Uplink User-Assisted Relaying in Cellular Networks

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SRE Presentation

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Overview

- Introduction
- Partial Decode-and-Forward Relaying
- PDF in Cellular Networks
- Cooperation Policies
- Simulations and Results
- Future Work

Introduction

- Relaying cooperative communications will play important roles in future generations wireless networks.
- Relay-aided cooperative communication techniques represent a promising technology that improves average rate
- We use Partial Decode-and-Forward relaying scheme
- We will explore two policies by which active User Equipments(UEs) pick their relays

Partial Decode-and-Forward Relaying

Two Phases

Total transmission period is divided into phases: 1. Broadcast phase and 2. Multicast phase as shown in the figure below.

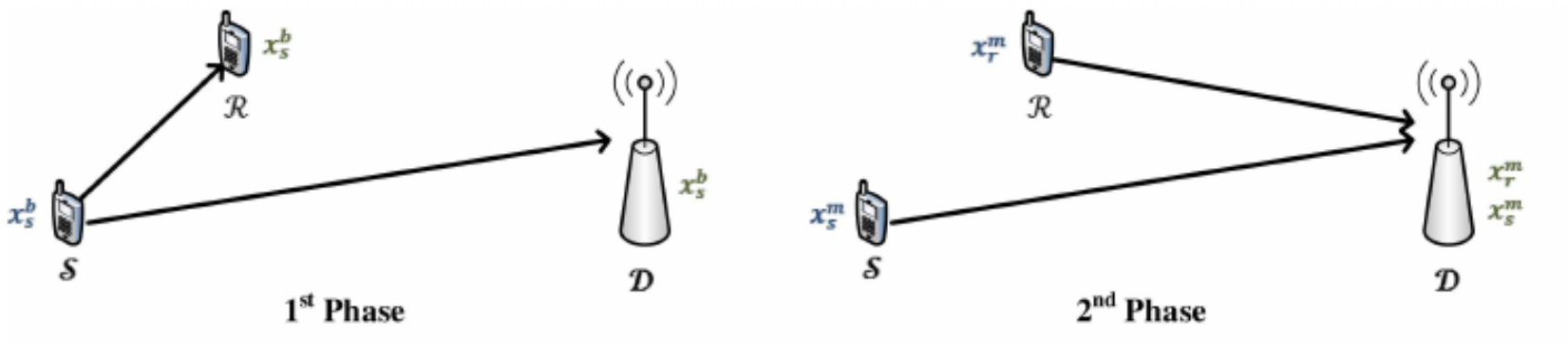

Figure: Two phases in PDF relaying.

Partial Decode-and-Forward Relaying

Transmit Signals

The signals transmitted by source and relay are as follows:

$$\begin{aligned} \text{Phase 1:} \quad & x_s^b = \sqrt{P_s^b}\, U_s^b, \\ \text{Phase 2:} \quad & x_r^m = \sqrt{P_r^m}\, U_s^{m_1}, \\ & x_s^m = \sqrt{P_s^{m_1}}\, U_s^{m_1} + \sqrt{P_s^{m_2}}\, V_s^{m_2} \end{aligned}$$

- All codewords above are picked from independent Gaussian codebooks with zero mean and unit variance.
- $\alpha_1 P_s^b + \alpha_2 P_s^m = P_s, P_s^{m_1} + P_s^{m_2} = P_s^m, \alpha_2 P_r^m = P_r$ where $\alpha_2 = 1 - \alpha_1$

Partial Decode-and-Forward Relaying

Received Signals

Signals received at relay, BS during broadcast(b) and multicast(m) phases:

$$Y_r^b = h_{sr} x_s^b + Z_r^b, \quad Y_d^b = h_{sd} x_s^b + Z_d^b$$

Z_r^b and Z_d^b are *i.i.d* $\mathcal{CN}(0, \sigma^2)$ that represent noises at $\mathcal{R}$ and $\mathcal{D}$.

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$$Y_d^m = h_{sd} x_s^m + h_{rd} x_r^m + Z_d^m$$

The above expression is true only if $\mathcal{D}$ has knowledge about the phase offset between $\mathcal{S}$ and $\mathcal{R}$.

Partial Decode-and-Forward Relaying

Achievable Rate

With received signals as above and joint ML decoding rule at destination, the achievable rate for this relaying scheme is:

$$R_{PDF} \leq min(C_1 + C_2, C_3)$$

where $C_1 = \alpha_1 \log\left(1 + |h_{sr}|^2 P_s^b\right)$,

$$C_2 = \alpha_2 \log\left(1 + |h_{sd}|^2 P_s^{m_2}\right),$$

$$C_3 = \alpha_1 \log\left(1 + |h_{sd}|^2 P_s^b\right) + \alpha_2 \log\left(1 + |h_{sd}|^2 P_s^{m_2} + \left(|h_{sd}|\sqrt{P_s^{m_1}} + |h_{rd}|\sqrt{P_r^m}\right)^2\right)$$

Future Work

Power Control

- We assumed that all nodes transmit at maximum power

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- A distance based power control method can be applied

Thank You!!