Activities in the European Optical Communications Field

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Abstract

The optical communication areas reviewed in the paper mainly relate to system and network based activities. A supporting European optical component program exists, of course, but this is not covered in detail in this review.

Within Europe there are a number of optical programmes being pursued independently by the various European companies and research organizations. In addition there are a number of very large multi-partner projects, which are funded through the European Community research programs, RACE (Research and Development in Advanced Communications Technologies in Europe) and ESPRIT (European Strategic Program of Research and Development in Information Technology). RACE is a major European Community action aimed at integrated Broadband Telecommunications. Currently the program is in its main phase, with systems and techniques being developed for the broadband network. Approximately 85 projects are in operation covering a range of components (active and passive) and materials, switches, integrated optics and optical systems.

It is convenient to categorize activities under two broad headings, customer premises/access and core network; the latter category includes long haul undersea systems. The following discussion attempts to illustrate main trends and activities rather than give a detailed account of all the major programs.

Customer Premises/Access

The main thrust of the RACE program lies in this area, with a number of major projects now well underway. The Coherent Multi Channel project (R1010) seeks to demonstrate a 10 channel coherent detection system for application in local loop. System includes wavelength referencing and start up procedures. The channel bit rate is 140 Mbit/s. Partners include GPT, HHI and Siemens. Project (R1036) involves the development of a High Density WDM/TDM broadband customer premises network. The technology involves a combination of high density WDM combined with electrical time division multiplexing. Total information capacity of channel to be greater than 38 Gbit/s; based on 16 × 16 star topology. Partners include BBC, STC, GEC, Alcatel. Multi Gigabit Transmission Technology (5–10 Gbit/s), for application in the subscriber loop is being developed in project (R1051). Currently, the architecture design has been realized and transmission at 10 Gbit/s has been demonstrated. Partners in this project include AT&T (Philips), Deutsche Bundespost, GPT, Telefonica.

A major ESPIRIT project UCOL (Ultra Wideband Coherent Optical LAN) is developing an optical LAN based on 20 channel DPSK coherent transmission, with TDMA. Bit rate per channel is 150 Mbit/s. Partners include Alcatel FACE, PTT Research Netherlands, SEL Alcatel.

Independent activities in the access area include TPON (Telephony over Passive Optical Network), which has been developed at BTRL, UK. This project is now in a trial phase, serving real customers. Research trends involve the use of Erbium fibre amplifiers as power splitters to increase the number of customers served from a single fibre. COSNET (Coherent Optical Subscriber Network) developed by PTT Research, Netherlands, supports bidirectional broadband communications and is designed to be compatible with narrowband ISDN.

A large optical switching project (OSCAR) is also run under the umbrella of RACE. This project aims at developing the basic switching technologies required for the evolution towards integrated optical networks. Switching fabrics based on Lithium Niobate and III-V material are being addressed.

CORE (Long Haul)

Network activities include wavelength routing techniques (BTRL,UK) which allow a logical network, based on wavelength defining the interconnection, to be overlayed on the physical network. WDM techniques also reduce the cost of cable and duct provisioning by making better use of the existing fibre. For the longer term, research and development

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into multi frequency coherent systems continues in a number of laboratories (eg HHI, BTRL). Coherent technology offers a number of advantages for long distance systems, for example detection sensitivity is still better than that achieved with direct detection and dispersion effects are far less significant. Field demonstrations in the UK, have included transmission over 200 km with two wavelengths (each at 565 Mbit/s) and an Erbium fibre repeater. More recently coherent transmission at 2.5 Gbit/s has been demonstrated, with a detection sensitivity of −39 dBm. Direct detection systems using optical preamplifiers based on Erbium doped fibre are now showing very promising results. Experiments at BTRL have demonstrated detection sensitivities of −43 dBm at 2.4 Gbit/s, a world record result.

The introduction of optical amplifiers has made the use of WDM economical in long haul networks, as fibre amplifiers can amplify a large number of wavelengths simultaneously without crosstalk. Erbium optical amplifiers have been developed in Europe by companies such as BT&D (UK) and Pirelli (Italy and UK). Undersea optical system manufacturers are interested in the use of optical amplifiers as linear repeaters and a number of experiments show the feasibility of this approach. For example, a 1000 km amplifier system has been demonstrated at BTRL, UK. For transatlantic length systems, non-linear transmission techniques (solitons) are now being studied seriously, as there is a fundamental limit to linear transmission in terms of bit rate and distance (for example 20 Gbit/s over 200 km has recently been observed as a particular limit on the two dimensional plane of speed and distance). Activities in a number of European companies have shown that solitons can readily be generated with semiconductor sources and that non-linear systems are robust in use and can be engineered for real applications.

A number of organizations have demonstrated transmission over long distances at bit rates in excess of 10 Gbit/s. SEL-Alcatel and BTRL, for example, have demonstrated the generation of 20 Gbit/s data by means of optical time division multiplex, with transmission over distances of 115 km and 200 km respectively.