# What Are All Optical Networks?

## Optical fibers connecting locations many miles apart and carrying digital information in the form of laser light pulses

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LumaCon optical interconnects are intended to be an enabler for optical networking systems. Before getting deep into the detailed subject of optical interconnects it is best one understands where and why optical interconnects are to be used. So one might ask the question what is the hype over the so-called “next generation network” or the “all optical network”. In a more basic question “what is an optical network? Well, in its most basic sense an optical network is just some flashing light traveling down a glass rod. The purpose of this flashing light is to transmit information, in much the same way that when ships have no radio signal they utilize shuttered spot beam lights to communication in a series light flashes. But an optical network can give much more useful information than "Hey, look at me?" In fact with our digital age, an optical network can transmit any information you can imagine — phone calls, videos, music, live TV transmissions, and in fact the entire worldwide web.

All of these sources of information can be transmitted over long distances by regular electrical signals traveling over copper cables. The key to an optical network compared with an electrical network is that the amount of information that can be transferred is vastly increased. Back in the days when our only needs were the occasional phone call, electrical networks could more than handle the demand. But today, with the great amount of information that needs to be transmitted across and between countries, optical networks are by far the most cost-effective solution.
So an optical network consists of large glass rods connecting different locations with flashing lights at each end? ... not quite, but the principle is similar. Instead of glass rods we have optical fibers. These are incredibly thin strands of glass (similar in diameter to one of your hairs) that can be many hundreds or even thousands of miles long. They connect different locations that are part of the “optical network.” The optical fiber is packaged up and protected in a surrounding cable, and then usually laid underground or undersea.

Unfortunately, if you tried shining a flashlight down a short glass rod, very little light would actually make it to the other end. And so to make an optical network that can carry information over such huge distances there are two things to be improved. First, the transmittance loss of the glass rod must be reduced to near zero. In optical fiber the glass that forms the fiber is specially designed to minimize attenuation due to imperfections, material variations and geometry (it has “low loss” or “low attenuation”). Second, the light sent through the fiber would not have sufficient power even at the source and its frequency would need to be controlled very tightly to work with the optical fibers described above. To solve this very high intensity laser light, capable of traveling much farther than regular light is used.

The laser light flashes on and off in a pattern that represents the information being sent. You can think of this as being analogous to the Morse code example above, where certain series of dots and dashes form information. The quicker the lasers can flash on and off, then the quicker the information can be transferred. The speed of transfer is known as “bit-rate” and is usually talked about in terms of bits per second — bps or bit/s (effectively the number of flashes possible per second). A typical optical network today can easily transmit 10 Gbit/s from one single laser — 10 Gigabits per second, which is 10 billion flashes per second. To put this into context, you could send the text of more than 1000 books in just one second. The latest optical networks are now operating at 40 Gbit/s and experimental systems far exceed that.

At the other end of the optical fiber is a light detector that senses the on-off flashes of light and converts them back into regular information — whether that's, say, a voice in a phone call or an image on a Web page.
The way that an optical network is generally used is that there will be optical fiber links between most large countries, between most large cities in a country, and then out from each of those cities to the smaller towns. These links between countries and major cities are typically known as the transport layer within a network. Within each of the cities the network is known as the metro layer. There are fringe areas between the cities and the transport (or long haul) that are known as the edge. The last mile architecture in most cities and in most buildings remains copper based today. However, newer neighborhoods and new buildings are beginning to be design day-one as fiber optic data platforms. This as businesses are growing to understand that mastery of information distribution can become a competitive advantage. Early adopters such as Wal-Mart and Dell are dealing deadly blows to their competitors as they have effectly altered the business environment through the use of data management and distribution.