National Centre for Radio Astrophysics

Internal Technical Report

A LOW COST SHORT REACH ANALOG FIBER OPTIC LINK FOR EMBRACE

By

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2004

Author: S. Sureshkumar Verified by :	Date of issue: 27/04/2004 Kind of Issue: Public	Scope: Fiber Optics
Approved by: Y Gupta	Status: Preliminary	Internal Technical Report No.:
	Revision no.: Ver.1	

National Centre for Radio Astrophysics

Distribution list

Group	Others	Circulation
1. J. D. Bregman 2. Y Gupta 3. G. W. Kant 4. GMRT SIRC		Publicly available

Document history

Revision	Date	Chapter / Page	Modification / Change
Ver.1	24/04/2004	5 chapters, 18 pages	

ACKNOWLEDGEMENT:

We thank **Prof. Yashwant Gupta.** *Dean of GMRT,* for making it possible to work on this assignment and giving constant encouragement with his valuable comments.

We also thank **Prof. S.K. Ghosh** *Centre Director NCRA,* for giving constant support during this work.

We thank **Shri. A Praveen Kumar**, *Group co-ordinator* for giving constant support during this work.

We also very much thankful to Pravin Raybole, M Gopinathan, Satish Lokhande of Fiber optic group for their help and support in completing the assignment successfully.

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ABSTRACT:

This is a technical note to study the possibility of using a low cost analog fiber optics link for EMBRACE, a SKA project proposed by ASTRON, Netherlands. The note is a design guide to an analog fiber optic link and describes the optimization of component specification to meet the performance and low cost requirement for the short distance link. A cost comparison is done with a coaxial cable link approach to the project.

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INTRODUCTION

1.1. Organization Profile:

National Centre for Radio Astrophysics has set up a unique facility for radio astronomical research using the meter wavelengths range of the radio spectrum, known as the Giant Metrewave Radio Telescope (GMRT), it is located at a site about 80 km north of Pune. GMRT consists of 30 fully steer able gigantic parabolic dishes of 45m diameter each spread over distances of up to 25 km. GMRT is one of the most challenging experimental programs in basic sciences undertaken by Indian scientists and engineers. GMRT is an interferometer which uses a technique named Aperture Synthesis [2] to make images of radio sources in sky.

CHAPTER -2

LINK DESIGN

2.1 **Intrinsic Gain**:

The analog fiber optic link has a conversion loss given by equation 1. Due to the parallel combination of R load and output impendence only half of the detected photodiode current is available and hence the factor ½ is used in the equations. The link has the conversion loss of 33.45 db in the link of the total RF loss will be 35.45db. .

$$G_i = 10.\mathrm{Log}10(\ \eta_l \,.\, R / 2\ )^2 \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

Where η_l = Slope efficiency of the laser diode in W/A
R = Responsivity of the photodiode in A / W

2.2 **XLS Spread sheet Calculation**:

In XLS spread sheet calculation we need to take individual block details like gain, noise figure, P1 dB and IP3. Followings are the methods/formulas used to calculate cascaded performance. The following block shows the n devices are connected and the each devices value is given. Gain 'G' in dB, Noise Figure 'N.F' in dB, Input 1 dB compression point 'IP1 dB' in dBm and input third order intercept point 'IIP3' in dBm. Where f is noise factor.

Fig 5

$$g = 10^{G/10} \quad G = 10 * \mathrm{Log}\ (g) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ (2)$$

$$f = 10^{N.F/10} \quad N.F = 10 * \mathrm{Log}\ (f)$$

$$p1dB = 10^{P1\ dB\ /10} \quad P1\ dB = 10 * \mathrm{Log}\ (p1\ dB)$$

9. CONCLUSION

The proposed link shows the possibility of having a low cost short distance analog fiber optics link for EMBRACE bridging in the full RF band. With the availability of VCSEL laser the link could cost low compared to a link using FP laser diode. Recent work has shown that VCSEL used for Gigabyte Ethernet can be used for analog optical links. It was shown that a 300 meter high bandwidth multimode fiber could transport frequencies up to 5 GHz with SFDR of 97 db.

9. REFERENCES

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2. http://www.iqcwireless.com

3. C. Carlson , " VCSEL for fiber optics RF links" in *Microwave Photonics* , Vol.10, P. 81-84, Jan 2002.