

Codebook-based Opportunistic (Multiple) Beamforming for DL MIMO Schemes

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IEEE 802.16m-08/016r1: Call for Contributions on Project 802.16m System Description Document (SDD) (2008-03-20),
downlink MIMO schemes.

Base Contribution:

N/A

Purpose:

For discussion and approval by TGm

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Introduction

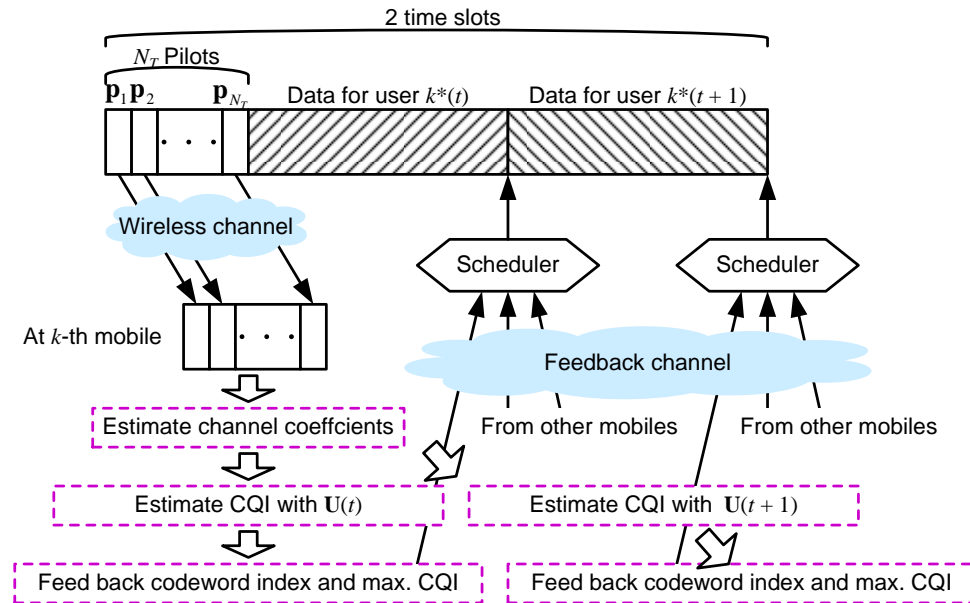
- Codebook-based CL-MIMO in 16e
 - Easy to implement with low overhead and good performance gain
- Opportunistic BeamForming (OBF)
 - Applicable to codebook-based CL-MIMO only using unitary matrix
- We propose “codebook-based CL-MIMO + OBF”
 - Provides significant performance gain with no additional overhead and system complexity

Introduction (Cont'd)

- Proposal
 - *Codebook-based Opportunistic BeamForming* (COBF) for SU-MIMO
 - Codebook-based CL-MIMO + OBF
 - *Codebook-based Opportunistic Multiple BeamForming* (COMBF) for MU-MIMO
 - Codebook-based CL-MIMO + OBF + SDMA

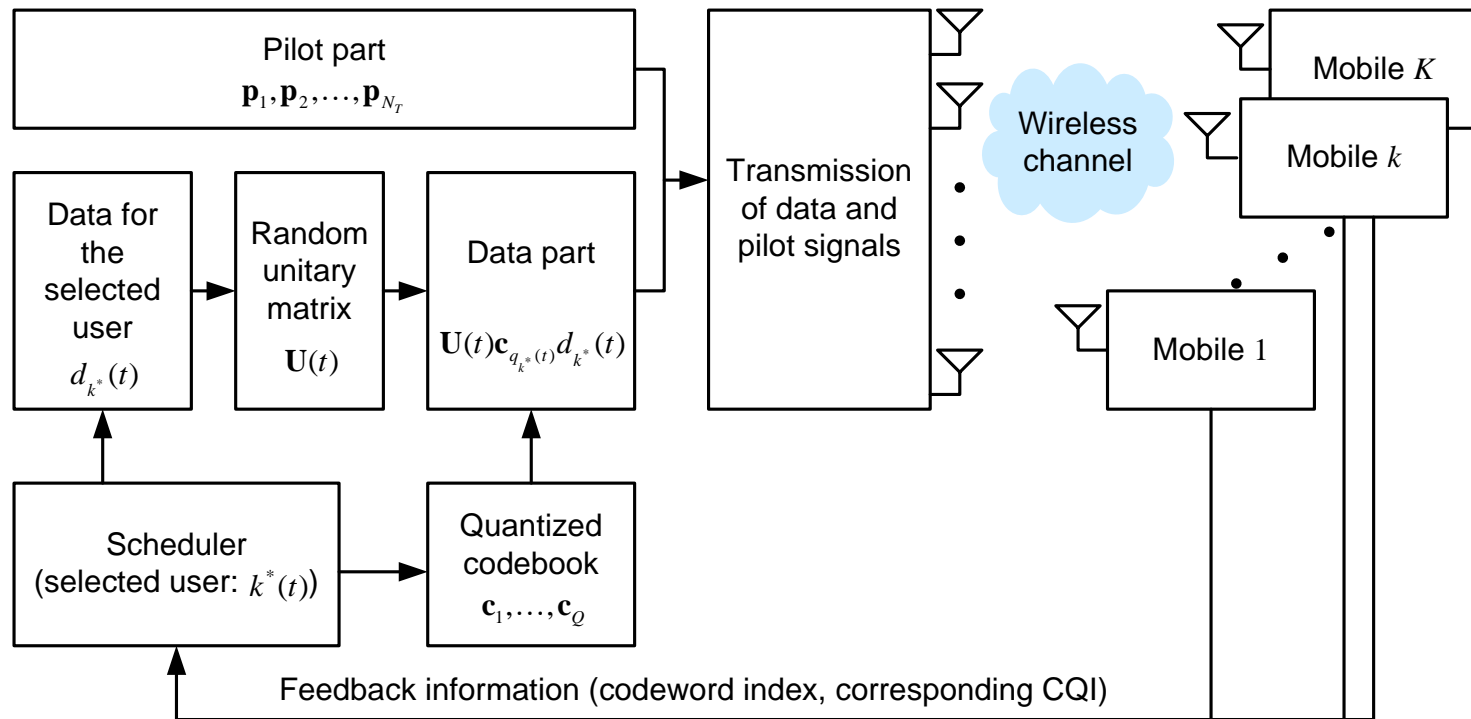
COBF

- Estimate DL channel with common pilots
- Find the best codeword with the largest CQI for each user for given a unitary matrix and a quantized codebook
 - Random unitary matrix for OBF effect
 - Quantized codebook for selection diversity
- For each user, feed back the selected codeword and the corresponding CQI (e.g., channel gain or SINR)



COBF

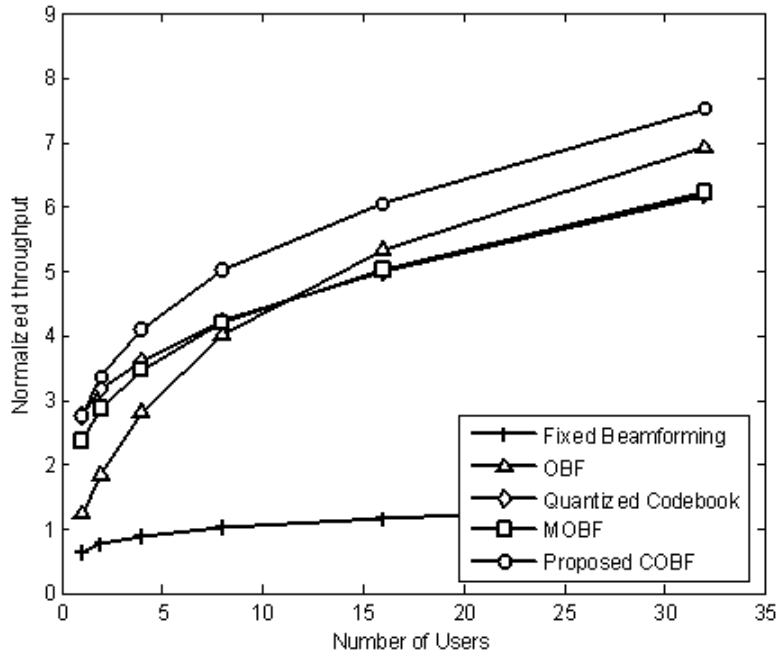
- At the BS, select the best user with the largest CQI and its codeword based on the CQI feedback and the scheduling algorithm



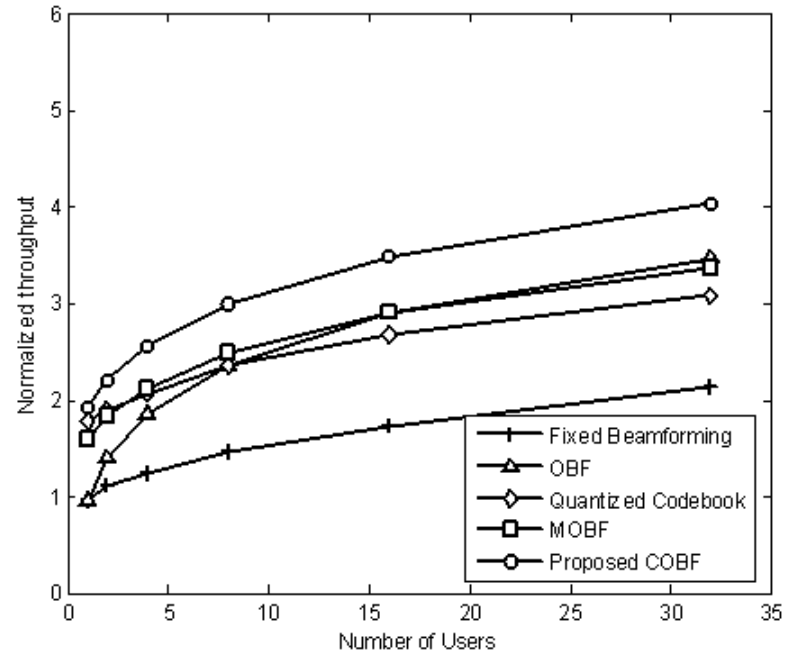
Performance Comparison

- Simulation Assumptions
 - Number of transmit antennas: 4
 - Number of receive antennas for each mobile: 1
 - Codebook: 3-bit DFT-like codebook
 - Mobility: 1km/h
 - Scheduling: PF
 - Comparison with fixed BF, OBF, Multiple-pilot-based OBF, quantized codebook

Performance Comparison (Cont'd)



(a) High spatial correlation

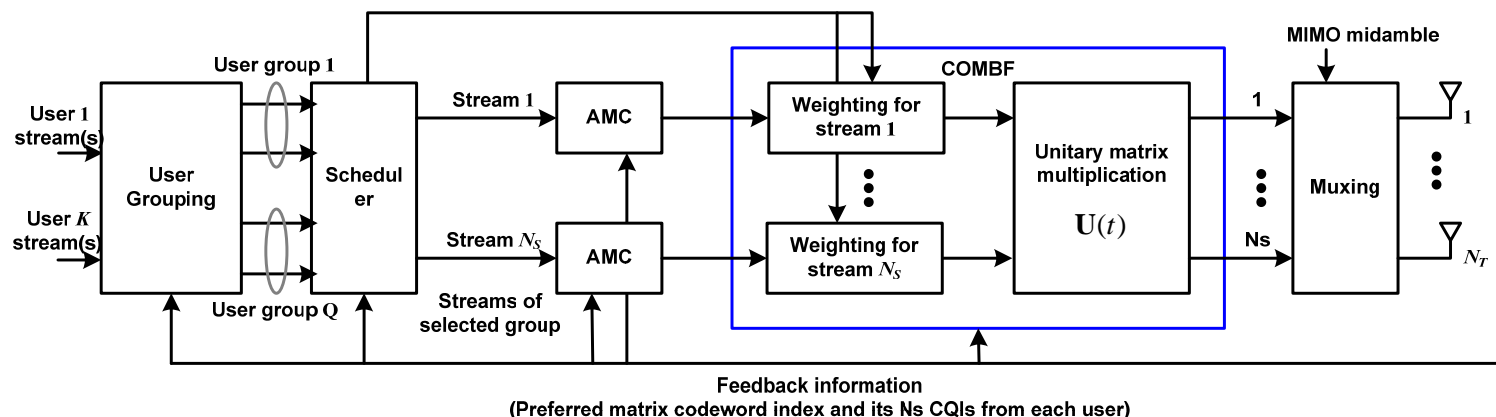


(b) Low spatial correlation

- COBF superior to the others in all corr. scenarios
- Performance gain larger at high corr.

COMBF

- Extending COBF to multiple beamforming
- Group users based on the codeword feedback
 - Users in the same group have the same codeword
- Select the best user with the largest CQI for each stream in each group
- Calculate sum-capacity for each group and select the best group with the largest sum-capacity

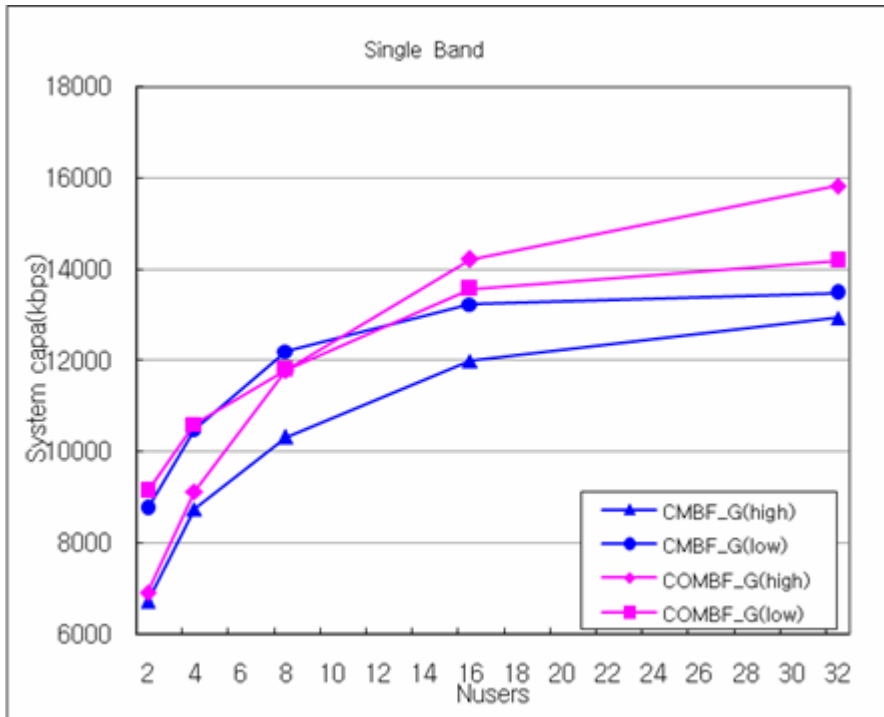


Performance Comparison

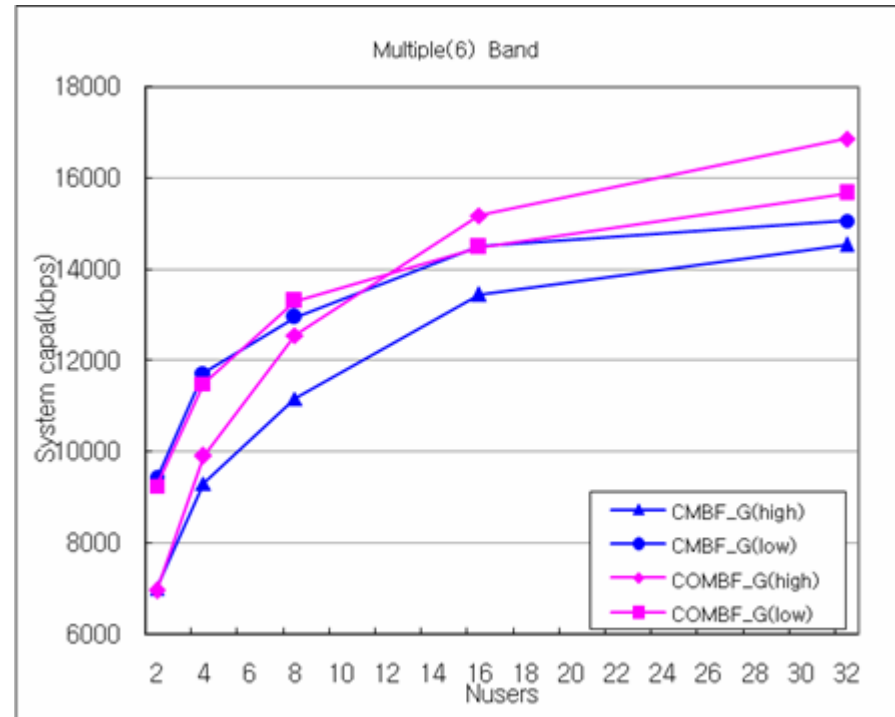
- Simulation Assumptions

- Number of transmit antennas: 4
- Number of receive antennas for each mobile: 2
- Sampling frequency: 10 MHz (FFT size: 1024)
- Effective number of subcarriers: 864
- Frame length: 5 ms, number of DL symbols: 24
- Number of subcarriers per subchannel: 48
- Subchannelization: AMC 2 bin x 3 symbol
- Mobility: 1km/h, Scheduling: PF per band
- Codebook: 3-bit codebook in IEEE 802.16e
- Goodput comparison with *Codebook-based Multiple BeamForming (CMBF)* (R1-0603353, 3GPP TSG RAN WG1 Meeting #44, Denver, USA, 13 – 17 February, 2006, “Downlink MIMO for EUTRA”)

Performance Comparison (Cont'd)



(a) Single-band



(b) Multi-band

- COMBF better than CMBF at high spatial corr.
- For small # users, better performance at low corr. (COMBF)
- Better performance with multi-band

Proposed Text for SDD

11.x. DL MIMO Schemes

Codebook-based closed-loop MIMO with opportunistic beamforming shall be used for DL single-user and multi-user MIMO.