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Plastic Optical Fibers in Access Networks

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Abstract

The increasing bandwidth needed by the business and residential users has been a challenge in recent years for telecom operators. For this reason, optical fiber became a candidate to access networks, allowing high transmission rates when compared with copper cable and coaxial cable or even with wireless communication systems. Optical fibers can exist in different materials: glass optical fiber (GOF) and plastic optical fiber (POF).

The aim of this paper is to study the use of POF in access network using a simulation software. Two scenarios were taken into account: the first is an implementation of a Gigabit Passive Optical Network (GPON) with GOF and POF and the second scenario consists on the analysis of the performance of POF in an environment where GPON and 10G-PON coexists on the same optical distribution network (ODN). It was observed that POF can be used in access networks but it is only feasible when the ODN attenuation is around 15 dB.

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Keywords: Glass optical fiber (GOF), plastic optical fiber (POF), access networks, GPON, 10GPON, optical distribution network (ODN).

1. Introduction

Access networks faced several challenges in recent years. One of these challenges is the convergence of voice, data and television (TV) on the same physical infrastructure [1]. Moreover, the explosive growth of broadband multimedia applications, such as high-definition television (HDTV), video on demand (VoD) and interactive games imposed a huge demand for bandwidth on the access network [2]. For that reason, copper and coaxial cable had shown some limitations in recent years, particularly in the potential for evolution in order to satisfy user's needs [1].

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Fortunately, researchers and equipment providers have found some good solutions and in the last few years newly developed PF-GI-POF (Perfluorinated Graded-Index Plastic Optical Fiber) has been demonstrated that can be used to provide high transmission rates with a minor investment [2].

The purpose of this work is to study the viability of the application of POF in access network ensuring the minimum requirements specified by the standards of PON technologies. In order for this to happen, it was used a program called VPIphotonics™ [3] to simulate an access network with different types of fibers. Two scenarios were taken into account: the first one is an implementation of a GPON network with multiple users and the second scenario consists on the analysis of the performance of POF in an environment where GPON and 10G-PON coexists on the same ODN [1].

2. Optical fibers

Optical fiber has an important part in telecommunications industry nowadays. They can exist in different materials: glass optical fiber (GOF) and plastic optical fiber (POF).

As shown in Fig. 1 GOF is used in telecommunications window wavelength (1310, 1490 and 1550 nm) while the POF operates in the visible spectrum. However we have been observed in last few years that new developments have been made in order to have reasonable attenuations in the wavelength window used in telecommunications. This can be done by using the most advanced POF at the moment (*Fontex*) that is made of perfluorinated polymer (PF).

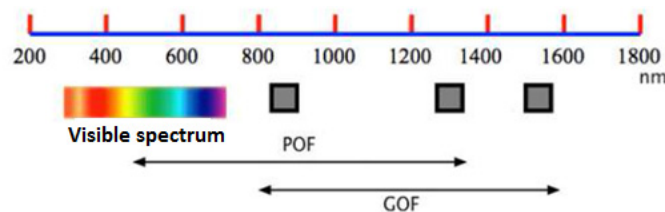


Fig. 1. Operating wavelength of POF and GOF

GOF have low attenuation allowing long-distance transmission but are fragile. Currently POF have a higher attenuation when compared with GOF but is more flexible and robust. Table 1 shows the characteristics of the fibers that were used in practice for simulation.

Table 1. Attenuation of fibers used in practice.

	G.651 <i>Clearcurve</i>	G.657 <i>Clearcurve</i>	<i>Fontex</i>
Type	MM-GOF	SM-GOF	PF-GI-POF
Manufacturer	<i>Corning</i>	<i>Corning</i>	<i>Asahi Glass</i>
Core diameter [μm]	50	8,2	120
Attenuation @ 1310 nm [dB/km]	0,6	0,35	18
Attenuation @ 1490 nm [dB/km]	0,4	0,24	120

As shown in Table 1, two GOFs models from *Corning* and one POF from *Asahi Glass* were chosen for test and comparison. These GOF fibers with the designation of *ClearCurve* are fibers specially developed by *Corning* for access networks with low attenuation due to curvatures.

In this work it is considered the best POF of the market which is produced by *Asahi Glass*, called *Fontex*. The manufacturer claims that *Fontex* can support 40 Gbps for a maximum distance of 100 meters at lab test (using

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