NASA Technical Memorandum 105167

Optical Multiple Access Network (OMAN) for Advanced Processing Satellite Applications

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Prepared for the
Summer Topical Meetings on Spacebourne Photonics:
Aerospace Applications of Lasers and Electro-Optics
sponsored by the Institute of Electrical and Electronics Engineers
Newport Beach, California, July 22–24, 1991

NASA

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by

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SUMMARY

Advanced Processing Satellites require a circuit switch which interconnects N uplink RF receivers with N downlink RF transmitters at a data rate D (see Figure 1). Optical multiple access networks based on code division multiple access (CDMA) are viable candidates for this switching function because they are compatible with bursty, asynchronous, concurrent communication [1,2,3] and minimize scheduling delays [4]. We have designed such a circuit switch based on temporal/spatial CDMA. The encoders and decoders are (0,1) pseudo orthogonal pulse sequences mapped into pseudo orthogonal matrix codes [5,6]. Optical delay lines are used to implement the matrix codes because the large data rate (>100 Mb/s) and number of users (8) result in short chip times (<1ns). In this paper we discuss the hardware design options and component trade offs which led to our design concept. A CDMA network of four users, weight four has been breadboarded to validate and demonstrate the concepts (see Figure 2). The three basic characteristics of code autocorrelation, codecross correlation, and multiple user interference (MUI) have been measured. The measurements show that the embodiment performs according to theory, so that the design rules [3] established for optical CDMA can be readily extended to spaceborne photonics applications. One of the critical measures of network performance is MUI [7]. Figure 3 shows a computer simulation of the effects of MUI on signal and clutter statistics of our matrix code design. Clearly, as the network is fully utilized there is a potential degradation in the system's bit error rate (BER) due to the CDMA codes. For this reason we are exploring error correction schemes which reduce this BER degradation.

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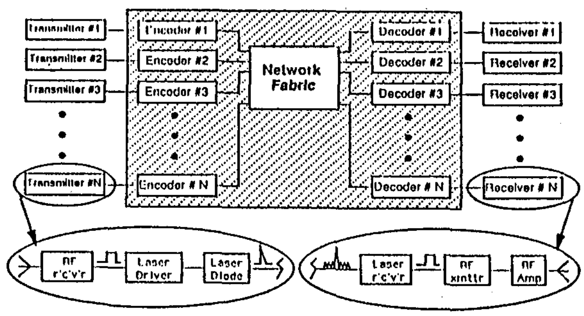

Figure 1. Block diagram of advanced Satellite Circuit Switch (ASCS).

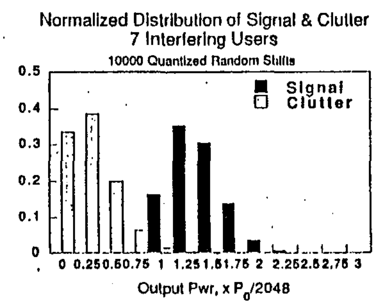

Figure 3. Computer simulation of 8 user network mutual user interference (MUI).

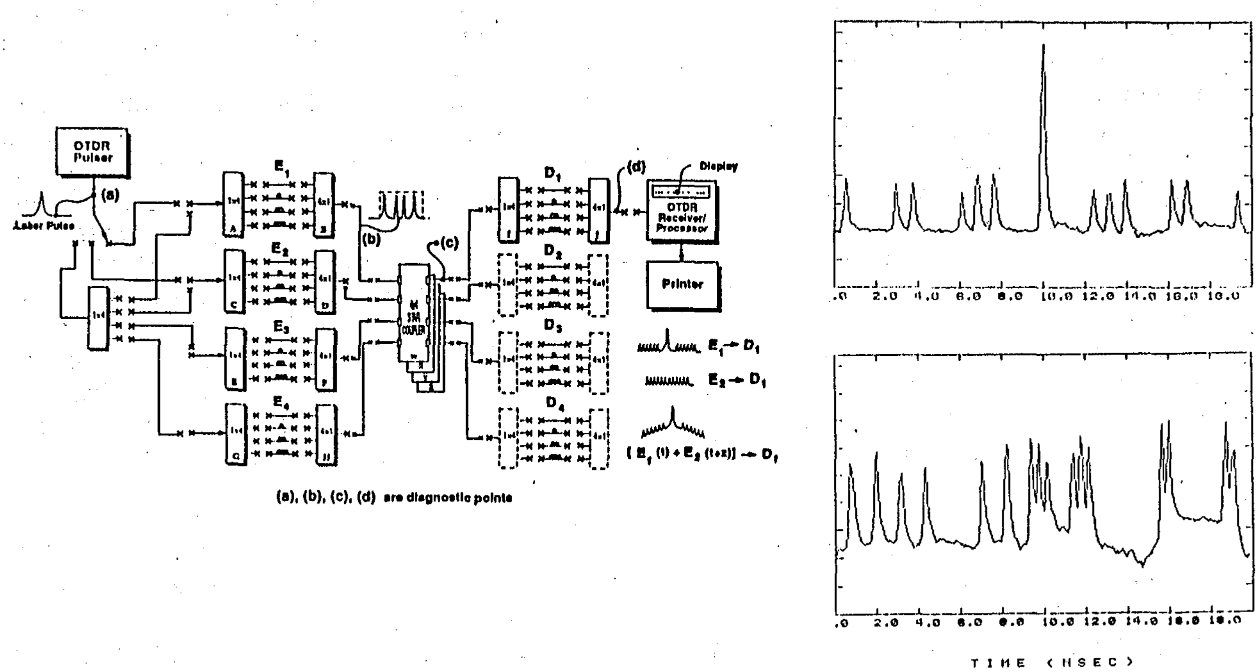

Figure 2. Experimental breadboard and typical autocorrelation, crosscorrelation measurements.

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Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TM-105167		

4. Title and Subtitle	5. Report Date
Optical Multiple Access Network (OMAN) for Advanced Processing Satellite Applications	
	6. Performing Organization Code
7. Author(s) Antonio J. Mendez, Robert M. Gagliardi, Eugene Park, William D. Ivancic, and Bradley D. Sherman	8. Performing Organization Report No. E-6458
	10. Work Unit No. 321-01
9. Performing Organization Name and Address National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio 44135-3191	11. Contract or Grant No.
	13. Type of Report and Period Covered Technical Memorandum
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546-0001	14. Sponsoring Agency Code

15. Supplementary Notes

Prepared for the Summer Topical Meetings on Spacebourne Photonics: Aerospace Applications of Lasers and Electro-Optics sponsored by the Institute of Electrical and Electronics Engineers, Newport Beach, California, July 22-24, 1991. Antonio J. Mendez, Mendez R&D Associates, El Segundo, California 90245; Robert M. Gagliardi and Eugene Park, University of Southern California, Los Angeles, California 90089; William D. Ivancic, NASA Lewis Research Center; Bradley D. Sherman, McDonnell Douglas, Long Beach, California 90846. Responsible person, William D. Ivancic, (216) 433-3494.

16. Abstract

An OMAN breadboard for exploring advanced processing satellite circuit switch applications is introduced. Network architecture, hardware trade offs, and multiple user interference issues are presented. The breadboard test set up and experimental results are discussed.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Optics; Processing satellite; Code-division; Multiple access; Photonic; Switching networks	Unclassified - Unlimited Subject Category 32

19. Security Classif. (of the report)	20. Security Classif. (of this page)	21. No. of pages	22. Price*
Unclassified	Unclassified	4	A02

NASA FORM 1626 OCT 86

*For sale by the National Technical Information Service, Springfield, Virginia 22161

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Space Administration

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