

A Novel Distributed Interference Mitigation Technique Using Power Planning

Virginia Corvino (CNIT-BO), David Gesbert (CNRS-Eurecom), Roberto Verdone (CNIT-BO)

SCENARIO: MULTI-CELL MULTI-CARRIER NETWORKS

- N CELLS
- DL OFDMA SYSTEM WITH S SUBCARRIERS
- UNITARY SPECTRAL REUSE
- U RANDOMLY UNIFORMLY DISTRIBUTED USERS
- RESOURCE ALLOCATION: POWER/SUBCARRIER
- METRIC: NETWORK CAPACITY $C_{net} = \sum_{n=1}^N C_n = \sum_{n=1}^N \sum_{s=1}^S C(s_n) = \sum_{n=1}^N \sum_{s=1}^S \log_2(1 + SINR_u(s_n))$

PROBLEM STATEMENT

- MODERN WIRELESS SYSTEMS ARE INTERFERENCE-LIMITED
- INTERFERENCE COULD BE MANAGED (AND POSSIBLY EXPLOITED) BY THE SCHEDULING AND RADIO RESOURCE ALLOCATION FUNCTIONALITIES

POSSIBLE APPROACHES: PROS AND CONS

Approach	optimality	signaling overhead	scalability
centralized	yes	yes	no
distributed	no	no	yes

OBJECTIVE OF THE WORK

- REALIZE FULLY DISTRIBUTED SCHEDULING AND RADIO RESOURCE ALLOCATION AMONG CELLS THROUGH THE INTRODUCTION OF STRUCTURING IN THE PROBLEM

THE IDEA OF POWER PLANNING

- EACH SUBCARRIER IS ASSIGNED WITH A FIXED TRANSMIT POWER LEVEL (POWER PROFILE DEFINITION OVER THE SPECTRUM)
 - DEPENDING ON THE CELL
 - DYNAMIC IN FREQUENCY BUT STATIC IN TIME
- MULTICARRIER MULTICELL TRANSMIT POWER VECTOR:

$$P = [P^{(1)} \dots P^{(K)}] \quad \text{s.t.} \quad \frac{1}{K} \sum_{k=1}^K P^{(K)} = \bar{P}$$

NUMERICAL RESULTS

SIMULATION PARAMETERS

- $N=9$ CELLS
- DL OFDMA WITH $S=128$ SUBCARRIERS
- $U=288$ RANDOMLY UNIFORMLY DISTRIBUTED USERS
- RAYLEIGH FADING, LOG-NORMAL SHADOWING AND PATHLOSS
- SCHEDULING: EQUAL MINIMUM RATE ($R_{target}=100$ kbit/s) ALLOCATION

POWER VECTOR DEFINITION

LINEAR MODEL

ITERATIVE PROCEDURE

- based on the gradient-ascent method
- objective: maximize C_{net}
- applicable to any scheduling policy
- run offline

VECTOR COMPUTATION

- power vector initialization: $P=P_0$
- distribution of U users and channel generation
- network capacity (C_{net}) evaluation
- power vector update: $P_{(i+1)} = P_{(i)} + \mu \frac{\partial C_{net}}{\partial P} \Big|_{P_{(i)}} P_{(i)}$ te:
- go to step 3 until convergence

INTERFERENCE PREDICTABILITY ALLOWS DISTRIBUTED SCHEDULING AND RESOURCE ALLOCATION AMONG CELLS

$K=3$