Instituto Superior
de Engenharia
Politécnico de Coimbra

Fiber-Optic Cable

Structured Cabling

Tomás Faria Ramos
2022140175

2023/2024

Contents

List of Figures

Chapter 1

Introduction to Fiber-Optic Cable

Fiber-optic media are any network-transmission media that uses glass, or plastic, fiber to transmit data in the form of light pulses.

Fiber-optic technology is more complex in its operation than standard copper media because the transmissions are light pulses instead of voltage transitions.

Fiber-optic transmissions encode the ones and zeros into ons and offs of light. The light source is usually either a laser or some kind of LED.

Fiber-optic cables are optimized for a specific wavelength of light. The wavelength of a particular light source is the length between wave peaks in a typical light wave from that light source.

Typically, fiber-optic cables use wavelengths between 800 and 1500nm, depending on the light source. Silica-based glass is most transparent at these wavelengths, and therefore the transmission is more efficient (there is less attenuation) in this range.

When the light pulses reach the destination, a sensor picks up the presence or absence of the light signal and transforms those ons and offs into electrical signals. The more the light signal bounces, the greater the likelihood of signal loss.

Most LAN/WAN fiber transmission systems uses one fiber for transmitting and one for reception because light only travels in one direction for fiber systems.

1.1 Advantages of Fiber-Optic Cabling

Some advantages of fiber-optic cabling are:

- Immunity to EMI;
- Higher data rates;
- Longer maximum distances;
- Better security.

Immunity to EMI

Fiber-optic cabling is immune to crosstalk because fiber uses light signals in a glass fiber, rather than electrical signals along a metallic conductor. It does not produce a magnetic field and thus is immune to EMI.

Fiber-optic cables can therefore be run in areas considered to be "hostile" to regular copper cabling (elevator shafts, near transformers, etc...).

Higher Data Rates

Because light is immune to interference and travels almost instantaneously, much higher data rates are possible with fiber-optic cabling technologies.

Single-mode fiber optic cables are capable of transmitting at multigigabit data rates over long distances.

Longer Maximum Distances

Typical copper data-transmission media are subject to distance limitations of maximum segment lengths no longer than one kilometer.

Single-mode fiber optic cables can span distances up to 70Km without using signal-boosting repeaters.

Better Security

Copper-cable transmission media are susceptible to eavesdropping through taps.

A tap is a device that punctures through the outer jacket of a copper cable and touches the inner conductor, intercepting electrical signals.

Because fiber-optic cabling uses light, it is immune to most types of eavesdropping.

Chapter 2

Types of Fiber-Optic Cables

Fiber-Optic cables come in many configurations. The fiber strands can be either single mode or multimode, step or graded index, and tight or loose-tube buffered.

In addition, a variety of core diameters exist for the fiber strands. Most often, the fiber strands are glass, but plastic optical fiber (POF) exists as well.

2.1 Composition of a Fiber-Optic Cable

A typical fiber-optic cable consists of several components:

- Optical-fiber strand;
- Buffer;
- Strength members;
- Optional shield materials for mechanical protection;
- Outer jacket.

Optical Fiber Strand

An optical-fiber strand is the basic element of a fiber-optic cable. All fiber strands have at least three components to their cross sections: the core, the cladding and the coating.

The Core

The fiber core is usually of some type of plastic or glass. Several types of materials make up the glass or plastic composition of the optical fiber core. Each material differs in its chemical makeup and cost, as well as its index of refraction, which is a number that indicates how much light will bend when passing through a particular material.

The Cladding

A fiber-optic strand's cladding is a layer around the central core that is the first and the smallest layer of protection around the glass or plastic core.

It also reflects the light inside the core because the cladding has a lower index of refraction than the core. The cladding thus permits the signal to travel in angles from source to destination.

The Coating

The protective coating around the cladding protects the fiber core and cladding from damage. It does not participate in the transmission of light, it's simply a protective material.

It protects the cladding from abrasion damage, adds additional strength to the core and builds up the diameter of the strand.