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News

The History of Optical Fiber

Through the 1800 & 1900s various scientists started playing around with guiding light through different materials, using all the principles that we have discussed, but that was still a long way off from the optical fiber transmission systems that we have today. On top of having optical fiber as a medium, we also needed a light source to generate signals and then an optical receiver to accept the signals. There was much to be done!

Major developments were happening in the world of semi-conductors from the late 1940s onwards. These developments were to create our transmitters and receivers, all based on the relationship between electrons and photons. This would allow us to generate signals at a certain color of light and then detect small amounts of that light at the receiving point. This world of optoelectronics is very interesting, but let's leave it for now. Suffice to say our

devices for converting electrical signals to optical signals and vice-versa were in development.

Scientists knew that by wrapping a material around a glass strand and altering the refractive index of the two materials, we could create **Total Internal Reflection** to keep the light in the central material. That was our way of transmitting information using light through the solid glass tube. By the end of the 1950s we had found that wrapping glass around glass was the best method and as such the core and cladding of optical fiber were created. Again, it was easy said but substantially more difficult to do.

Progress

By 1965 a German physicist, **Manfred Boerner** created the first optical fiber data transmission system – it was basic, but we had started.

Around the same time **Charles Kao** from China and **George Hockham** from England, both working for the British Company STC started developing theories that the material used in the medium – the glass – could be significantly improved and as such the losses in the system would dramatically drop. By reducing the losses in the fiber, greater distances could be achieved, and optical systems would find more real-life uses. Their theory stated that silica glass with high purity should be used and this work would earn them a Nobel Prize many years later.

At the start of the 1970's engineers at Corning in the USA took the theoretical work from the STC guys and developed optical fiber with losses below 20dB/km. I put that figure in purely for reference as before the work of Kao & Hockham the attenuation figures were heading towards 1000db/km. With further improvements through lots of research and testing, Corning were down to 4dB/km attenuation by the late 1970s. An amazing improvement and one that started to support longer distances and true communication systems.

Multimode Fiber

All this development work had given us multimode fiber. The term multimode originates from the fact that the core (the bit where we want the light to stay) can support multiple modes of light. Think of a light bulb omitting thousands of light rays and we can get a number of those into the core material. They pass to the end of the fiber but as some of them pass through more material, due to the different paths, they arrive at different times

and have different amplitudes (sizes). These variations create a problem for us called Modal Dispersion.This creates a bandwidth limitation in multimode fiber and is a factor of distance, core diameter and wavelength.

The solution to this multimode problem was quite simple; if we can shrink the fiber core down far enough it would only support one mode of light. Again, simple in theory but tougher to do in practice. I should add at this point that the core diameter of Multimode fiber is 50 or 62.5µm and Singlemode is 9 µm – where 1µm is one millionth of a meter. Not wanting to upset any of our follicly-challenged readers but the average human hair is 85µm. Through the 1980s developments were made in the manufacturing of Singlemode (they thought long and hard about that name!) fiber and very importantly in the connectors and equipment that had to go with that Singlemode fiber. As you can imagine when you have a core diameter that is 9µm you need tolerances on all equipment that are very tight.

We are now on a timeline heading towards the end of the 1980s. Our singlemode fiber is supporting much higher data rates, of just under 2Gbps (2 thousand million digital bits per second) and importantly doing that over distances of up to 50Km.

I think again that is a good point in the history of optical fiber to rest at.

By Iain Deuchars, General Manager, ComNet International.