

Advantages of Fiber Optic Transmission Technology

The use of fiber optics is fast becoming the medium of choice for telecommunication systems, television transmission and data networks. Fiber optic cables have a multitude of advantages and benefits over the more traditional methods of information systems, such as copper or coaxial cables.

Generally, sooner or later any network installer and planner reaches the limits of current network media – be it coaxial cables using HFC technology or EOC, or copper networks using ADSL or VDSL, or even Ethernet over Power networks. And yes, radio waves also have it's limits as we will see further in this article. In general, here are 10 main advantages to chose optical fiber as transmission media for your networks:

- Long Transmission Distance
- Dielectric Protection
- Speed
- Small size & Light weight
- Easy Installation and Upgrades
- Secure Transmission
- EMI and RFI immunity
- Low Cost
- Unlimited Bandwidth
- Efficient Data Signalling

Long Transmission Distance

The low attenuation and superior signal capacity found in optical systems allow much longer intervals of signal transmission than metallic-based systems. Metal based systems require signal repeaters to perform satisfactory. Fiber optic cables can transmit over hundreds of kilometres without any problems. Even greater distances are being investigated for the future.

To use fiber optics in data systems have proven to be a far better alternative to copper wire and coaxial cables. As new technologies are developed, transmission will become even more efficient, assuring the expansion of telecommunication, television and data network industries.

If you are limited with 100 m or so of UTP Cat 5 cable for your Ethernet, then even wiring a building is a problem not talking about last mile access. This is why nowadays, ADSL last mile access is widely replaced by FTTx PON based solutions.

It is not that expensive any more to send gigabit ethernet over 120 km and more and even using 1 fiber only. That is not possible using copper media and hard to be done by means of wireless.

Dielectric Protection

The thunderstorm may kill 40% of your EoC based coaxial network modems, and een burn network cards of some enduser PC's. For fiber optical connection, no any specific grounding (as for cable itself) will be needed. And sometimes, building electric current can get injected in regular copper communication cables, and that can cause injuries and death of people.

Also copper wire transmission can generate sparks, causing shortages and even fire. Because fiber optical strands use light instead of electricity to carry signals, the chance of an electrical fire is eliminated. This makes fiber optics an exceptionally safe form of wiring and one of the safest forms of data transmission.

Speed

One of the greatest benefits to using fiber optic systems is the capacity and speed of such a system. Light travels faster than electrical impulses which allow faster delivery and reception of information. Fiber optic cables also have a much higher capacity for bandwidth than the more traditional copper cables.

Small size & Light weight

For copper cables it just meant this. More channels, bigger size. More strands, more cross interference. Before, when between cities these cables were installed as backbones, you could hear someone else talking in your conversation on phone. And what you do when you have dugged in a cable and you run out of the capacity? With fiber, you can only change equipment or even a fiber module to higher speed, but here you need this huge investment of laying completely new cable. And this is not just digging – you need apply permissions from authorities to dig streets – that is another nightmare usually.

Also, if that copper cable is big and fat, it must be heavy as well, right? And the more heavy it is, more copper in there, the more risks are that someone will steal a part of it for precious copper needs. This allows fiber to be used even in temporary applications, like concerts to connect large screens using HDMI over fiber converter, disaster affected areas and more. And then consider ships and aircrafts – for these, any additional weight is a concern.

Easy Installation and Upgrades

Long lengths of optical cable make installation much easier and less expensive. Fiber optic cables can be installed with the same equipment that is used to install copper and coaxial cables.

Secure Transmission

Optical systems are more secure than traditional mediums. Electromagnetic interference causes coaxial cables to leak information. Optical fiber makes it impossible to remotely detect the signal which is transmitted within the cable. The only way to do so is by actually accessing the optical fiber itself. Accessing the fiber requires intervention that is easily detectable by security surveillance. These circumstances make fiber optics extremely attractive to governments, banks and companies requiring increased security of data.

Also it is clear that security risks normally comes from 2 sources – signal is getting radiated beyond cable and there is a possibilities easily tap in as parallel channel. How to do that with copper it is easily under stable for anyone, and also it is clear that modulated signal over copper cables can be received by sensitive equipment. For optical cable, signal is traveling in the center of cable (core), and so it is not radiated outside of the cable at all. Also, if you try tap in the cable, it will degrade the optical signal and monitoring personnel will see that immediately and use reflectometer to find exact place where it happened.

EMI and RFI immunity

These 2 benefits are mainly because low attenuation rate of optical signal and low pulse dispersion. So, such an immunity just dramatically increases hassles and you can pull optical strand just near some power wiring in building. Remember the days when you installed CCTV security system for a bank and then to see later distorted signal at DVR signal? Well these days are over, because now you can send video direct over the fiber. Now matter, be it HDMI, CCTV PAL type, or DVI or even KVM for the computer, all is possible.

Also coaxial cables have a tendency for electromagnetic interference, which renders them less effective. Fiber optics is not affected by external electrical signals, because the data is transmitted with light.

Low cost

Several kilometers of optical cable can be made far cheaper than equivalent lengths of copper wire. Service, such as the internet is often cheaper because fiber optic signals stay strong longer, requiring less power over time to transmit signals than copper-wire systems, which need high-voltage transmitters.

So, add it all together now – high transmission distances, resistance and immunity to noise, and hey – fraudsters will not steal it, since it's not valuable as copper – we have a total project costs spiraling down. Now even countries in for example middle east who preferred quick and easy installation of radio links, now prefer invest in optical fiber, because spectrum get's crowded, cables stolen, and signal degrades on bad weather – you name it! That adds not just to cable costs, but also increases maintenance cost and requires keep more personnel.

Unlimited Bandwidth

Optical Fiber really have almost no limits how fast and much information can be sent through it. There is a study from Lucent Technologies, what theoretically single mode fiber is capable to transmit on even 200 Tbps speed! Now isn't that "enough" can you think application that will use that amount of speed?

Why is that so, that fiber optical cables are able to carry such a speeds? This is because technology allows to use modulators on very high datarates. Just check this 40 GB fiber media converter – isn't that so long ago when having gigabit connection was such a non-achievable dream even in highly urbanized areas?

Second thing worth to remember is that over fiber optical cable you are able to transmit several wavelengths at the same time, thus doubling, or multiplying speed many times. For example first these examples in market was classic WDM single fiber media converters, which used 2 wavelengths – 1310 and 1550 nm over same 1 fiber, and later CWDM – Coarse Wavelength Division Multiplexing, and DWDM – Dense Wavelength Division Multiplexing were introduced.

CWDM then already as opposite to WDM with it's 1310/1550 nm division already used up to 16 channels (or wavelenghts), while DWDM already allows send up to 200 of wavelenghts, over same fiber!

So, when we say unlimited bandwidth, we mean that what you can is to install a fiber, and then always come back upgrading to to higher speed as market needs are becoming more and more hungry, people rely more and more on streaming video services instead of downloading content before watching it. This is another benefit of fiber optical equipment itself, because all components made usually supports vendor interoperability, and you can replace even parts of the elements only.

Efficient Data Signalling

Fiber optic systems are much more effective than coaxial or copper systems, because there is minimal loss of data. This can be credited to the design of optical fibers, because of the principle of total internal reflection. The cladding increases the effectiveness of data transmission significantly. There is no crosstalk between cables, e.g. telephone signals from overseas using a signal bounced off a communications satellite, will result in an echo being heard. With undersea fiber optic cables, you have a direct connection with no echoes.

Unlike electrical signals in copper wires the light signals from one fiber do not interfere with those of other fibers in the same cable. This means clearer phone conversations or TV reception.