

# Dark Optical Fiber Models for Broadband Networked Cities

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## INTRODUCTION: THE BROADBAND PERSPECTIVE

The world economy is currently moving in transition from the industrial age to a new set of rules, that of the so-called “*Information Society*,” which is rapidly taking shape in different multiple aspects of the everyday life. In fact, the exponential growth of the Internet, the penetration of mobile communications, the rapid emergence of electronic commerce, the restructuring of various forms of businesses in all sectors of the economic activity, the contribution of digital industries to growth and employment, and so forth, are among the current features of the new global reality, and they are all considered significant dynamic factors for further evolution and development (Commission of the European Communities, 2005).

Changes are usually underpinned by technological progress and globalization, while the combination of worldwide competition and digital technologies is having a crucial sweeping effect. Digital technologies facilitate transmission and storing of information, while they offer multiple access facilities, in most cases without implying subsequent extra costs. As digital information may be easily transformed into economic and social value, this can offer huge opportunities for the development of new products-offerings, services, or applications. Thus, information becomes the “key-resource” and the prime “engine” of the new e-economy (Crandall, Jackson, & Singer, 2003).

Companies in different sectors have already started to adapt to the new economic situation in order to become e-businesses (Commission of the European Com-

munities, 2001c). In addition, the full competitiveness of the state in the current high-tech digitally converging environment is strongly related to the existence of modern digital infrastructures of high capacity and of high performance, rationally deployed and properly priced, capable of providing easy, cost-effective, secure, and uninterrupted access to the international “digital web” of knowledge and commerce without imposing any artificial barriers and/or restrictions (Wallsten, 2005).

Broadband development is nowadays an essential strategic priority (Chochliouros & Spiliopoulou, 2005), not only for the European Union (EU) but for the global environment. More specifically, broadband can be considered an “absolutely necessary prerequisite” in order to materialize all potential benefits from information society facilities and so to improve living standards (Commission of the European Communities, 2001b). The availability, access, and ultimate use of broadband in both business and residential settings are critical issues. Both businesses and consumers can derive increased benefits from the availability of broadband connection to the Internet, as the technology speeds up some applications and creates entirely new possibilities (Hu & Prieger, 2007).

To appropriate further productivity gains, it should be necessary to exploit advances offered by the relevant sophisticated technologies, including high-speed connections and multiple Internet uses (Commission of the European Communities, 2002). However, to obtain such benefits, it should be necessary to develop modern, cooperative, and complementary network facilities and suitable underlying infrastructures. Among the various alternatives, optical access networks (OANs) can be

considered, *for a variety of explicit reasons*, as a very reliable and effective solution, particularly in urban areas (Green, 2006).

The development of innovative communications technologies, the digital convergence of media and content, the exploitation and the penetration of Internet, and the emergence of the digital economy are main drivers of the networked society, while significant economic activities are organized in networks (including development and upgrading), especially within urban cities (Commission of the European Communities, 2003, 2006). In fact, cities remain the first “interface” for citizens and enterprises with the administration and the main providers of public services.

In recent years there have been significant advances in the speed and the capacity of Internet-based backbone networks, including those of fiber nature (Agrawal, 2002). In this context, there is a strong challenge for the fast exploitation of the so called “dark fiber” infrastructure, mainly as a means for realizing access networks. Such networks are able to offer a quite remarkable increase both in bandwidth and quality of service for new and innovative multimedia applications, also including “triple play” services (Lovink, 2002).

## **NETWORKED CITIES: TOWARDS A GLOBAL AND SUSTAINABLE INFORMATION SOCIETY**

Information Society applications radically transform the entire image of our modern era. In particular, a great variety of innovative electronic communications and applications provide enormous facilities both to residential and corporate users (Commission of the European Communities, 2001a), while cities and regions represent major “structural” modules. Local authorities are key players in the new reality, as they are the first level of contact between the citizens and the public administrations and/or services. Simultaneously, because of the new information geography and global economy trends, they also act as major “nodes” in a set of inter-related networks, where new economic processes, investment, and knowledge take place. Recently, there is a strong interest for cooperation between global and local “players” (through schemes of private/public partnerships) in several cities of the world, especially for the widespread use of knowledge and technology. Encouraging investment in infrastructure (by incumbent

operators and by new entrants) and promoting innovation are basic objectives for further development.

Towards realizing this target, the deployment of dark fiber optics infrastructure (Arnaud, 2000), under the form of Metropolitan Area Networks (MANs), can guarantee an effective “facilities-based” competition, with series of benefits. It also implicates that, apart from pure network deployment, there would be more and extended relevant activities realised by other players, such as Internet Service Providers (ISPs), Application Service Providers (ASPs), operators of data centres, and many more. Within the same framework, of particular importance are business opportunities especially for the creation of dark customer-owned infrastructure and carrier “neutral” collocation facilities.

In recent years there have been major advances in the speed and the capacity of Internet backbone networks, including those of “fiber-based” infrastructure (Green, 2006). The latter can provide reliable responses to the current market requests for increased bandwidth usage and for more enhanced better quality of services offered. At the same time, such networks may contribute to significant reductions in prices with the development of new (and competitive) service offerings. In the context of broadband, local decision-making is extremely important. Knowledge of local conditions and of local demand can encourage the coordination of appropriate infrastructure deployment, thus providing ways of making investments, sharing facilities, and reducing costs (European Parliament and Council of the European Union, 2002a). In this important area, the EU has already proposed suitable policies (Chochliouros & Spiliopoulou, 2003b) and has organized the exchange of “best practice” at national, regional, and local level, while it is expected that it will promote the use of public/private partnerships.

Since the initial deployment of fiber in backbone networks, there was an estimate that fiber could be easily deployed to the home as well. A number of various alternate “FTTx” schemes or architecture models such as, for example, Fiber to the Curb (FTTC), Fiber to the Building (FTTB), Fiber to the Home (FTTH), Hybrid Fiber Coaxial (HFC), and Switched Digital Video (SDV) have been introduced (Arnaud, 2001) and tested, to promote not only basic telephony and video-on-demand (VOD) services but several broadband applications as well (Prat, Balaquer, Gene, Diaz, & Fiquerola, 2002). Most of such initiatives have been (widely) deployed by telecommunications network operators in the marketplace (Keiser, 2006; OFCOM 2006).

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