is used to transmit multiple video streams. However, video transmitted in modern IP networks uses compression technology to achieve the same video fidelity with much less bandwidth. As would be predicted by Moore's Law,[2] video compression technology improves with time, leading to less bandwidth consumption with each iterative improvement.

The following table summarizes the bandwidth needs for two generations of video compression technology. The first, MPEG2, is the technology used in DVD movies. The second, H.264, is the technology used in the HDTV, HD-DVD and Blueray video formats.

Figure 3. Improvement in Video Compression

	SD Video	HD Video
MPEG2	4-6 Mb/s	~30 Mb/s
H.264	1-2.5 Mb/s	6-9 Mb/s

Thus, a subscriber wanting to use voice, data and view a single HD video stream all at the same time would need as little as 12 Mb/s of bandwidth (6-9 Mb/s for the video stream with 3-6 Mb/s for data and voice). If 50 Mb/s were available, the subscriber could

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[2] "..(T)he first microprocessor only had 22 hundred transistors. We are looking at something a million times that complex in the next generations—a billion transistors. What that gives us in the way of flexibility to design products is phenomenal." Intel founder, Gordon E. Moore, in 1965. Moore's Law is invoked more generally to describe the tremendous expansion of speed and capacity by all kinds of computer-like devices.

simultaneously watch 3-4 HD videos, provide two voice streams to each of the family's 5 children and browse the web using an 8 Mb/s connection (as fast as the most up-to-date cable modems). Obviously, despite the advocacy of "gigabit to the home," existing Internet applications would be unable to make use of most of that extraordinary bandwidth.

Q14. How do access networks differ in the physical infrastructure they employ?

A14. One of the Internet's design goals was to permit the user to operate over many different physical networking media. Different network technologies have been used by businesses, incumbent telecommunications, cable companies and others. Each technology offers the same capabilities, but at different performance and cost. There are many technologies to consider, and those technologies continue to evolve in terms of performance (speed) and cost.

Q15. Please review the specific different types of access technology and their primary characteristics.

A15. There are five main types of access technology, Ethernet, Digital Subscriber Line (DSL), Cable Broadband, Wireless Broadband, and Fiber and Verizon's FiOS (an example of FTTH). I will briefly describe each one.

Ethernet

Ethernet is used within most business premises and some homes, multi-unit dwellings and increasingly for distribution in "edge networks." Because the technology is a widely adopted commodity standard, components can be relatively inexpensive. Ethernet over copper cabling has limited range ($<$1km and ~100m for 1 gigabit speeds). Ethernet using fiber has longer distance limits, providing 1 gigabit and 10 gigabit speeds to distances exceeding 20km. Ethernet is used in some high-speed broadband deployments, but adoption of the technology for residential broadband is limited by the rapidly-improving capabilities of existing incumbent wiring technologies (i.e., DSL and Cable Modems) and the lack of a large market for gigabit residential connections. Ethernet technology is being deployed in some "greenfield" networks such as the Utopia network in Utah.

Digital Subscriber Line

DSL is a family of technologies developed to use the existing telephone wiring access plant. All of the technologies are designed to work in conjunction with existing voice telephony services. The most commonly used variant of DSL is called ADSL (asymmetric digital subscriber line), which uses the available bandwidth to provide up to 6 Mb/s of downlink connectivity and up to 640 Kb/s of uplink connectivity. Many subscribers are limited to the G.lite version of ADSL, which constrains downlink bandwidth to 1.5 Mb/s and uplink bandwidth to 256 Kb/s.

The majority of DSL deployments in the U.S. use ADSL and ADSL G.lite. Many countries, including France, Sweden, Japan and South Korea, have begun to deploy VDSL, and some countries started deploying VDSL2 in 2007. Recently, Texas

Instruments developed a technology called UDSL (uni-DSL) that allows the different DSL standards to be deployed over the same physical plant, reducing the cost for technology changes.

Figure 4. Distances for Various DSL Technologies

DSL Type	Range (kft)	Downstream Rate	Upstream Rate
ADSL G.lite	18 kft	1.5 Mb/s	0.256 Mb/s
ADSL	12 kft	6.0 Mb/s	0.640 Mb/s
VDSL	3.2 kft	26 Mb/s	3.0 Mb/s
	1 kft	52 Mb/s	6 Mb/s
VDSL2	3.2kft	50 Mb/s	50 Mb/s
	1.63kft	100 Mb/s	100 Mb/s
LR-VDSL	16 kft	1-4 Mb/s	0.600 Mb/s
ADSL2+	3 kft	24 Mb/s	1.1 Mb/s
	12 kft	6 Mb/s	0.512 Mb/s
UDSL		Same as VDSL2	

The different types of DSL support provision of broadband at various distances from the network switching equipment. The enhancements in speed and distance over time are based on the innovation and technology improvements of the equipment located at the end of the copper wires.

In the DSL marketplace, distances are usually specified in kilo feet (1 kft is approximately 300 meters). The distances in the DSL specifications are from the point of distribution, which can be either a central office or a remote distribution point in a multi-dwelling unit (MDU), business or neighborhood. Thus, if a group of customers lives far from a central office, it may be more cost effective to run fiber to a distribution unit near their homes and then use the existing copper infrastructure to deliver 100 Mb/s VDSL2 connections to the homes, rather than to provide new fiber connections to each home. The highest-speed DSL technologies, such as VDSL and VDSL2 are being adopted in the United States. In order to achieve the higher speeds provided by VDSL, most providers are overlaying a fiber network to individual MDUs or neighborhoods. This is done to balance the cost of deploying new infrastructure to each residence when the existing telephone infrastructure is capable of 100Mb/s speeds.

In short, DSL is an evolving standard because the performance of the electronics and the physical architectures permit meaningful improvements to copper-based speeds if the loop lengths are shortened and more advanced versions of DSL are deployed.

Cable Broadband

Cable broadband services are provided by cable television providers using an existing coaxial cable plant (coax). The DOCSIS standards ("Data Over Cable Service Interface Standards") govern the physical and logical signaling over the coax plant. Just as DSL standards work in conjunction with existing voice signals on a phone line, the DOCSIS standards work in conjunction with existing standard-definition (SD) and high-definition (HD) television signals over the coax infrastructure.

The current DOCSIS 2 standard provides performance of up to 42 Mb/s downstream and 30 Mb/s upstream using a single 6 MHz channel. That bandwidth is shared between multiple users and individual usage is usually "capped" at 8 Mb/s downstream with 384 Kb/s upstream. Equipment meeting the recently released DOCSIS 3 standard can theoretically achieve downstream performance of 160 Mb/s using multiple channel frequencies (although it is not certain that this technology will operate at these rates in the field). Unlike earlier DOCSIS standards, the entire 160 Mb/s theoretically may be made available for a single user. As with DSL networks, data signals are distributed to cable modem termination equipment using a fiber network (forming a so-called hybrid fiber-coaxial network).

Wireless Broadband

Broadband Fixed Wireless (BFW) refers to various technologies used to provide high data rate wireless services to users whose locations are fixed. BFW can be viewed as a substitute in some applications for other current broadband access technologies, such as DSL and cable modem (although BFW is not necessarily a true substitute). In the recent past, BFW has most often been deployed through technologies such as Local Multipoint Distribution Service (LMDS) and Multi-channel Multipoint Distribution Service (MMDS). The initial rollout of BFW technologies did not result in the market penetration that many observers anticipated. Some of the reasons for the shortfall included high deployment costs, poor service availability and complications from the use of proprietary technology. The development of new standards, including 802.16 (also called WiMAX), may breathe new life into the BFW market.

The 802.16 standard has only recently been deployed. Speeds of 6 Mb/s have been measured at distances of 6km (19kft).

Fiber and Verizon's FiOS (FTTH)

Unlike basic ADSL technologies, solutions using optical fiber that extends all the way to the customer's premises require a new physical plant to be installed. Most services being deployed in the United States (such as Verizon's FiOS system) use *passive optical networking* or PON networks. In these systems, a signal is modulated by a laser at a central office or a local distribution center. Different variants provide different speeds and ranges. The current BPON and EPON services provide a total of 1.2 Gb/s bandwidth at distances up to 20 km (65 kft). Recent standards such as GPON increase the bandwidth to 2.5 Gb/s at distances of up to 60 km. The bandwidth is shared among as few as 16 and as many as 256 users, resulting in a per-user bandwidth of 75 Mb/s to 4.6 Mb/s, depending on the number of subscribers for EPON/BPON. GPON rates would double the throughput. Current FiOS service offerings range from 5 Mb/s to 50 Mb/s. As with coaxial cable TV distribution systems, passive optical networks allow additional broadcast distribution of TV signals by simply splitting the fiber to multiple homes.

By comparison, *active* fiber networks use switches throughout the network to deliver peak speeds of up to 1 GB/s to individual users. Active fiber networks lack the ability to broadcast a common signal using passive optics; instead, active fiber networks must use switch protocols such as IP multicast. Generally, active fiber networks are thought to cost more to deploy than passive networks due to these additional switches and lasers. However, active networks also enable flexible networking organizations that allow companies to allocate dedicated bandwidth for specific tasks and services, such as providing reliable VoIP, Internet and TV services over the same infrastructure.

Q16. Please summarize how these various access technologies are suited to different situations.

A16. The key insight in the short summary above is that there are several very viable and cost-effective technology options that all provide high data rates up to 100 Mb/s or 150 Mb/s per residence and the "appropriate" technology depends on various factors, including density, geography, likely customer demand, the presence or absence of existing facilities and their condition, and financial issues.

Q17. According to your assessment, is DSL still a viable technology, or should other access technology be mandated?

A17. It is a fallacy that DSL is a dead-end technology and that DSL and fiber technologies are in opposition. Each technology has a place in the deployment of Internet technologies, as has been shown in deployments in South Korea and Japan. South Korea largely has deployed VDSL and VDSL2. Japan has a combined deployment of VDSL and fiber-to-the-home: DSL technologies are used when existing physical plant is available, while fiber is used when greenfield networks are possible or when economics warrant the build-out. In short, mandating a particular technology, such as fiber to the home (FTTH), is not a wise choice. Illustrating this principle, some telecommunications providers are deploying passive optical networking, which is a technology with its own limitations, as it may not be able to offer gigabit speeds to individual users. Switching to an active optical networking would require additional investment, highlighting that technologies (even those such as FTTH) are in evolution and that it is prudent to build networks that can be evolved.

Q18. Is the FairPoint technology deployment strategy consistent with that of other broadband providers both in the US and abroad?

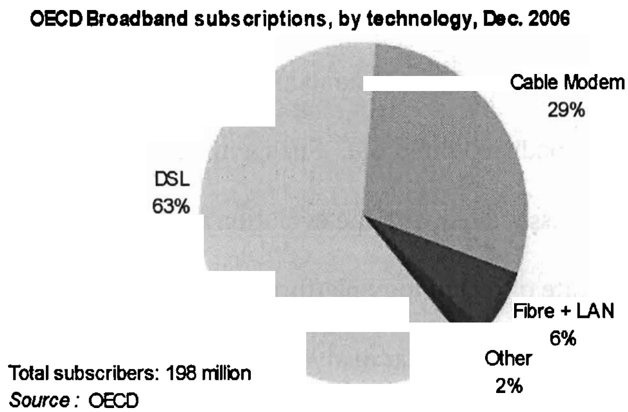
A18. The FairPoint broadband deployment plan, which I describe in more detail below, is consistent with the technologies currently being deployed by other operators in the United States and abroad. There are some areas in the U.S. where companies are deploying FTTH, but those regions typically are either greenfield developments or areas where deployment costs are low relative to the potential returns (more urban, high population density regions).[3] With the exception of Verizon's "FiOS" project, which is targeted to the carrier's more densely populated service areas, virtually all major telephone company broadband projects in the United States use DSL and cable modem technology (and, to a lesser extent, wireless) as the primary "last mile" connection to customers. In fact, it is well documented that DSL is the technology of choice for most telephone companies investing in broadband and that FTTH comprises only a small percentage of the deployed broadband.[4] According to the Organization for Economic Cooperation and Development (OECD), the breakdown of broadband technologies globally in December 2006 was as follows:

- DSL : 63%
- Cable modem : 29%
- FTTH/FTTB : 6%
- Other (e.g. satellite, fixed wireless, powerline communication) : 2%

[3] "Broadband access evolution Pathways beyond ADSL", Alcatel Technology White Paper.

[4] http://www.oecd.org/document/7/0,3343,en_2649_37441_38446855_1_1_1_37441,00.html

Figure 6. Broadband Access Technologies



Q19. Can you summarize the economic and deployment issues facing broadband?

A19. Yes. It is understood that the cost of deploying technology varies greatly and that different technologies have different strengths based on a variety of demographic considerations.[5] Therefore, the decision regarding the broadband technology in which to invest requires an understanding of a complex and evolving number of variables. Investment decisions are based on engineering, economics and market conditions. These decisions are not being driven by explicit government obligations. At the end of the day, a fair-minded analysis is required. The decision how far to push fiber toward the customer is based on an evaluation of whether the market will support the deployment cost.

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[5] See "Broadband access evolution Pathways beyond ADSL", Alcatel Technology White Paper. This article provides data on the relative capex required to deploy a variety of broadband access technologies and shows how DSL is a logical migratory path to FTTH.

Q20. Given such varying economic and technical factors, would it be wise to implement a policy mandate regarding what architecture of services should be adopted?

A20. Such a mandate would ignore the complex financial investment and operating cost decisions associated with broadband build out. Such a mandate would also ignore the diversity of complex issues associated with the evolution of the technology. The idea of mandating a specific data rate or technology platform ignores the determinative factors that drive investment decisions. (A similar analysis must be done for a public investment decision.) A specific data rate might be established as a goal, but requiring a carrier to invest when the return on investment is unknown makes poor business sense. It also puts at risk other basic regulatory goals, such as affordability of service and the financial integrity of the provider. The few carriers that have adopted a "mainly fiber" model generally either already have relatively concentrated service areas or, in the case of Verizon, the carrier is focusing fiber investment in urban areas. Given the deployment considerations that I have described, policymakers with plans to promote broadband deployment must consider not only the speed of the broadband network, but also how rapidly the service is deployed, the breadth of deployment within the service territory, the costs of investment, the resultant price of service, the financial health/longevity of the provider, and the ability to upgrade the deployment as the technology and customer demand evolve.

Q21. Turning specifically to the FairPoint broadband plan, please describe its basic design philosophy?

A21. FairPoint follows the well-understood best practice of first ensuring that the core (backbone) of the network is sufficiently robust to handle the subsequent build out of edge (or access) technologies. In following this philosophy, the company is implementing an Internet Protocol/Multiple Protocol Label Switching (IP/MPLS) core backbone, which will support 10 Gigabit per second data rates. This is a more modern technology than the ATM/SONET technology that Verizon presently has installed in New England. In fact, the Verizon backbone causes a number of inefficiencies and extra costs in the network. In the Verizon network, customer data begins as Ethernet Frames (variable size data packets), which are then encapsulated in ATM cells, which are in turn encapsulated into SONET frames. This means that 20-30% of the network bandwidth is spent on this overhead. It is also difficult to conduct intelligent IP network management because of the different layers of encapsulation, which results in further overhead as data flows in inefficient routes. In contrast, the FairPoint approach makes use of newer technology, namely Gigabit Ethernet, which allows the Ethernet frame from the customer to be more easily routed through the network with less overhead. Ethernet has a 5-6% overhead due to encapsulation, and Gigabit Ethernet can reduce that overhead to 1%. Moreover, IP routers and switches are designed to process Ethernet data directly, making for a more efficient network.

A second FairPoint design practice involves choosing the access technology that best matches the customer's needs. After first upgrading the core (backbone) of the network, FairPoint then is able to modernize the edge (or last mile) of the network in a way that other carriers using ATM/SONET-based backbone cannot. In the second tier of its network, FairPoint will make use of Multi Service Access Nodes (MSAN), which is network equipment that can support a range of access technologies, e.g., basic telephone service, ADSL, VDSL and FTTH. FairPoint presently plans to deploy ADSL2+ and VDSL2, which will support up to 25 Mb/s and 100 Mb/s, respectively (depending upon distance). However, MSANs will allow FairPoint to deploy FTTH for greenfield builds, new businesses and other rebuilds.

In its current service areas across the U.S., FairPoint today serves its broadband customers using different access technologies, including copper, fiber, copper/fiber hybrid, and wireless (in the form of radio frequency transmission). More specifically, FairPoint provides broadband service to its customers with FTTH, ADSL, ADSL2+, VDSL and WiMAX. Ultimately, the customer is indifferent to the specific access technology, provided the service offers reliable and appropriate speeds, consistent with the customer's demand.

FairPoint's initial deployment plan in New England anticipates the use of several types of technologies, with a view to supporting a migration toward higher-speed[6] architectures such as fiber-to-the-home. Part of FairPoint's success in rolling out broadband has been based on the ability to deploy a mix of technologies and tailor technology choices to suit

[6] More accurately, higher "bit rate," which is the number of bits that are conveyed or processed per unit of time. Bit rate is often expressed as connection speed, transfer rate, channel capacity, maximum throughput or bandwidth capacity.

the demands and conditions of each geographic area. The key insight is that FairPoint has the flexibility to evolve its entire network in a way that best ensures meeting the customers' demands in a cost-effective and efficient manner.

Q22. Are you able to provide an evaluation of the FairPoint Broadband Network Design Plan (FairPoint Plan) for Northern New England and Vermont specifically?

A22. Yes. FairPoint's plan for Vermont is representative of FairPoint's plans forNorthern New England. FairPoint has been successful in deploying broadband to lower-density areas. Ninety-two percent of FairPoint's current northern New England customers have access to FairPoint broadband. The FairPoint Plan is a reasonable and sound approach to aggressively deploy broadband to consumers throughout the region. Of the 85 Verizon Central Offices (COs) in Vermont, 73 presently offer at least some broadband service. FairPoint plans to enable the other 15 COs and aggressively upgrade the digital loop carriers to further deploy broadband to more customers. The FairPoint Plan is based on an investment approach that targets both improvement of the core network and deployment of broadband services to consumers. Specifically, FairPoint plans to deploy an IP/MPLS backbone network to ensure that its broadband users do not experience major source congestion as data travels to and from other networks. Additionally, FairPoint plans to increase the availability of broadband to a much higher percentage of locations in the region. The FairPoint Plan, which is described in the Joint Rebuttal Testimony of Michael Harrington, Michael Brown and John Smee, describes how much will be invested in the network and when the investment will occur. It also describes the types of technologies that will be deployed and how the technology supports migration toward higher-speed architectures such as fiber-to-the-home. FairPoint has announced that it will exceed Verizon's obligation under the Amended Incentive Regulation Plan to be 80 percent broadband qualified by 2010.

Q23. In summary, what has your research and analysis revealed about the FairPoint broadband plan for New England?

A23. FairPoint is approaching the evolution of its broadband service to New England customers in a way that is consistent with well-understood best practices in network design. The company is building out the core of its network to ensure that the architecture is more flexible and that no bottlenecks exist as higher data rate services are deployed at the edge. The company is expanding the reach of broadband to customers in northern New England so that availability is expected to improve markedly from the current level. Finally, the company is designing its network to support a variety of emerging technologies, which will allow for the deployment of various broadband access technologies that match the needs of the customer. To review the summary at the beginning of my testimony, I conclude:

1. *The plan establishes a solid network core that can efficiently service customers using a variety of access network technologies that are appropriate to specific locales.*

2. *The plan is consistent with the technologies currently being deployed by other operators in the United States and abroad.*

3. *The plan is designed to ensure a significant and wide-spread build-out to large numbers of additional customers.*

4. *The plan will provide increased capacity for most current uses and can be evolved as needed to meet higher speed customer needs.*

5. *The plan will help develop the infrastructure required to meet the needs of particular high-capacity customers.*

Therefore, I conclude that DSL is a reasonable, forward-looking technology and that FairPoint's plan is a sound approach to broadband deployment.

Consistency with Vermont's Broadband Goals

Q24. Have you reviewed the Vermont Department of Public Service (DPS) reports concerning broadband deployment?

A24. Yes.

Q25. Could you please summarize the VT DPS documents?

A25. Yes. I reviewed *Access for All: Meeting Vermont's Broadband and Wireless Goals* (February 2007) and *Understanding Broadband Deployment in Vermont* (February 2007). Together, these documents describe how Vermont state agency and department policies, procedures and regulations affect broadband deployment and how Vermont may make the best progress in achieving its broadband deployment goal of providing ubiquitous broadband availability to all Vermonters by 2010 –fostering rapid deployment of broadband to fill gaps in availability, while making efforts to support development of next generation networks that will not be quickly outdated.

Understanding Broadband Deployment notes Vermont's challenge in deploying ubiquitous broadband services in a largely rural (and low population density), rocky and mountainous state, which increases deployment costs and both decreases incentives for large companies and creates a barrier for fiber, cable and fixed wireless start-up companies with little capital for initial equipment investment and operating costs, while satellite and fixed wireless will quickly be outdated by increasing bandwidth demands of new applications. There is a dual problem of capital availability (large national companies such as Verizon and start-ups as in the case of WISPs) and prohibitive infrastructure cost (Fiber, Cable). Large national companies are more apt to focus investment on dense population areas and deploy new technologies there, while WISPs are under-funded and Fiber and Cable infrastructure are too costly to build out in low density areas. The report states:

> Large national providers have had the capital resources to deliver on large broadband deployment . . . but Vermont has not been the most compelling market on its own for capital investment by these corporations. These larger companies have capital resources across the corporation that dwarf the capital needs of Vermont. However, they . . . have many demands, often more profitable than Vermont opportunities, for their overall capital resources.[7]

The report further states that, "Small local WISPs have been a sector with extreme capital challenges. These companies are start-ups . . . they are often financed by their owner or a

[7] Understanding Broadband Deployment, p. 10.

small number of private individuals with only limited financial resources."[8] Concerning cable, the report concludes that, "(t)he cost for cable line extension is approximately $20,000 per mile. This relatively high cost presents a barrier to expanding into low-density areas."[9]

Q26. Are the goals of the FairPoint plan consistent with Vermont's goals?

A26. Yes. The FairPoint plan has the same goals as outlined in the VT DPS reports. Broadly, FairPoint's plan calls for deployment of broadband services to areas in Vermont that are currently un-served, particularly rural areas, while also installing infrastructure that is capable of meeting strenuous demands of future applications; a plan completely in line with the broadband goals of Vermont.

Q27. Does the FairPoint plan help achieve the goals specified in the VT DPS documents?

A27. Yes. As stated, Vermont's goals are two-fold:

1. To foster rapid deployment of broadband in the short-term so that by 2010 there is ubiquitous broadband availability; and
2. To ensure in the long-term that Vermont's networks remain adequate to support the demands of future applications –"networks capable of delivering video, very

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[8] Id. at 11.

[9] Id. at 13, citing data from Adelphia's 2005 Annual Report.

high speed Internet, and voice [next generation networks] . . . characterized by an increasing use of fiber optic technology . . ."

FairPoint's plan addresses Vermont's first goal by specifically targeting lower-density, rural, un-served areas. FairPoint has demonstrated success in deploying broadband to lower-density areas, as demonstrated by the high percentage of current FairPoint northern New England customers that have access to broadband services. As discussed above, FairPoint plans to enable the 15 COs in Vermont that do not already support broadband to do so and aggressively upgrade the digital loop carriers to further enable broadband to more customers. Thus, FairPoint plans to upgrade the current telephony infrastructure to deploy broadband services to customers that can be reached, but do not currently have broadband availability through Verizon.

FairPoint's plan meets the second goal of the development of next generation networks (now being deployed in larger metropolitan areas) that are capable of supporting future Internet, television and telephone services. FairPoint's plan calls for intensive infrastructure installation and upgrades, building out a robust core, or backbone, network and modernizing the access network.

Q28. Could you provide the details of how FairPoint's plan meets the goal of providing next generation networks capable of delivering video, very high speed Internet, and voice with increasing use of fiber optic technology with respect to the core or backbone portions of its network?

A28. Yes. FairPoint's planned network, as described above, would clearly support Vermont's goal of developing a next generation network capable of supporting video, Internet, voice and emerging applications. To give a specific example, IP/MPLS and IP/Ethernet architectures provide for IP multicast services such as IPTV. This same multicast capability also can be used for schools and businesses to broadcast video or audio from one location to multiple locations. This can be used to provide for broadcast of lessons from one school location to many and for video conferencing from one business location to several on the network. Including Internet Group Multicast Protocol (IGMP) allows for minimal bandwidth usage on the network and minimizes the risk of network congestion. FairPoint presently offers IPTV services in Yelm Washington and is developing them for use in Missouri across the IP/Ethernet based network. This service includes 145 plus channels of Video, 45 channels of Music and Video on Demand. Thus, FairPoint's plan supports Vermont's specific goal of next generation networks that support video and goes beyond by supporting IP multicast services while minimizing any congestion when utilizing this application.

Q29. How does FairPoint's plan meet the goal of providing next generation networks capable of delivering video, very high speed Internet, and voice with increasing use of fiber optic technology with respect to the access network portions of its operation?

A29. A second FairPoint design practice involves choosing the access technology that best matches the customer's needs. After first upgrading the core (backbone) of the network, FairPoint then is able to modernize the edge (or last mile) of the network in a way that other carriers using ATM/SONET-based backbone cannot. In the second tier of its network, FairPoint will make use of Multi Service Access Nodes (MSAN), which is network equipment that can support a range of access (last mile) technologies, e.g., basic telephone service, ADSL, VDSL and FTTH (Fiber To The Home). FairPoint presently plans to deploy ADSL2+ and VDSL2, which will support up to 25 Mb/s and 100 Mb/s, respectively (depending upon distance). MSAN devices also support the provisioning of Fiber to the home utilizing either Gigabit Passive Optical Networks (GPON) or Active Ethernet standard technology to allow 2.4 Gb/s of total bandwidth with an average bandwidth of IP/MPLS 75 Mb/s per customer using GPON or up to 1 Gb/s with Active Ethernet.

MSANs will allow FairPoint to deploy FTTH in the future for greenfield builds, new businesses and other rebuilds. FairPoint has deployed Fiber-to-the-Home from this same platform in several new Greenfield subdivisions in Washington, Florida and Missouri using both GPON and Active Ethernet. In its current service areas across the U.S., FairPoint today serves its broadband customers using different access technologies, including copper, fiber, copper/fiber hybrid, and wireless (in the form of radio frequency transmission). More specifically, FairPoint provides broadband service to its customers with FTTH, ADSL, ADSL2+, VDSL and WiMAX. Ultimately, the customer is indifferent to the specific access technology, provided the service offers reliable and appropriate speeds, consistent with the customer's demand. FairPoint's initial deployment plan in New England anticipates the use of several types of access technologies, with a view to supporting a migration toward higher-speed architectures such as fiber-to-the-home. Part of FairPoint's success in rolling out broadband has been based on the ability to deploy a mix of technologies and tailor technology choices to suit the demands and conditions of each geographic area. The key insight is that FairPoint has the flexibility to evolve its entire network in a way that best ensures meeting the customers' demands in a cost-effective and efficient manner. The FairPoint Plan is a reasonable and sound approach to aggressively deploy broadband to consumers throughout the region. The FairPoint Plan also is based on an investment approach that targets both improvement of the core network and deployment of broadband services to consumers.

Q30. You have explained how the details of the FairPoint plan help meet the Vermont's policy goals and concluded that it is a reasonable and sound approach. Why do you conclude that FairPoint's plan for broadband deployment in Vermont is sound and reasonable?

A30. Specifically, FairPoint plans to deploy an IP/MPLS backbone network to ensure that its broadband users do not experience major source congestion as data travels to and from other networks. Additionally, FairPoint plans to increase the availability of broadband to a much higher percentage of locations in the region. The FairPoint Plan explicitly states how much will be invested in the network and when the investment will occur. It also describes the types of technologies that will be deployed and how the technology supports migration toward higher-speed architectures such as fiber-to-the-home.

FairPoint is approaching the evolution of its broadband service to New England customers in a way that is consistent with well-understood best practices in network design. The company is building out the core of its network to ensure that the architecture is more flexible and that no bottlenecks exist as higher data rate services are deployed at the edge. The company is expanding the reach of broadband to customers in northern New England so that availability is expected to improve markedly from the current level. Finally, the company is designing its network to support a variety of emerging technologies, which will allow for the deployment of various broadband access technologies allow the provisioning of more enhanced services and data rates as they are requested.

Q31. Does this conclude your rebuttal testimony?

A31. Yes.