Optical Data Communication

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This special section of *Optical Engineering* is dedicated to optical data communication, which is among the fastest growing applications of optics in the information age. Seventeen papers appear in this special section, dealing with a broad range of subjects encompassed by the topic area. This special section is particularly timely, since the past year has included several milestones in optical data communications: industry acceptance of the Gigabit Ethernet and FICON standards, commercial availability of parallel optical interconnects, increased use of wavelength division multiplexing in datacom systems, and the introduction of several new types of small form factor fiber optic connectors.

The first paper in this section provides an overview of datacom standards and technologies (ESCON/SBCON, ATM/SONET, FDDI, fiber channel, FICON) as well as future directions (parallel optics, wavelength division multiplexing, Gigabit Ethernet, and other areas). The next two papers deal with the development of new laser sources for data communications. Vertical cavity surface emitting lasers (VCSELs) at short wavelengths are important for parallel optical arrays. Significant research is in progress to develop long wavelength VCSELs, which at present can only be fabricated in a handful of laboratories around the world. This paper describes the development of long wavelength VCSELs with record low threshold current and threshold current density, as well as continuous operation at room temperature. A potential alternative to long wave VCSELs is large spot size lasers which relax alignment tolerances and potentially reduce manufacturing costs of fiber optic transceivers. The next two papers describe the use of short wavelength VCSELs in parallel optical data links, which are emerging as commercially available products.

Three papers deal with new types of small form factor optical fiber connectors which are being proposed for data communication systems. Approximately one half the size of conventional SC duplex connectors, they are equivalent in size to an RJ-45 electrical outlet. Although there are many small form factor connector proposals, these papers describe some of the different technical approaches to reducing the size of optical connectors. One possibility is to use existing ceramic ferrules, but placed much closer together than standard duplex connector housings (the fiber jack or FJ connector). Another option is to design a new type of ferrule which can accommodate multiple fibers (the SC/DC connector). The most revolutionary approach is to eliminate ferrules altogether, and align the fibers using v-groove technology (the VF-45 or Volition connector). The design and performance of these optical connector options is described. In some applications, it is not possible to install optical fiber cable between two locations; optical communication may still be possible, however, using a free space optical data link as described in the next paper.

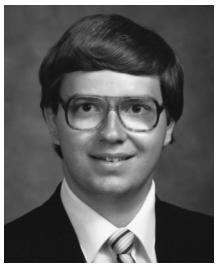
The Gigabit Ethernet standard, IEEE 802.3z, has received a great deal of attention following its introduction this past year, and may be the first optical interconnect which is introduced at a cost competitive with copper data links. The next paper addresses one of the most fundamental technical problems encountered by this new standard, differential mode delay, which limits the ability to operate both long and short wavelength transmitters over existing multimode fiber. In this paper, an approach to the design of optical mode conditioners is presented which controls the transmitter launch conditions to achieve greater effective bandwidth; a summary of the Gigabit Ethernet Task Group's findings in this area is presented.

The next two papers describe research into data communication devices. A paper dealing with the Optochip research consortium describes the integration of optical and electronic devices. Another paper presents several applications of ''smart pixels,'' hybrid optical/electronic devices which have found datacom applications in high-speed digital optical switching and real time data compression.

The next group of papers deals with emerging optical datacom network technologies and architectures. The use of time division multiplexing is discussed as a possible way to achieve data rates approaching 100 to 250 gigabits per second. A network architecture based on parallel optical fiber ribbons is described. A new type of ATM switch is proposed, which utilizes optical signal processing techniques and code division multiple access (CDMA) to enhance performance. The use of wavelength division multiplexing (WDM) for datacom networks is addressed by the paper on Cobnet, a venture of the Esprit program. Finally, another paper describes an application of dense WDM technology in a multi-site Parallel Sysplex.

I would like to thank all of the authors who have taken the time to prepare papers on their research in this field for publication in this special section of *Optical Engineer-*

ing, and to the reviewers for their comments and suggestions. I would like to extend special thanks to the past Editor, Dr. Brian Thompson, for giving me the opportunity to serve as guest editor. I'm also grateful to the editorial staff at SPIE and *Optical Engineering* for their excellent support in the preparation of this issue.



Casimer M. DeCusatis is an advisory engineer for IBM Corporation, System/390 Server Division, Poughkeepsie, New York, where he has participated in many data communications development teams for ESCON transceivers and cables, the InterSystem Channel used on five generations of Parallel Sysplex architectures, the OETC and Jitney parallel optical links, the 9729 Optical Wavelength Division Multiplexer (winner of the 1996 *Photonics Spectra Circle of Excellence Award*) and FDDI/ATM interfaces for the Open Systems Adapter family. He received the MS and PhD degrees from Rensselaer Polytechnic Institute (Troy, New York) in 1988 and 1990, respectively, and the BS degree magna cum laude in the Engineering Science Honors Program from the Pennsylvania State University (University Park) in 1986. He is co-inventor on 13 patents and author of over 50 technical papers, as well as the book *Acousto-optics: Fundamentals and Applications* (Artech House, 1990). He has contributed chapters to several books, served as co-editor of the *Handbook of Fiber Optic Data Communications* (Academic Press, 1998), and as editor of the *Handbook of Applied Photometry* (AIP Press and Springer-Verlag, 1997). Dr. DeCusatis is currently president of the Institute for Optical Data Communications. His other research interests include signal processing using wavelets, which has been the subject of recent invited talks in St. Petersburg, Russia, and Gdansk, Poland. Dr. DeCusatis is a member of the Optical Society of America, IEEE, SPIE, Sigma Xi Research Society, and 10 academic honor societies including Tau Beta Pi and Eta Kappa Nu; he has also been profiled by various biographical publications including *Who's Who in Science and Engineering*.