scrambling codes for decode and forward d2d noma

Abstract—The abstract goes here.

Index Terms—

1 Introduction

A half duplex cooperative relaying protocol exploiting the concept of NOMA is proposed. The system architecture consists of a relay M, a relay R and a destination D as drawn in Figure. 1. All the links M-D and R-D are assumed to be available and subjected to independent Rayleigh fading. Parameters h_1, h_2, refer to the respective channel coefficients of M-D and R-D links. The data transmission in the proposed protocol is performed simultaneously as follows.

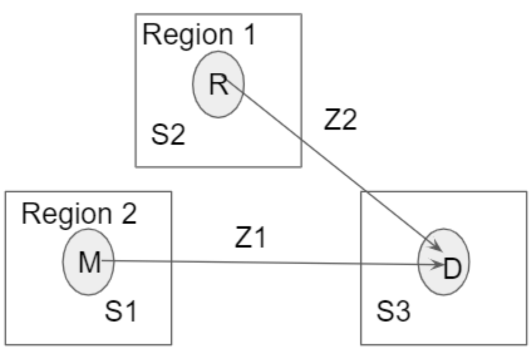

Figure 1: Receiving two NOMA signals simultaneously at destination D

1.0.1 Signal transmitted by relay M

The relay M, generates a composite NOMA signal,

$$Z_1 = \sqrt{\alpha_1}x_1 + \sqrt{\alpha_2}x_2, \tag{1}$$

consisting of two symbols x_1, x_2. The power allocation factors with x_1 and the power allocation factors with x_2 are respectively denoted by α_1 and α_2 where $\alpha_1 > \alpha_2$ and $\alpha_1 + \alpha_2 = 1$.

Scrambling codes are used to separate signals coming simultaneously from many different UEs or many different gNBs. Hence, using scrambling codes to enable the receivers to separate the different NOMA signals sent by distinct transmitters is proposed. Further, it was assumed that each square area of $100m^2$ in the network area is defined by a unique signature scrambling code.

Each device has a prior knowledge of the list of such scrambling codes in the network area. Hence, depending on the location coordinates of the transmitter, it selects its own signature scrambling code from the list. Then, a precoding is performed on the NOMA signal using the unique scrambling code of relay M, S_1, to generate the precoded NOMA signal,

$$Z_1 = \sqrt{\alpha_1}(S_1 \cdot x_1) + \sqrt{\alpha_2}(S_1 \cdot x_2), \tag{2}$$

1.0.2 Signal transmitted by relay R

Similarly, The relay R, transmits a precoded NOMA signal with the scrambling code S_2,

$$Z_2 = \sqrt{\beta_1}(S_2 \cdot x_3) + \sqrt{\beta_2}(S_2 \cdot x_4), \tag{3}$$

consisting of two symbols x_3, x_4. The power allocation factors with x_3 and the power allocation factors with x_4 are respectively denoted by β_1 and β_2 where $\beta_1 > \beta_2$ and $\beta_1 + \beta_2 = 1$. Further, the precoded NOMA signals of relay M and relay R are transmitted simultaneously with the respective total transmit powers of P_m and P_r.

1.0.3 Received signal at destination D

The received signal at destination D therefore is given by,

$$\begin{aligned} y_D = &\underbrace{h_1\sqrt{P_m\alpha_1}(S_1 \cdot x_1) + h_1\sqrt{P_m\alpha_2}(S_1 \cdot x_2) + n_1}_{\text{NOMA signal 1}} \\ &\underbrace{h_2\sqrt{P_r\beta_1}(S_2 \cdot x_3) + h_2\sqrt{P_r\beta_2}(S_2 \cdot x_4) + n_2}_{\text{NOMA signal 2}}, \end{aligned} \tag{4}$$

where n_1, n_2 are the complex additive white Gaussian noise (AWGN) added at destination D with zero mean and variance σ^2.

1.0.4 Decoding at destination D

First, the two NOMA messages are separated by using the scrambling codes. The received signal will be multiplied by each scrambling code, S_1, S_2. Since the product of two scrambling codes is zero, each NOMA signal can be separated by such multiplication.

Once, each NOMA signal is separated, each NOMA signal is decoded using successive interference cancellation method to extract the x_1, x_2, x_3 and x_4 symbols. In order to decode NOMA signal 1, the symbol x_1 is decoded first since x_1 is dominant over x_2 at the destination. Hence, D first decodes x_1 by considering x_2 as noise. Next, the decoded symbol x_1 is subtracted from the received signal and thus extracts x_2. Similarly, the same procedure is applied on NOMA signal 2 and x_3 and x_4 are extracted. For clear understanding, the SIC process at D used to extract x_1 and x_2 is pictorially represented at Figure. 2.

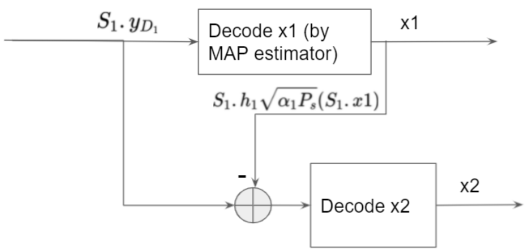

Figure 2: SIC at destination D to extract $x1$ and x_2

2 Conclusion

The conclusion goes here.

Appendix A
Proof of the First Zonklar Equation

Appendix one text goes here.

Appendix B

Appendix two text goes here.

References

[1] H. Kopka and P. W. Daly, *A Guide to LaTeX*, 3rd ed. Harlow, England: Addison-Wesley, 1999.