1. Executive Summary

In the 1990's and early 2000's, utilities went through the partnering frenzy with carriers or established their own telco subsidiaries to build out fiber routes with the anticipation of selling the capacity to customers. In the last few years, however, and significantly noticed since the 2004 fiber report, the number of competitive telecom business units (Utelcos) significantly declined, leaving in its wake a fiber plant ripe for the use and development for internal purposes, or for selling excess capacity as a "side" business. Utilities, seeing losses in operation of their Utelcos, realized that they were best to stick to their core business, and leave the telco business to carriers or others who had telecommunications as their core business areas. The Utelco Alliance, formed as a group of telecom service providers with UTC, is nearly ended. Some of the notable Utelco sales since the 2004 fiber report include:

- Dominion Telecom to a subsidiary of Elantic Networks, Inc.: 2004
- Con Edison Communications to RCN: 2005
- Progress Telecom to Level 3: 2006
- PPL telecom to Communications Infrastructure Investments: 2007
- Idacomm to American Fiber Systems: 2007

Today, based on the respondents to the survey conducted for this report, any buildout of fiber networks is considered first as a priority to meet internal operational requirements, then secondly, to sell excess capacity. However, selling the excess capacity and putting investment in the fiber plant is done only when there is a customer in hand. At that point, the cost to establish dark fiber to the customer (including extending fiber to their premise) is established, with terms and conditions to ensure the utility can recover its cost in a reasonable time frame.

1.1 Fiber Application and Technology Trends

Based on KEMA industry experience and the research performed for this Report, fiber is found to be in widespread use throughout the utilities. However, new additions to existing plant is limited, driven only when an opportunity exists to expand, such as through partnering to help pay for the fiber (right-of-way for fiber strands), or new transmission line builds where optical ground wire can be installed the most cost-effectively. In the case of those utilities who sell excess fiber, additions are considered when finding a customer who can help recover the cost of a build.

Of the utilities surveyed, a vast majority indicated that internal uses for the fiber network (corporate or operational) were the main driver for the investment. A breakdown of the reasons is shown in Figure 1-1.

Fiber buildout plans are a result of opportunities that develop to build on a specific route. Reasons given for these opportunities include:

Opportunity to install Optical Ground Wire (OPGW) on new transmission lines, or replace groundwire on existing transmission lines: Installation of fiber at the time of a needed groundwire addition or replacement has been found to be the most cost effective installation of fiber along transmission lines.

Partnering opportunity to trade right-of-way for fiber: For long haul or even metro applications, to install a reasonable run of fiber may be difficult to prove as a business case. However, if a partner can be found to share the cost, installation becomes more justifiable. The utility has right-of-way, which is a valuable commodity that can be traded for fiber strands.

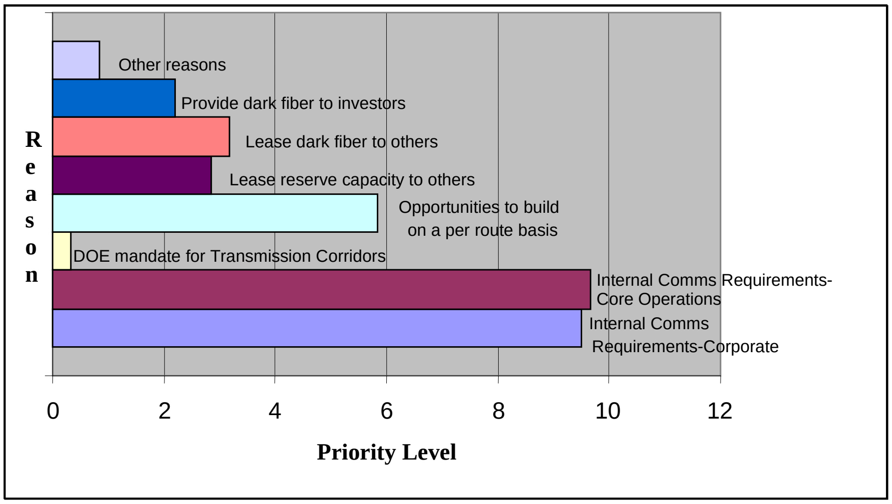

Figure 1-1: Utility Drivers and Priorities to Implement Fiber

Opportunity to sell excess capacity and help pay for fiber install: Many utilities who installed fiber in the 1990's were justifying its use for core internal operations, but able to prove a business case to management through the notion of being able to sell excess capacity to help offset the cost of implementation. The primary driver then, and still is today, to support internal data requirements.

Internal requirements that had to be met, such as relay circuit, or corporate WAN connectivity: Driving core internal requirements included the use of fiber for certain relay protection schemes between substations. Fiber was installed on specific routes between the substations, which provided a starting point for expansion of the fiber transport. To meet future considerations of the Intelligent Grid and to support substation and distribution automation, AMI, and special applications such as surveillance video, existing low-speed circuits to substations will eventually need to be upgraded, and will be the source of future internal requirements.

1.1.1 Trends in the Use of Wave Division Multiplexing

Utilities are finding more use for Wave Division Multiplexing (WDM), opting for installing dense wave division multiplexing (DWDM). However, in the DWDM system only a few wavelengths (up to 5 or 6) are actually equipped and being used. Typical applications for wavelengths include:

- Separate wavelengths for operational and corporate data networks to ensure a secure separation.
- 2.5 or 10 Gbit Ethernet on its own wavelength.
- Optical paths more than a few miles.
- SONET architecture overlayed on a wavelength.
- Storage Area network (SAN)/Fiber Channel connectivity between data centers.

At this time, the use of WDM is deployed in a small fraction of the utility total fiber network, typically no more than 5 to 10 percent of total cable mileage, on routes of high usage, such as between a primary and backup control or data center. Maintaining separation of operational data and corporate networks was a significant factor. Primary reason cited for deploying DWDM was that it is was more economical than lighting up additional fiber or expanding existing capacity. This suggests that DWDM is the practical solution for expansion on short routes.

1.2 Fiber Use in Utility Operations

Two types of cables are widely used by power utilities: ADSS cables and Optical Ground Wire (OPGW). OPGW is installed on transmission lines, while ADSS is mainly installed on lower voltage facilities such as distribution poles. Fiber is also direct buried or placed in underground conduits, mainly in metro areas. Redundant glass strands are normally provided to accommodate the following concerns, which are specific to a power utility:

- Direct control paths for transfer trip switching.
- Need for more fibers as size of rings is reduced.
- Partial cable damage.
- Back-up paths for fiber damage in adjacent communication rings.
- Dedicated systems on dedicated fiber for different critical functions.

It is clear that fiber is the preferred media for a backbone network to support multiple fringe or edge networks that may not require the bandwidth or reliability. Fiber generally is used to connect to critical bulk power substations, with other technologies considered for distribution substations. The fiber networks that are established for the transmission substations are used as the backbone to support point-to-point wireless or leased facilities to distribution substations.

Fiber is considered for backhaul applications, but once again only if it can be justified over less expensive wireless backhaul solutions, such as point to point microwave. Justification of fiber has occurred in most utilities through partnering and tradeoff agreements, or with the notion that excess capacity can be resold to others.

Future applications for substation automation, distribution automation, and Intelligent Grid, as well as surveillance video, will drive future IP and Ethernet requirements. These applications will tend to increase bandwidth requirements for internal operational needs.

1.2.1 Commercial Applications of Utility Fiber

Most of the utilities interviewed sold dark fiber to carriers as their primary customer base. Typically, the number of carriers was about a half dozen. The fiber may be provided as part of a partnership to third parties who market and sell services to end users, such as internet service or bandwidth. Typically dark fiber was sold directly wholesale by the utility to the carriers, or large enterprise customers who had multiple locations requiring connectivity. There were also cases of partnership with ISPs to provide internet services to residential and business customers. The ISPs were actually the customers of the utility.

It was noted by most of the utilities surveyed, especially the IOUs and Co-ops, that pricing dark fiber is done on an individual case basis (ICB). There are no longer specific rates for “fiber/mile” like the previous metric, and no significant investments are made on speculation. Now, pricing is done more on a cost recovery basis – once a customer order is in hand, the utility will then determine what it takes to provide the requested connectivity, with the number of strands needed. Cost estimates will be developed for extending fiber to the customer location from the nearest fiber backbone access point, and the length of lease or IRU will be based on the economic recovery goals. Once the cost and engineering is performed, construction begins with an upfront construction payment made by the customer.

The carriers will typically purchase long-haul fiber via IRU’s, but however consider other options for metro, driven by the contractual agreement they may have with their customers. It was noted that long haul fiber, which was traditionally cheaper than metro fiber, is now harder to secure access to than metro fiber.

Any new major routes or additions will most likely be through partnering arrangements which may be of two scenarios:

1) Trading right-of-way for fiber strand IRUs.

2) Trading owned fiber strands on an existing route for fiber strand IRUs in another entities cable on another routes desired by the utility.

Initially when the bulk of fiber was installed at some utilities, it was proven for internal use by citing the capability to sell excess capacity, as part of a business plan. Today, this appears to be the exception rather than the rule. For the future, utilities anticipate that the "Intelligent Grid" may be a factor to extend services to customer homes, and fiber may play into that as one of several connectivity options.

1.3 Assessment of Current Fiber Business Climate

The most drastic trends have occurred in the wireless arena where the commercial wireless industry revenues grew from $10.2 billion in 1993 to a more than eightfold increase of $88.0 billion in gross revenue by 2003.[1] From an infrastructure point of view, CTIA estimates that the need for cell sites will grow from approximately 180,000 sites to over 270,000 sites by 2010 to accommodate the growing demand and capacity requirements driven by the roll-outs of UMTS, EV-DO, and HSDPA systems.[2] These and other telecommunications industry statistics are contained in Appendix A of this report.

The primary take-a-ways from the statistics and conclusions is four-fold:

- The long distance industry in most tier-one and tier-two markets is a commoditized market, and will face further challenges with advances in VoIP telephony.
- The market shift towards wireless and other networked access mandates an unparalleled access to the end user with content driving bandwidth needs to homes, businesses, and mobile users.
- Consolidation over the last five years has dramatically decreased the number of wholesale providers at both the long-haul, and metro levels of high capacity transport systems creating fewer choices for buyers.
- Demand of and for wireless use and content, despite advances in bandwidth throughput technologies, require more spectrum and a significant number of aggregation points that, today, fiber optic technologies are most efficient at handling.

These trends and facts as overlaid with industry consolidation, convergence of services, technology gains of equipment, wireless bandwidth availability, and government mandated access to ILEC infrastructure is at the root of the opportunity that is available to those that have access to the last-mile where physical access, or converged transport technologies for fixed, or mobile applications can be deployed.

Specific usage trends are emerging in the telecom world that point to robust growth of services. <u>However, that growth should be tempered by the fact that falling prices continue to drive the adoption of services in</u>

1 All revenue estimates per the latest FCC SOCC Report release from 2005.
2 From the CTIA Wireless Report of December 2005

the marketplace. Overall, despite significant transport, and MOU[3] price decreases, overall revenues from both the wireless, and most components of the wire-line sectors, are increasing.[4] (See Appendix A Statistical Trends).

1.3.1 The Rise of Ethernet

The most noted trend in the utilities surveyed was increasing demand for Ethernet services. This was the area expected to have the most future growth and activity. As most large enterprises have Ethernet deployed, and the capability exists to extend the Ethernet across the enterprise, then it logically follows that demand for Ethernet will increase. Edge applications are growing in number and complexity, resulting in growing Ethernet deployments by large enterprises. Demand for increased Ethernet speeds will also drive the demand for fiber or wave multiplexing; Ethernet speeds above 10 megabits per second generally require a transport media other than copper.

1.3.2 Sampling of Utility Trends Selling Fiber Products

Utilities are commercially involved in the selling of dark fiber, wavelengths on a WDM system, and lit bandwidth, as well as co-location, maintenance and construction services. Their primary customers are the carriers, thus they have the business model of a "carrier's carrier". Utilities are also targeting enterprise customers to work with as a direct sell. Utilities are seeing increases in demand for more capacity from the carriers, and have also seen significant growth in the private enterprise customer market. Private enterprise customers are typically large, having multiple locations that need to be connected such as banks, hospitals, and governments. These organizations also have IT organizations, so they also have a level of knowledge in communications and networks. Thus there is less of a burden on the utility to educate and deal with customers with a limited knowledge base.

Figure 1-2 shows examples of Utelco service offerings in certain markets around the US. Utilities in general are very strong at building and providing infrastructure and can leverage this capability in a competitive market, since it is evident that there is no significantly new infrastructure being built in today's telecommunications environment. Pricing is remaining constant and contract terms or getting shorter, consistent with overall industry trends observed.

1.4 Commercial Fiber Strategies for Today's Utilities

The commercial fiber provider market has shifted somewhat over the last several years in that some key providers are beginning to eliminate dark fiber as an item in their sales portfolio. Fiber providers can mitigate this issue in a variety of ways including:

3 Minutes of Use
4 See data from Federal Communications Commission, SOCC Report 2005, http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/SOCC/scc04idx.pdf Additional industry segment reports can be found at http://www.fcc.gov/wcb/iatd/stats.html

- Controlling the contracting term lengths of Dark Fiber agreements.
- Maintaining price points for Dark Fiber services that make good sense in the market despite competitive issues.
- Limiting resale of dark fiber.

Utility	Market	Dark Fiber	SONET	Ethernet	ISP, Rf, & Satellite	Collocation	Custom Fiber/Rf Builds
Edison Int'l	So. Cal.	*	*	*		*	*
Duke Energy	North Carolina	*	*	*		*	*
Florida Power & Light	Southern Florida	*	*	*	*	*	*
Duquense Energy	Pittsburgh, PA	*		*			*
Allegheny Energy	Western PA	*	*	*			*
City Utilities	Springfield, MO	*	*	*		*	*
Salt River Project	Greater Phoenix	*	*			*	*
LCRA	Central Texas	*			*	*	*
MEAG	Georgia	*	*	*	*		*
Benton PUD	SE State of WA		*	*	*		*
City of Palo Alto	City of Palo Alto	*					*
City of Anaheim	City of Anaheim	*					*
Silicon Valley Power	Santa Clara	*					*

Figure 1-2: **A Sampling of UTelco Service Offerings**

Any provider, by limiting the term length of its fiber contracts, can control to a certain degree the outside exposure associated with low cost lit service price offerings as made available on the dark fiber it has leased. For example, by limiting contract term lengths to five years versus the once common 20-year IRU, a provider can review and manage, over the mid-term, any negative impact a dark fiber sale may have against its own competitive services.

Utilities have the ability to adjust their pricing to strike a balance between whether lit services should be offered as opposed to dark fiber. Companies, however, should look at themselves first and determine whether their core competencies are better suited to a base service offering of dark fiber, or a more intricate service set of lit service which requires more stringent performance thresholds to be met on top of maintaining the underlying dark fiber.

In addition, utilities offering dark fiber should limit, or exclude the ability of dark fiber customers from reselling any of the dark fiber procured. This issue takes into account further technological breakthroughs that may cause an entity to attempt to rid itself of contractual obligations by subletting its fiber in the event its strand count need has diminished.