Effect of Optical Channel Bandwidth on the Immunity of NRZ and RZ Linear Codes

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Abstract - **A comparative assessment of the required bandwidth of the optical channel of FOTS using NRZ and RZ linear codes is given in this paper.**

Keywords - **linear coding, wave division, bandwidth, immunity, dispersion.**

I. INTRODUCTION

Modern systems have to provide large amounts of data at high rate using fiber-optic cables. Further increase of the STM level has been suspended due to the influence of dispersion and the lack of hardware components to provide a high-speed signal transmission. Therefore these SDH systems were replaced by new WDM systems. There is RZ linear code is used in WDM systems. Source [1] indicates that such a code requires increase of the bandwidth by 100%, despite the fact that it leads to an increase in noise level.

The purpose is to study the effect of optical channel bandwidth on the immunity of NRZ and RZ linear codes.

II. CALCULATIONS

The immunity A_I, as a function of variable bandwidth ΔF, is determined by the initial immunity A_{II} and by the immunity variation ΔA_I:

$$A_I(\Delta F) = A_{II} - \Delta A_I . \quad (1)$$

The immunity variation ΔA_I consists of three terms, which are defined by changes in pulse amplitude (ΔA_{AI}), under influence of noise (ΔA_{NI}) and by dispersion variation (ΔA_{DI}).

The resulting magnitude of the immunity variation of RZ-like code ΔA_{INRZ} is equal to:

$$\Delta A_{INRZ} = \Delta A_{\grave{A}I} + \Delta A_{NI} + \Delta A_{DI} . \quad (2)$$

It is shown that

$$\Delta A_{AI} = 10\log(1 + z^2 + \frac{2,07}{p^2}) , \quad (3)$$

where:

p - is a parameter which demonstrates how many times the bandwidth of the transmitter and receiver is changed over the NRZ code bandwidth,

z – is a relative value of the dispersion of optical fiber.

The noise increases in proportion to p, so

$$\Delta A_{NI} = 10\log(p) , \quad (4)$$

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In accordance with [2]:

$$\Delta A_{DI} = 20\log(\frac{1}{1 - 2e^{-\frac{2,76}{1+z^2+\frac{2,07}{p^2}}}}) . \quad (5)$$

The resulting magnitude of the immunity variation of RZ-like code ΔA_{IRZ} is equal to:

$$\Delta A_{IRZ} = \Delta A_{\grave{A}I} + \Delta A_{NI} + \Delta A_{DI} , \quad (6)$$

where

$$\Delta A_{AI} = 6 + 10\log(0,25 + z^2 + \frac{2,07}{\eth^2}) , \quad (7)$$

$$\Delta A_{NI} = 10\log(p) , \quad (8)$$

$$\Delta A_{DI} = 20\log(\frac{1}{1 - 2e^{-\frac{2,76}{0,25+z^2+\frac{2,07}{\eth^2}}}}) . \quad (9)$$

The results of the calculations are shown in Fig. 1.

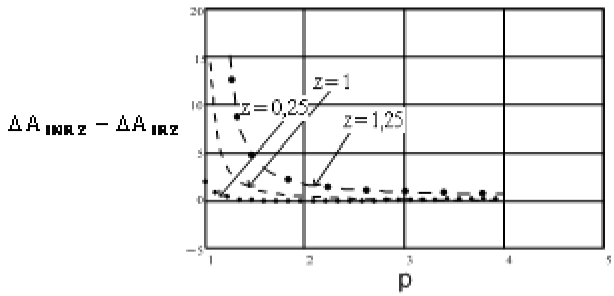

Fig. 1. The effect of p variation on the immunity of NRZ and RZ codes on p at different z values.

III. CONCLUSION

The results demonstrate the advantages of RZ code over NRZ for all the values of z, so the losses $\Delta A_{INRZ} > \Delta A_{IRZ}$. It is clear that there is no need to increase the bandwidth by 100% for RZ code, as it is usually recommended, since if z < 0,25, then losses of NRZ and RZ codes do not differ for bandwidth increase by 20%

REFERENCES

[1] Корнейчук В. И. Волоконно-оптические системы передачи / В. И. Корнейчук, И. П. Панфилов. – Одесса: Друк, 2001. – 436 с.: ил.

[2] Брескин В. А. Влияние дисперсионных искажений на длину регенерационной секции волоконно-оптических систем передачи / В. А. Брескин, А. Д. Мазур // Наукові праці ОНАЗ ім. О.С. Попова. – 2008 – №1. – с.80-84.