Statistical Signal Processing and Wireless Communications

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Wireless Research Map Overview

- Ultimate goal of project
- Relationship to other projects
- High-level timing goals

Diagram:
- Mobility
- Information Speed (Mbit/s)
- Ubiquity

- 2G
- 3G
- 3.5G
- B3G / 4G
- 4G Access in broad sense

- RF-ID net
- Sensor net
- Ad hoc net
- Near Field Comm. net

- Nomadic Wireless Access
- W-LAN

- Broadband connectivity:
  - High-speed
  - High-capacity
  - Low bit cost
  - IP-based

- Super reachability (under weak connectivity):
  - huge terminal number
  - super small device (1mm^2)
  - super low latency (1ms)
  - non IP-based (Post IP)
  - ad hoc networking
B3G/4G Wireless Research

- MIMO technology
  - Space-time coding, beamforming, diversity techniques, precoding, array signal processing

- Multi-access air interface
  - OFDM, WCDMA, TD-SCDMA, UWB

- Advanced error-correction coding
  - Turbo, LDPC, iterative processing

- Information theory / communication theory
  - Capacity analysis
B3G/4G Wireless Research

- Transmitter/receiver signal processing
  - Channel estimation, interference suppression, equalization

- Link adaptation techniques
  - Adaptive coding, modulation, power control, hybrid ARQ

- Cross-layer design and optimization
  - MAC protocols, admission control, TCP enhancement, mobility management, QoS

- Cognitive radio
  - Dynamic spectrum sensing and access
  - Coding, modulation, resource allocation
Air interface

Channel coding

Link adaptation

Cross-layer optimization

Signal processing

PHY

Channel coding

MIMO

Link adaptation

Cross-layer optimization
Wireless Ad Hoc NW Research

- Target applications:
  - IEEE 802.16 WiMax mesh networks
  - Multihop wireless backhaul networks
  - Wireless sensor networks

- Key approaches
  - Cross-layer design
  - System optimization tools
  - Distributed algorithms
Wireless Ad Hoc Networks

Systematic optimization techniques

- Decomposition techniques to obtain distributed algorithms
- Game theory to model interaction among distributed agents
- Appl.-specific optimization heuristics for combinatorial problems

Systematic design to obtain near-optimal solutions in short design cycle

- Leverage powerful MIMO technologies
- Synergy effect for different application scenarios

Advanced MIMO PHY techniques

- Cluster of cooperative transceivers forming virtual antenna arrays
- Potential gains in terms of performance, energy consumption

Inter-disciplinary collaboration

- Cross-layer optimization
- Metrics from different layers considered jointly