

IEEE Milestones in Electrical Engineering and Computing

World's First Low-Loss Optical Fiber for Telecommunications

In the 1970's in Corning labs, three scientists Dr. Robert Maurer, Dr. Peter Schultz and Dr Donald Keck, designed the first ever low-loss optical fibre composed of a highly pure optical glass which facilitated the transmission of light over long distances, by taking advantage of the physical phenomenon of total internal reflection. Fast forwarding thirty five years, optical fibres are now the leading physical layers used in high speed data transmission in the world today, offering speeds of up to and including 400 gigabits per second over a single channel using "4-mode orbital angular momentum multiplexing."¹

Total internal reflection is the physical phenomenon in which light, or any wave form, attempts to pass from a medium of a higher refractive index to a medium of a lower refractive index. If the propagating waves strikes the boundary between the medium at an angle larger than the critical angle then the light wave will be entirely reflected back into the medium of higher refractive index. This phenomenon was utilized by the scientists at Corning in order to develop the optical fiber we now use today. The methodology was to encapsulate a highly transparent glass of a high refractive index by a glass of a lower refractive index, then should the light entering the tube be strike the boundary at an angle greater than the critical angle then it will be reflected continually off the boundary walls along the fibre.

The development came about when "members of the British Post Office came to Corning seeking assistance in creating pure glass fiber optics. Their design required a single-mode fiber (100 micron diameter with a 0.75 micron core) having a total attenuation of about 20 dB/km"², in the mid 1960's. This meant that Drs Maurer, Schultz and Keck would have to improve the current technology by an astonishing amount as the current technology at the time had attenuations of 1000dB/km. Not only did they reach their target in the space of a few years but they exceeded it, developing a cable that worked with attenuations of 17dB/km, an overall improvement in transparency of the optical lenses by a factor of 1098, a momentous achievement by any standards. This paved the way for other astonishing feats including the internet and other telecommunication outlets including television, and home telephones, changing both the telecommunications industry and the world in an indescribable way. It is also used in lasers as a medium to transport light³.

Today optical fibers are comprised of three parts, "(1) the core that carries information in the form of light signals; (2) the cladding which surrounds the core trapping the light within it; and (3) the durable, protective outer coating. Encoded into light signals, information travels through the fiber where it is decoded locally or thousands of miles away"⁴. However one of optical fibers' most useful attributes is its' ability to be modified by altering the materials, processes, and the refractive index profile⁵. What may be most surprising is that the technology is still only as thick as a strand of human hair but due to the high transparency of the glass the optical fibre provides the almost perfect physical layer. It then should not surprise us to here that over 1.5 billion kilometres of optical fibre are now installed and in use throughout the globe, a testament to its' reliability; it is extremely difficult to bug or contaminate optical fibre after it has been tested, cost effectiveness; as it is can hold a signal for hundreds of miles before any need to boost the signal strength unlike copper, and durability; every sample tested in Corning labs have a strength per centimetre ratio of 100000 pounds/square inch, a remarkable achievement when compared to steel or copper, especially when one considers it is the thickness of a human hair and also has the ability to bend.

Another prize aspect of optical fibre is that it is environmental friendly when compared to other mediums, e.g. copper. Unlike copper optical fibre does not generate inordinate amounts of heat during signal transmission and saves both money and the environment when it comes to power hungry data centre cooling systems. "Businesses interested in internationally recognized Leadership in Energy and Environmental Design (LEED) certification are choosing optical fiber cabling systems to create more cost-efficient, environmentally friendly data centers."⁶

As I hope you can now see the induction of Corning's Low-Loss optical fiber into the IEEE Milestones is well justified and perhaps slightly overdue. Not only was it an astounding in its own right, but it has facilitated the progression of technology to reach a level unobtainable had it not been for the development of the "World's First Low-Loss Optical Fiber for Telecommunications" discovered by Dr. Robert Maurer, Dr. Peter Schultz and Dr Donald Keck in Corning labs for the British Post Office those thirty five years ago. Furthermore, with continued research and further development in the field being carried out at institutions like Corning and elsewhere, who knows what future technology may be achievable as a result of optical fibre communication.

CITATIONS, REFERENCES AND READING MATERIAL

1. http://www.ieeeighn.org/wiki/index.php/Milestones:World%27s_First_Low-Loss_Optical_Fiber_for_Telecommunications
2. http://www.ieeeighn.org/wiki/index.php/Milestones:World%27s_First_Low-Loss_Optical_Fiber_for_Telecommunications
3. http://media.corning.com/flash/opticalfiber/2012/coming_optical_fiber/Documentation/FIBER_MATTERS/flipbook/585324499/files/inc/585324499.pdf
4. <http://www.ece.umd.edu/~davis/optfib.html>
5. <https://www.google.ie/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&cad=rja&uact=8&ved=0CD8QFjAF&url=http%3A%2F%2Fwww.corning.com%2FWorkArea%2Fdownloadasset.aspx%3Fid%3D39421&ei=9OfZVLvLYflsATKmlKgCw&usq=AFQjCNEwrDWixjLRT6kivPtDVzWLvsWWW>
6. http://media.corning.com/flash/opticalfiber/2012/coming_optical_fiber/Documentation/FIBER_MATTERS/flipbook/585324499/files/inc/585324499.pdf

<http://demonstrations.wolfram.com/TotalInternalReflection/>

<http://www.stmary.ws/HighSchool/Physics/home/notes/waves/TotalInternalReflection.html>

Importance of Professional Associations

The importance of professional associations like the Institute of Electrical and Electronics Engineers (IEEE) and Engineers Ireland are invaluable for a practicing and professional engineer. They not only promote engineering to outside community but also help establish and maintain a set of standards for professional engineering and engineering education, as well as standards of ethics and conduct, ensure that qualified candidates are granted their professional titles, act as an authoritative voice for the engineering profession as well as providing opportunities for engineers who are still in a stage of career development¹.

As a governing body over engineering, both in the world and in Ireland, professional associations provide a base for healthy competition including excellence awards (IEEE Milestones in Electrical Engineering and Computing) and peer reviewing, which improves the quality of products and services developed in the area of electrical and electronic engineering and computing. As a result we have seen a technological movement in our field that has progressed at a far more rapid rate than any other sector. This has allowed electrical and electronic engineers, as well as those involved in computer development, to enter the lives and homes of almost everyone in the planet. Inventions such as the internet, mobile phones, computers and so much more have progressed exponentially due to the standards and visions of the entire engineering community as a whole.

The IEEE alone has more than 430,000 members internationally making it the largest the largest professional association in the world². With all these people combined the wealth of knowledge and ideas for innovative new technologies is indescribable and affords engineers to push the boundaries of what we as a people believe possible. They create an environment where members collaborate on world-changing technologies – from computing and sustainable energy systems, to aerospace, communications, robotics, healthcare, and more³.

As bodies which also deal largely in the peer reviewing and publication of new technologies, engineers are given the opportunity to both assist and provide positive criticism which can later be used to assist in further development. The IEEE alone publishes nearly a third of the world's technical literature in electrical engineering, computer science, and electronics. This includes approximately 170 transactions, journals, and magazines published annually. In cooperation with John Wiley and Sons, Inc., IEEE also produces technical books, monographs, guides, and textbooks⁴. These textbooks are then used to impart knowledge onto a new generation of engineers providing a platform of knowledge from which innovation can grow. They also provide a reputable and trusted bank of information which can then be referenced and cited in further technological papers.

Professional associations also provide financial aid for some companies and/or individuals who are in need of financial assistance. Grant schemes are commonplace and give those who otherwise would not have been able to a foothold in an ever-growing ever-changing environment. They also provide capital for workshops which can then be used which assist in the spreading and sharing of information throughout the technological sector⁵.

Furthermore they provide a wealth of experience and know how, as well as a number of different assistance options for those running businesses in the sector. Be that management or personal development courses, professional accreditation, or patenting. Professional associations provide the means for businesses and individuals alike to improve themselves and in doing so the standards of engineering in the world today.

Professional associations also help spread a vision for the future. In the IEEE and Engineer's Ireland's case, a vision were technology continues to assist in the everyday lives of the people around us as well as ignite wonder and provide deeper meaning to physical phenomena.

As detailed above professional associations like the IEEE and Engineers Ireland are invaluable to a practicing engineer in the world today and unquestionably have assisted in shaping the world around us immeasurably.

CITATIONS, REFERENCES AND READING MATERIAL

1. <http://www.engineersireland.ie/About.aspx>
2. https://www.ieee.org/about/today/at_a_glance.html
3. <https://www.ieee.org/about/index.html>
4. https://www.ieee.org/about/today/at_a_glance.html
5. https://www.ieee.org/about/today/at_a_glance.html