Multi-terminal Wireless Communication: Theoretical Limits, Coding Schemes, Resource Allocation

Srikrishna Bhashyam

Department of Electrical Engineering
Indian Institute of Technology Madras

October 2012

Multi-terminal Wireless Communication

Multi-terminal Wireless Systems

- Cellular Systems
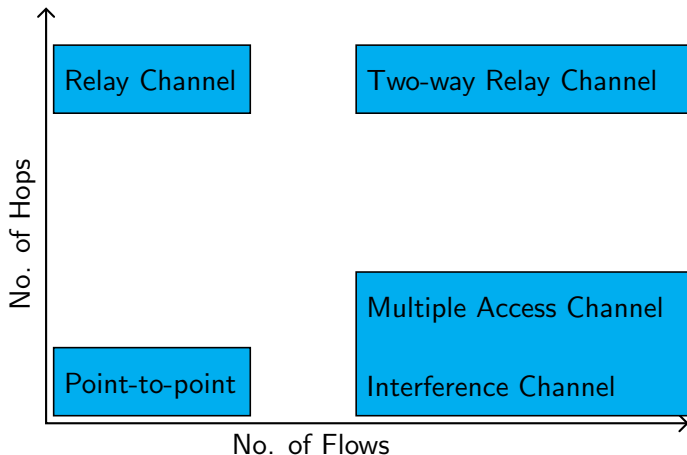- Wireless LANs
- Sensor Networks

Challenges

- Time-variations, adaptation
- Shared resources, Interference

Design Approaches

- Static resource sharing $\implies$ Dynamic resource sharing
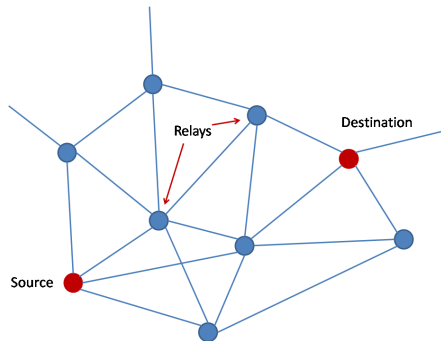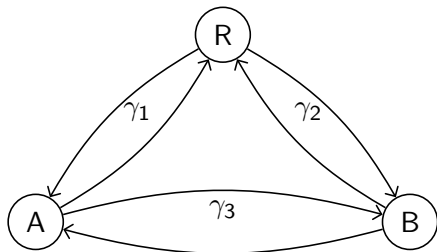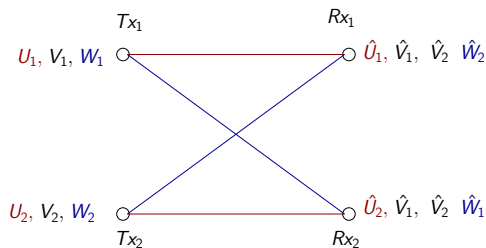- Interference Avoidance $\implies$ Interference Processing

Multi-hop Multi-flow Wireless Communication

- Multiple flows or source-destination pairs: Interference
- Multiple hops: How should information flow from source to destination?

Theoretical Limits

- X Channel
- Relay network: single flow
- Two-way relaying

Tx_1 Rx_1

U_1, V_1, W_1 $\hat{U}_1, \hat{V}_1, \hat{V}_2, \hat{W}_2$

U_2, V_2, W_2 $\hat{U}_2, \hat{V}_1, \hat{V}_2, \hat{W}_1$

Tx_2 Rx_2

R

γ_1 γ_2

γ_3
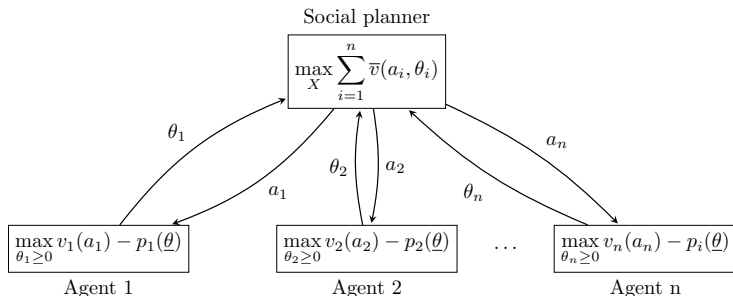
A   B

Relays

Destination

Source

Relaying Protocols and Coding Schemes

- Dirty paper coding for MIMO broadcast
- Nested codes for two-way relaying
- Multihop relaying
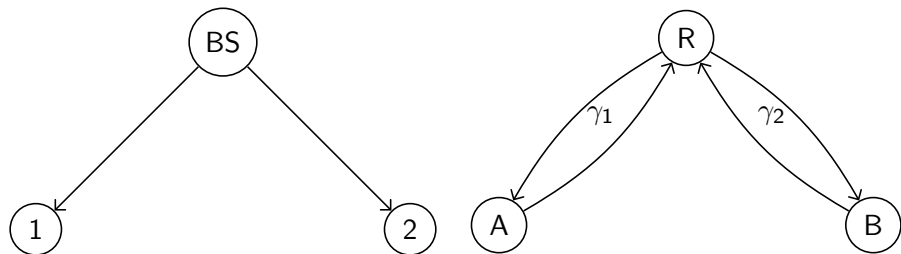
Network Resource Allocation

- Efficient resource allocation needs information
    - How to use partial/imperfect Information?
    - What if users/terminals are strategic?

- Centralized vs. Distributed optimization
- Can we design an interaction mechanism to achieve system objective?

Social planner

$$\max_X \sum_{i=1}^n \overline{v}(a_i, \theta_i)$$

θ_1 $\quad$ a_1 $\quad$ θ_2 $\quad$ a_2 $\quad$ θ_n $\quad$ a_n

$$\max_{\theta_1 \geq 0} v_1(a_1) - p_1(\underline{\theta})$$

Agent 1

$$\max_{\theta_2 \geq 0} v_2(a_2) - p_2(\underline{\theta})$$

Agent 2

$$\ldots$$

$$\max_{\theta_n \geq 0} v_n(a_n) - p_i(\underline{\theta})$$

Agent n

http://www.ee.iitm.ac.in/∼skrishna/