FIBER OPTICS COMMON TRANSCEIVER MODULE

Herbert D. Hendricks

NASA Langley Research Center

Long Term Objectives:	Develop space qualified fiber optics transceiver for information networks application in Space Station. Advance the technology to increase the system data handling capability, reduce the overall device size and improve efficiency and sensitivity.
Importance of Problem:	Fiber optics information networks provide a means to achieve a high data rate communication system that is evolutionary and expandable for use on the Space Station. A space/military qualified approach to the problem will help advance the technology development and make more refined and advanced communications system available earlier.

FIBER OPTICS COMMON TRANSCEIVER MODULE

Related R & D: Comments related to other R & D in this area has been obtained from AGED"C" reviews, Tri-Service Working Group on Fiber Optics, Published Literature and Private Communications.

Hybrid Fiber Optics Transceivers: Commerically available devices are available from a few kiloBits to 500-700 MegaBits that are designed around discrete devices and combinations of discrete devices and hybrid integrated devices. High speed transceivers tend to use more integrted devices such as pin-FET preamplifiers, amplifiers and comparators. GaAs FET laser driver circuits are coming into greater use. This also includes the hybrid integration of the laser current mirror drive circuit. DOD, U.S.Army, has a military qualified 50 MBit transceiver module.

Monolithic Fiber Optics Transceiver: Currently DARPA is funding Rockwell International and TRW for the integration of semiconductor lasers and photodetectors with GaAs FET technology for high speed transceivers for fiber optics and microprocessor communications.

DOD is also funding some monolithic pin-FET preamplifier development in InGaAsP/InGaAS/InP which was formerly funded by NASA. Objectives of the program also encompasses a transmitter development effort.

Japan has demonstrated a number of monolithic approaches for a pin-FET preamplifier and a

FIBER OPTICS COMMON TRANSCEIVER MODULE

Technical Approach: The technical approach centers around past in-house tasks in the development of hybrid fiber optics transceivers, coordination of transceiver development with DOD and finally a RADC study of transceiver requirements for the Air Force.

Fiber Optics Hybrid Transceiver: The current approach is to build onto a RADC common transceiver module contract which is currently dircted toward a 200 MBits transceiver within one year. NASA also prevailed to have an added breadboard development of a 1 GBit design.

GaAs foundry services are being followed along with commerical development of hybrid integrated transceiver devices. A 3 GBit front end laser driver and photodetector preamplifier is being pursued in-house using available GaAs GigaBit technology.

Monolithic Transceiver: Discussions are being carried on with a number of DOD offices about the next generation transceiver designs. Discussions center around both AlGaAs and InGaAsP material/device systems.

FIBER OPTICS COMMON TRANSCEIVER MODULE

Technical Results and Accomplishments

Hybrid Transceivers

Demonstrated an in house version utilizing a hybrid receiver approach consisting of 1) an integrated pin-FET transimpedance preamplifier, 2) Avantek amplifiers, and 3) high speed ECL comparators. Transmitter design utilized a GaAs-FET current mirror and bias circuitry, Tau-Tron drivers and photodiode feedback and T.E. cooler control circuitry. Device performs at 500 MBits at 1 milliwatt power output, -35 dB sensitivity and with 10^{-10} bit error rate in fiber optics networks.

Designed a 3 GBit transmitter and receiver front end based on GaAs FET GigaBit Logic Devices. Investigated Tektronix CAD GaAs FET design based Daisy Systems and corresponding foundry services.

Currently have a joint contractural effort with RADC for the development of a 200 Mbit/sec military qualified transceiver and a breadboard study of a 1 GBit/sec transceiver.

Monolithic Transceiver

Tracking DOD R & D efforts and Japanese efforts while looking for supporting funds.

Progress towards planned milestones on schedule.

FIBER OPTICS COMMON TRANSCEIVER MODULE

HOW CURRENT RESULTS AND ACCOMPLISHMENTS WILL ENHANCE NASA CAPABILITY IN COMPUTER SCIENCE AND DATA SYSTEMS

Current advancements in commerical and military qualified device/component/transmitter/receiver technology point toward the acceptance of fiber optics in communications, computer and data systems. This task will be the implementation of technology to provide a space qualified transceiver for use on Space Station. With the complimentary funding from RADC/AF this should supply a much needed transceiver for use on Space Station with relative little NASA funds and in a short time frame.

A greater advancement could be made by utilizing GaAs FET technology to reduce the ECL power consumption and improve the overall electronic/optical system thermal load while increasing the ability to transfer data at higher speed with greater efficiency.

GaAs mesFET and GaAs HEMT technology with both depletion and enhancement devices will provide the high speed parallel processing capability of the future.

FIBER OPTICS COMMON TRANSCEIVER MODULE

MAJOR MILESTONES

Demonstrate military qualified transceiver - 4/86

Demonstrate 1 GBit breadboard transceiver design -4/86

Demonstrate Space Qualified Transceiver - 6/87

Demonstrate greater than 1 GBit transceiver - 6/88

RESOURCE REQUIREMENTS	85	86	87	88	89
($k)	0	200	200	400	400
(MY)	0	.1	.1	.2	.2

FIBER OPTICS COMMON TRANSCEIVER MODULE

ISSUES: Funding for GaAs-FET Transceiver
Space Qualifications for Space Station
Upper Limit Data Rate Requirement

COMMENTS: All programs coordinated with DOD Tri-Service Committee on Fiber Optics