NEW PARADIGM RESOURCES GROUP, INC.'S

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Key Data & Analysis … Concisely Presented

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Dark Fiber: Means to a Network

INTRODUCTION

Of course, dark fiber does not get its name from being colored black. Rather a more accurate description would be the following:

> *Dark fiber is optical fiber infrastructure (cabling and repeaters) that is currently in place but is not being used. Optical fiber conveys information in the form of light pulses so the "dark" means no light pulses are being sent.*[1]

Why does dark fiber exist in the first place? One may initially think that given the high expense of digging up the ground, companies would install only as much fiber as their operations called for. However, it is due to the high cost of building a network that companies often lay more lines than what's needed, *i.e.*, they can avoid future costs of having to install more fiber again and again as their needs increase.

Overall, three basic scenarios transpire once the fiber is put in the ground depending upon the character of the company or organization doing the installation. Some companies are what New Paradigm Resources Group, Inc. (NPRG) refers to as the *active fiber installers*. For these companies much of their whole reason for existence revolves around getting excess fiber in the ground in order to sell or lease to other companies or individuals who want to establish an optical network among their own locations. Other companies initially end up putting the fiber in the ground for their own use or for the provisioning of their services to customers only to realize that they have excess capacity. Therefore these companies *react* to the situation by becoming ad-hoc dark fiber providers leasing capacity as an additional part of their repertoire of services depending upon customer need. Finally, there are organizations such as municipalities or scientific research networks that install fiber specifically for their own use and simply keep in *reserve* any excess capacity that they may have with the assumption that sooner or later it will be filled.

The companies or organizations that build dark fiber networks can in addition be dichotomized as either long haul or metro providers. The former lay fiber in the style of the interexchange carriers (IXCs) (in fact many long haul providers are IXCs) connecting point-to-point over vast distances. The metro providers of course grapple with the harder challenge: comprehensively laying down accessible fiber in urban areas—where digging up the ground can be a logistical and bureaucratic nightmare—so as to cover the proverbial "last mile."

At this stage the reader may want to ask him or herself what's so great about dark fiber beyond its mundane applicability as an information conduit? Well, first of all dense wavelength division multiplexing (DWDM) and other bandwidth extension technologies are dramatically increasing the amount of information that can be put on a strand of fiber decreasing the mundane factor and upping that of applicability. But beyond its obvious

[1] David Foxley, "*Dark Fiber*," 1999 TechTarget.com, Inc., 31 January 2002.

importance as an optical information conduit, what is the importance of dark fiber as a customer product? This is an important question because it looks beyond the issue of overcapacity or under capacity addressing the intrinsic value of dark fiber to an organization. Clearly, if dark fiber is something that is intrinsically valuable to the end user, in the long run both users and the companies that they are obtaining dark fiber from stand to benefit notwithstanding the short run issues of there being too much or too little fiber in the ground.

What we will argue here is that dark fiber does have intrinsic customer value. Taken as a given its uses as an informational transport medium, what is really remarkable about dark fiber is its applicability as a means to a robust and flexible network structure for any organization that acquires it. Finally, this paper will conclude with dwelling on the availability of dark fiber and its typical costs.

THE POTENT EFFECT OF DARK FIBER ON AN ORGANIZATION'S TRADITIONAL TELECOM MODEL

In a nutshell, an organization's dark fiber network can provide an alternative pipeline serving to circumvent the traditional carrier business model based on managed network services built around carrier-owned infrastructure.[2] This is especially true as metro area fiber branches out to combine with other private long haul, DWDM networks. By essentially giving organizations the raw material for their own networks, dark fiber transfers to them many of the network leveraging advantages once had only by carriers. In short, dark fiber is a means to a network, a way for non-telecom entities to have some of the communication and cost advantages of the telecom providers.

Properly deployed, dark fiber utilized for metropolitan area networking applications provides organizations with the following general network advantages:[3]

- It puts the organization in the driver's seat in terms of control of the growth and development of its network by providing nearly unlimited, unmetered bandwidth.
- The above translates into stronger user guarantees with regard to capacity, speed, flexibility, security, and reliability.
- Dark fiber provides greater control over the provisioning of telecom services given that they have more flexibility and options with regard to network connections

[2] Bill St. Arnaud, *"Frequently Asked Questions about Customer Owned Dark Fiber, Condominium Fiber, Community and Municipal Fiber Networks"* 2001 Canarie, 31 January 2002.

[3] Cheri Podzimek, *"Taking a Second Look at Dark Fiber"* 2000 BICSI, 31 January 2002 .

- Finally, communication operation costs are lowered.

More specifically, dark fiber offers a range of additional network advantages as detailed below.[4]

For large of small organizations or enterprises:

- Significant reduction in local loop telecom costs.
- Allows for the business to connect directly to a collocation facility, thus providing streamlined access to a greater number of service providers as well as the ability to seamlessly change providers as need be.
- "Customer facing" servers such as e-commerce servers, web hosting servers, *etc.* can be located at carrier neutral collocation facility where there is redundant power, 24-hour security, and multi-homing services. If the telecom link between the collocation facility and the office goes down, no customers are affected.
- Ability to deploy redundant paths to multiple carriers, thus avoiding the cost and headache of having to purchase separate SONET-based services from different carriers at considerable cost.
- Relocation of speed sensitive network servers to a server farm. Normally speed sensitive servers such as LAN-based video and audio servers have to be located on the LAN next to the user. However, as there are no speed limitations with dark fiber these servers can be easily located at a central server making overall network management easier.

For the owners of large buildings:

- Elimination of congestion in the risers from new-entrant telecom companies wanting access to a building's tenants, thus saving valuable floor space.
- Reduction of congestion in the building access ducts and machine rooms.
- Significant reduction in the cost of telecom services for tenants.
- Allows for the building to connect directly to a collocations facility thus having streamlined access to a greater number of service providers as well as the ability to seamlessly change providers as need be.

[4] Bill St. Arnaud, *"Frequently Asked Questions about Customer Owned Dark Fiber, Condominium Fiber, Community and Municipal Fiber Networks"* 2001 Canarie, 31 January 2002.

Interestingly enough, even companies that don't have a lot of dark fiber, such as ISPs or small communication providers, also benefit even if they are not the ones purchasing the fiber. This is due to the fact that with potential customers already having dark fiber, they can compete for business on a level playing field with the RBOCs and larger telecom firms without being at a disadvantage for establishing a last mile connection since the customer already owns the fiber.[5]

As evidenced from above, what a dark fiber network basically does is transfer control of the last mile from carrier to customer. No longer being a mere passive recipient of a connection with a greater network, organizations can now actively connect with it in whatever ways that their dark fiber strands can reach. In a word, the availability of dark fiber enables organizations to have greater autonomy in how they can position and structure their telecom networks. Problems about waiting for a carrier to decide how to bridge the last mile thus become less relevant.

Given the fact that dark fiber can go in one continuous strand from user to ultimate destination, no active devices are required in the fiber path. The user does not need to invest in expensive network path devices such as SONET multiplexers, Add/Drop multiplexers, ATM switches, routers, *etc.* In fact for reliability a customer can simply install additional fiber links to various service providers—typically this is less expensive than having some kind of total managed service from a carrier.[6]

To sum up, dark fiber allows a user's network costs and complexities to be reduced in a number of ways:[7]

- Customers can have a single unprotected fiber link and basically have the same level of reliability as currently exists with their carrier.
- Dark fiber has no active devices in its path, therefore it is easier to manage and fewer things are likely to go wrong.
- Dark fiber allows organizations to centralize servers and/or outsource many different functions such as web hosting, server management, etc.
- Centralization can allow for the need for fewer servers, thus reducing overall network management expense.
- Finally, fiber has greater tensile strength than cooper or steel, is less susceptible to breaks from wind or snow loads, and can be repaired and maintained by a variety of outsourced providers.

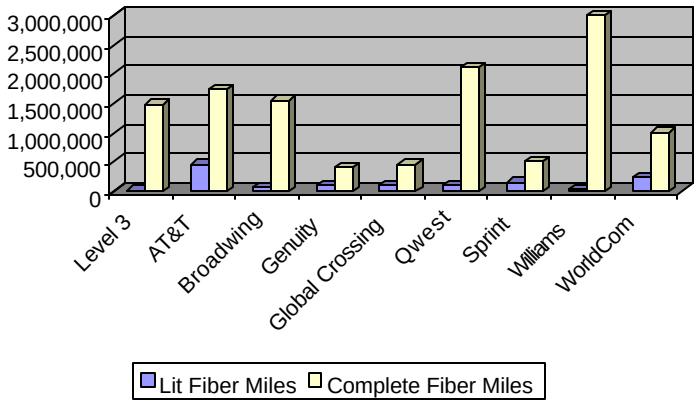
[5] *Ibid.*
[6] *Ibid.*
[7] *Ibid.*

THE AVAILABILITY OF DARK FIBER

According to most industry analysts there is a large amount of dark fiber in the ground that is currently not being used, in fact most industry analysis suggests that some *95 percent* of installed fiber is dark. Much of the reason for this derives from the fact that many telecom providers overestimated customer demand and overbuilt their networks. Where this leaves the end user is in the enviable position of being able to draw upon the surplus in both the long haul and to lesser extent in the short haul arenas.

The fact that there is current surplus in dark fiber is confirmed by some of the latest industry data[8]:

Figure 1: North American IXC Fiber Deployments vs. Fiber Lit

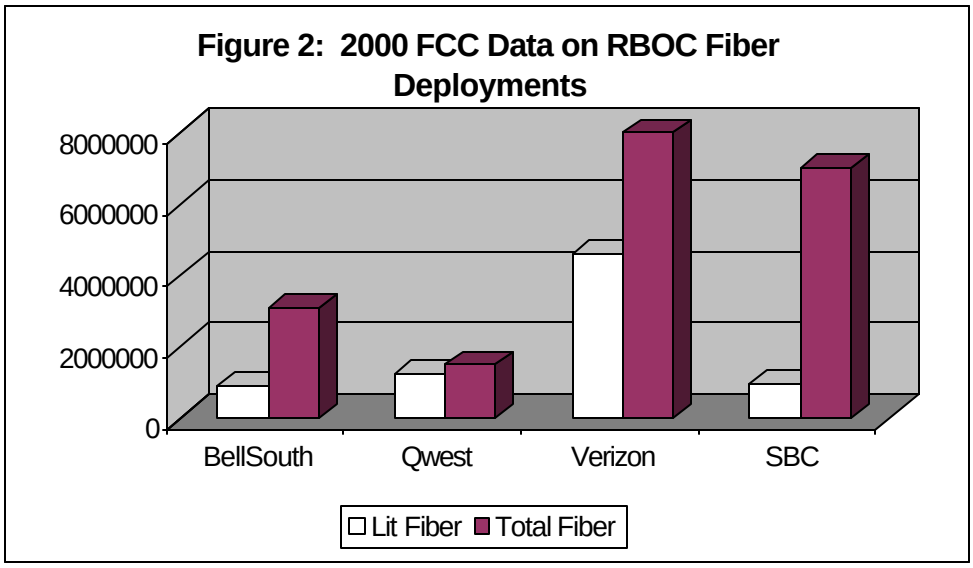


Source: Level 3

Nor is this issue of over capacity only limited to long haul fiber of the IXCs.[9]

[8] Sam Kingston, *"Optical Fiber and Components,"* 2002, Dresdner Kleinwort Wasserstein Securities Limited, 31 January 2002.

[9] *Ibid.*



Source: FCC

So even in the metro areas, the RBOCs, at the very least, appear to have significant amounts of available dark fiber. Overall the evidence seems to point to the fact that the RBOCs and the other metro fiber providers will continue to want to sell dark fiber on their networks in order to recoup some of the massive installation costs that they incurred in putting the fiber in the ground.

COSTS AND OWNERSHIP STRUCTURE OF DARK FIBER

Typically, when wanting to get some existing dark fiber, a user will have two general options: either buying up the fiber from a carrier or committing to an indefeasible right of use (IRU) with that carrier. An IRU functions the same way a lease on an apartment or building would function, *i.e.,* the fiber is the customer's to use for a specified period—usually 20 years—with basic maintenance remaining the responsibility of the carrier. Just like certain types of leases, the IRU can be looked upon as a physical asset, which can be resold, traded, or used as collateral. [10]

Obviously dark fiber that is already installed is the real bargain since the biggest cost component of fiber networks is the installation cost. As costs stand right now, strands of fiber can go for as little as $.50 per meter per strand (if the fiber is directly purchased by the user) to around $6.00 per meter per strand for a 20 year IRU. Given that the whole dark fiber industry is evolving, there also definitely exists a possibility for

[10] Bill St. Arnaud, *"Frequently Asked Questions about Customer Owned Dark Fiber, Condominium Fiber, Community and Municipal Fiber Networks"* 2001 Canarie, 31 January 2002.

"wheeling and dealing" down the price. In some cases, by agreeing to pay for certain build outs and swapping fibers with other new entry carriers knowledgeable fiber customers can lower their IRU costs to around $3.00 per meter per strand, while customers that buy the fiber may be able to reduce their per strand cost to less than $.10 per meter per strand. It is in fact predicted that as the industry matures the cost of deployed dark fiber is expected to drop down to $.07 to $.10 per meter per strand.[11]

In addition to the actual prices per strand of fiber, typically the cost equation also consists of the following components:[12]

- Trunks: The main fiber cables that may carry hundreds of fiber strands owned by a variety of carriers and institutions. Usually the cost is shared by the parties using the trunk

- Laterals: Fiber cables from the customer premises to the nearest splice point on the cable trunk. These are the fiber stands whose pricing scheme is explained in the paragraph above.

- Termination Panels: The facilities within the customer's premise for the termination of the fiber. On average a fiber panel termination is about $5,000 but may vary from as little as a few hundred dollars to $15,000-$20,000. The large variation in cost is due to many factors including whether the installers have to drill through concrete walls to terminate the fiber and/or bring up the fiber several floors in a building riser.

- Additional Customer Premise Equipment: This usually consists of simple laser devices called transceivers, which are required to light up the fiber. These devices will work with SONET, ATM, and Ethernet devices at either end of the fiber connection. As such there are usually only three things that can go wrong with user fiber: the source transceiver, the destination transceiver, or the fiber itself.

  Typical prices for transceivers in late 2001 ranged from $500 for a Fast Ethernet (100 Mbps) to $2,500 for a Gigabit Ethernet transceiver. It is predicted that prices for such equipment will drop dramatically in the coming years.

It should be mentioned that the above cost scheme is for businesses that want their own dark fiber, not for CLECs or potential carriers that want to purchase giant dark fiber networks to use in service provisioning—this situation raises issues beyond the scope of this paper.

[11] *Ibid.*
[12] *Ibid.*

Like other network services, the actual cost of dark fiber will vary based on volumes purchased as well as whether the plan of use involves total ownership, an IRU, or a month-to-month fee plan, which is being offered by a few providers. The month-to-month fee plan withstanding, most users opt for some kind of IRU or in a few cases for total ownership. It would be wrong however to merely view IRUs and total ownership as having some kind of strict dichotomy between them. It would be more appropriate to characterize these two concepts as being together on one spectrum. The fact of the matter is that many carriers can offer the user a variety of "ownership" plans, which vary depending upon the infrastructure, maintenance, and technical support, furnished by the provider. Another option sometimes taken advantage of is for the user to buy the network outright and then turn over its maintenance and support to a third party provider.

It should also be noted that by owning its own dark fiber network, a company gains the ability to capitalize telecom expenses associated with the network rather than treating them as an ongoing service cost. As a capital investment dark fiber may also be depreciated for federal tax purposes. The really interesting thing about fiber is that it at once is a capital investment, which can be traded like a commodity. Certainly, fiber swaps will remain important as companies may have over capacity along some routes and under capacity along others. Michael Gisby describes an interesting tax nuance of this fact in *tele.com*[13]:

> *Swapping is another effective tax strategy when dealing with dark fiber. Under this approach, a company with excess fiber or capacity on its Chicago-Los Angeles route but not enough on its Chicago-New York lane, for example, can team up with another company that may have the opposite situation. The swap may be considered either a leasehold swap or an asset swap with similar consequences. In fact, these contracts can often be structured as a Section 1031 transaction, which is essentially a tax-free swap transaction. This is allowed because each company is basically gaining the same thing back that it swapped, making it a nontaxable event.*

CONCLUDING NOTE

One danger for dark fiber as a stable paradigm is that providers providing multigigabit wavelength services, such as DWDM, that have greatly multiplied the bandwidth potential of dark fiber, may reduce the need for users to acquire that much dark fiber in the first place. For the time being, dark fiber critically applied can be a good investment for an organization needing its own fully autonomous stock of bulk bandwidth and connectivity. Of course, for those organizations that feel less of a need to have their own autonomous fiber network and want more from the service side, some

[13] Michael Gisby, *"Companies with dark fiber are in luck—if they understand the tax implications,"* 2001 tele.com, 31 January 2002.

kind of managed wavelength service may be of more appeal to them. Still, DWDM and other wavelength technologies, as argued at the start of this paper, may also make organizations want fiber all the more since it remains the critical conduit for these wavelength technologies. In the coming years it will be interesting to watch how plain dark fiber will compete against wavelength as a cost-effective transport medium, however, at this early stage one can only state that both mediums have different types of costs associated with them and appear to appeal to different types of organizations as mentioned above. At any rate, whether as a commodity or capital investment, dark fiber is surely versatile in its applications as a potential bandwidth conduit and as the bedrock for an organization's own autonomous private network.

APPENDIX:

MAJOR NORTH AMERICAN DARK FIBER PROVIDERS

ACSI Network Technologies	Dominion Telecom	Neon
Adesta Communications	Enkido	PFNet
AEP Communications	Enron Broadband Services	Phonoscope
Aerie Networks	Evolution Networks	Progress Telecom
American Fiber Networks	Fiber Technologies	Qwest
AT&T	FiberNet Telecom Group	R&B Communications
AVISTA	Fiberworks	SBC
BellSouth	First Energy	SDN Communications
Broadwing	FPL Fibernet	Sierra Pacific Sprint
BTI Telecom	Genuity	Time Warner Telecom
C2C Fiber	Global Crossing	Touch America
C3 Networks	Global Metro Networks	Verizon
Cambrian Communications	GPU Telecom Services	Viatel Global Communication
Caprock Communications	KMC Telecom	WCI Cable
CFW Communications	Level 3 Communications	Williams Communications
Con Edison Communications	Lightwave Communications	XO
Dedicated Fiber Solutions	Looking Glass Networks	
	MCI Worldcom	
	Metromedia Fiber Networks	
	NeesCom	

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(Info as of 02/01/2002)

Provider*	Ticker Symbol	Close 2/01/2002	Market Cap ($000)**	52 Week Range	1Mo.% Change	12 Month % Change ***
Adelphia Business Solutions	ABIZ	$0.12	$16,140	0.0500 - 9.6875	-79%	-99%
Allegiance Telecom	ALGX	$5.50	$633,600	2.7400 - 35.7500	-34%	-83%
Alltel Corporation	AT	$55.68	$17,283,072	49.4300 - 65.1500	-10%	-6%
AT&T Corporation	T	$16.52	$58,480,800	14.7500 - 24.6000	-9%	-32%
AT&T Canada	ATTC	$29.87	$2,900,377	27.0100 - 30.8125	-1%	-2%
BellSouth Corporation	BLS	$39.20	$73,696,000	36.2600 - 44.1900	3%	-9%
CEI Networks	CENI	$31.55	$254,609	13.3750 - 38.7500	-1%	109%
Choice One Communications	CWON	$2.40	$247,200	1.0300 - 16.3750	-31%	-84%
Citizens Communications	CZN	$10.03	$28,986,700	8.2000 - 15.8800	-6%	-28%
CoreComm Ltd.	COMM	$0.10	$9,840	0.0600 - 3.5000	-33%	-97%
Commonwealth Telephone Co.	CTCO	$41.45	$969,930	28.2500 - 48.8900	-9%	13%
Covista Communications, Inc.	CVST	$7.44	$80,352	1.1875 - 10.2500	-23%	272%
Cox Communications	COX	$37.08	$22,270,248	35.2400 - 47.1000	-12%	-21%
CTC Communications	CPTL	$4.70	$127,370	2.6500 - 15.6250	-9%	-68%
CTC Exchange Services, Inc.	CTCI	$15.55	$292,340	10.2500 - 24.0000	-6%	-13%
CenturyTel, Inc.	CTL	$31.88	$4,498,268	25.4500 - 36.5000	-3%	3%
Electric Lightwave, Inc.	ELIX	$0.47	$24,111	0.2300 - 6.1875	57%	-91%
FiberNet Telecom Group, Inc.	FTGX	$0.30	$12,150	0.1100 - 6.0000	-19%	-94%
Focal Communications Corporation	FCOM	$0.40	$68,520	0.2700 - 17.8750	-34%	-97%
General Communications, Inc.	GNCMA	$8.70	$475,890	6.8750 - 12.4500	2%	16%
HickoryTech Corporation	HTCO	$14.50	$201,550	12.0000 - 19.1875	-14%	-20%
ITC DeltaCom	ITCD	$0.38	$23,712	0.2800 - 9.1250	-56%	-96%
Level 3 Communications	LVLT	$3.01	$1,152,529	1.8900 - 46.3750	-40%	-92%
MCI Group	MCIT	$11.91	$1,408,953	10.6900 - 19.3300	-6%	N/A
MFN, Inc.	MFNX	$0.41	$316,356	0.2500 - 17.4375	-7%	-97%
Mpower Communications, Inc.	MPWR	$0.34	$20,196	0.0900 - 9.1250	-24%	-93%
Network Plus Corporation	NPLS	$0.28	$18,788	0.1600 - 8.7500	-76%	-97%
Neon Communications, Inc.	NOPT	$0.39	$8,307	0.2700 - 19.9375	-86%	-98%
NTELOS, Inc.	NTLO	$9.50	$160,550	5.8000 - 31.0900	-39%	-61%
Penn Telecom, Inc.	NPSI	$17.00	$255,000	9.6250 - 18.9800	-8%	55%
Pac-West Telecomm, Inc.	PACW	$0.59	$21,299	0.4200 - 6.6875	7%	-90%
RCN Corporation	RCNC	$2.12	$206,276	1.7500 - 12.7500	-28%	-82%
Qwest Communications International	Q	$10.00	$16,600,000	8.5100 - 41.8900	-29%	-76%
SBC Communications, Inc.	SBC	$36.96	$124,185,600	35.0900 - 50.8500	-6%	-27%
Sprint Corporation	FON	$17.22	$16,761,948	13.8000 - 25.5700	-14%	-30%
TDS Metrocom	TDS	$84.65	$4,960,490	79.4000 - 111.2500	-6%	-20%
Time Warner Telecom, Inc.	TWTC	$12.55	$1,435,720	5.7600 - 78.1250	-29%	-84%

Provider*	Ticker Symbol	Close 1/16/2002	Market Cap ($000)**	52 Week Range	1Mo.% Change	12 Month % CHANGE ***
U.S. LEC Corp.	CLEC	$4.95	$129,195	2.1600 - 9.3750	-9%	-36%
Verizon Communications	VZ	$46.60	$126,286,000	43.8000 - 57.4000	-2%	-15%
Williams Communications Group	WCG	$1.42	$696,794	0.5500 - 18.7500	-40%	-92%
WorldCom Group	WCOM	$9.61	$28,445,600	6.9000 - 23.0625	-32%	-57%
DSLnet Communications	DSLN	$1.00	$64,800	0.1400 - 4.0000	-21%	-67%

* Companies included in this ***MarketWatch*** are publicly-held CLECs, Data CLECs, ILECs, ILECs owning CLEC subsidiaries, and RBOCs.

** Market Capitalization is calculated as the current market price times the most recent reported shares outstanding.

*** " N/A" indicates the information is not available because the stock began trading within the month, or less than 12 months ago.

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