The World Wide Web of Glass: The Past, Present and Future of Fibre Optics

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Abstract

Using sun and reflectors, communicating with light goes back thousands of years. But with the advent of lasers and optical fibres in the later half of the past century a revolution occurred in the telecommunications industry. A single fibre made of a flexible strand of ultra-pure silica, with a width not much greater than that of a human hair, has the capacity to transmit more than 250 million simultaneous telephone conversations, or to provide 5 million broadband internet connections. Moreover it can do this over transoceanic distances. This explosion in data transfer capacity, speed and system reach has changed the world through the internet and in order to satisfy our ever increasing communications needs a cloak of optical fibres now covers the globe.

This development of today's fibre networks has only been possible due to a number of key scientific breakthroughs, as well as huge and sustained investment in optical fibre telecommunications technology over the years. Major advances have been required in manufacturing processes, as well as in both component and system concepts. For example, the invention of the optical fibre amplifier at Southampton University in the mid-1980s eliminated signal attenuation as a fundamental limit to the distance and speed that data can be sent through optical fibre cables. Prior to this, signals had to be converted from the optical to the electronic domain every few tens of kilometres and this imposed a huge bottleneck to system capacity. Until recently, it had been widely assumed that the transmission bandwidth available from optical fibres as developed in the mid-70's was effectively infinite relative to our needs. However, due to increased internet uptake and the emergence of new and ever more bandwidth hungry applications, there is a growing realization that this is no longer the case. Indeed, without further innovations, the data carrying capacity of our current fibre networks could be exhausted within the next 5-10 years.

In this talk I will review the historic development of optical fibre technology and describe the current state-of-the-art in terms of transmission performance. I will then describe possible ways forward to avoid the looming bandwidth-crunch ahead. Time permitting I will also describe some of the other emerging applications of fibre technology which range from demonstrating nuclear fusion, use in cutting and welding steel and discovering new oil reserves.

David J. Richardson holds a personal Chair in Photonics at the University of Southampton and is Deputy Director of the Optoelectronics Research Centre (ORC) where he is responsible for Optical Fibre Device and Systems research. His current interests include amongst others: optical fibre communications, high power fibre lasers and nonlinear fibre optics. He has published more than 700 conference and journal papers in his time at the ORC, and produced over 20 patents. He is a frequent invited speaker at the leading international optics conferences and is an active member of both the national and international optics communities. Prof. Richardson, a founder of SPI Lasers Ltd., was made a Fellow of the Optical Society of America in 2005, a Fellow of the IET in 2008 and most recently a Fellow of the Royal Academy of Engineering in 2009.