Throughput Improvement with Relay-augmented Cellular Architecture

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Throughput Improvement with Relayaugmented Cellular Architecture

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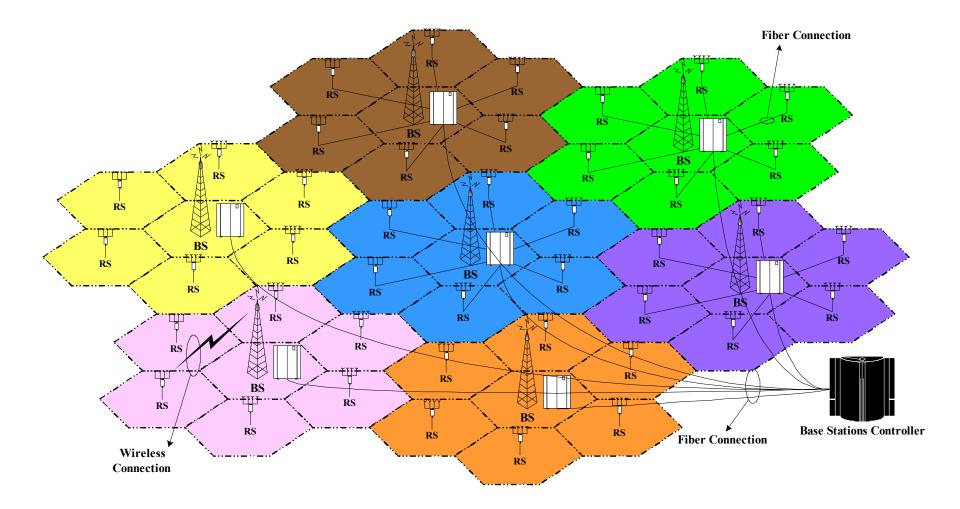
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Outline

- Relay-augmented Cellular Architecture
- Classification of Relay Scenarios
- Simulation Results
- Summary

Relay-augmented Cellular Architectures



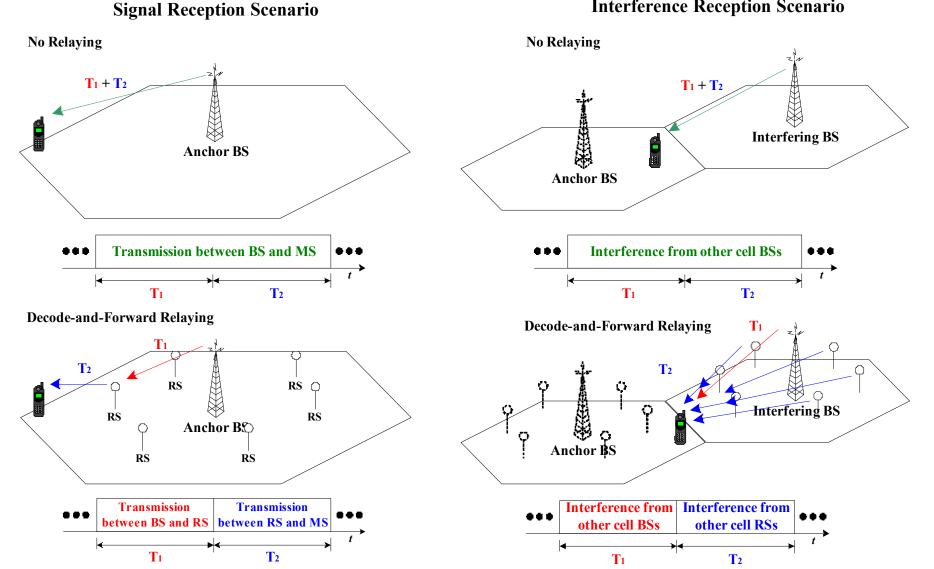
Classification of Relay Scenarios

- Classified by function of relay station (RS)
 - Amplify-and-Forward
 - Analog repeater, less delay.
 - Decode-and-Forward
 - Digital repeater, more delay.
- Classified by interfaces of BS↔RS and RS↔MS transmission
 - Homogeneous
 - BS↔RS and RS↔MS transmissions are both in the same air-interface
 - Ex. Both of them are in IEEE 802.16 air-interface
 - Heterogeneous
 - BS↔RS and RS↔MS transmissions are in difference air-interfaces
 - Ex. BS↔RS in IEEE 802.16 interface, RS↔MS in IEEE 802.11 air-interface.
- Classified by the mobility of relay station
 - Fixed relay (considered in following study cases)
 - Mobile relay

Classification of Relay Scenarios

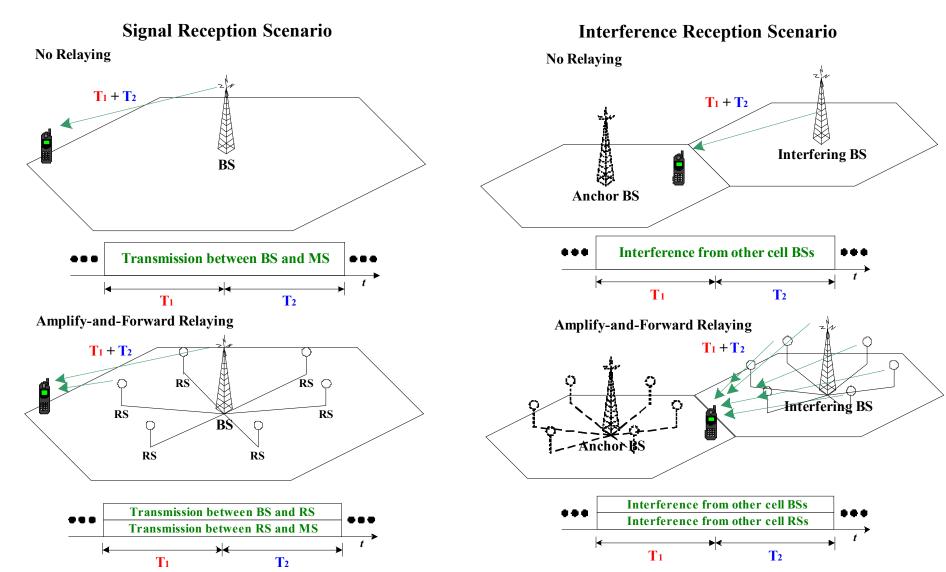
Downlink Decode-and-Forward Relaying

Interference Reception Scenario



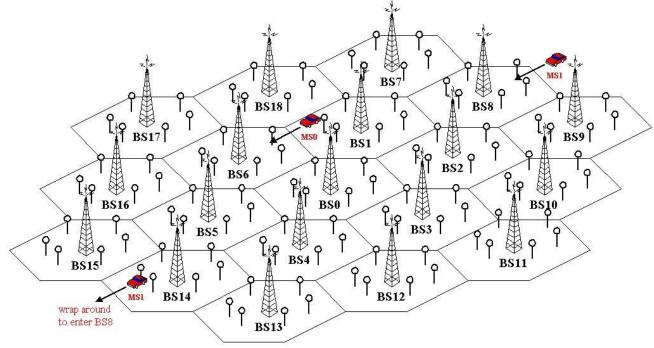
Classification of Relay Scenarios

Downlink Amplify-and-Forward Relaying



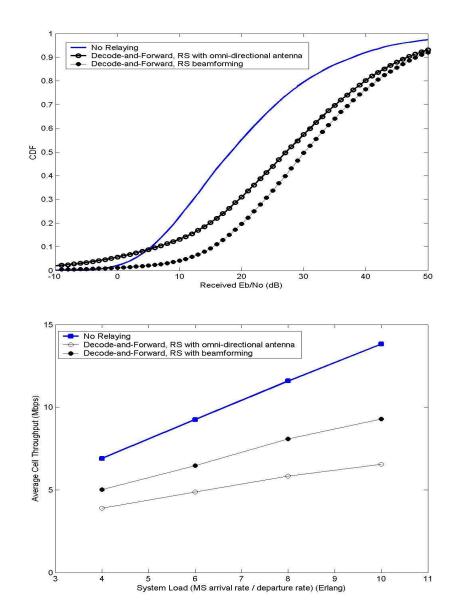
Simulation Results

- Relay-augmented cellular OFDMA system
 - Downlink transmission
 - 19 cells with universal frequency reuse and FUSC permutation
 - Each cell has 6 sectors and 2km coverage
 - Each cell has 6 relay stations (RS) with half base station (BS) coverage
 - Radio bandwidth: 6MHz (2048 sub-carriers)
 - <u>Vehicular</u> test environment



Simulation Results

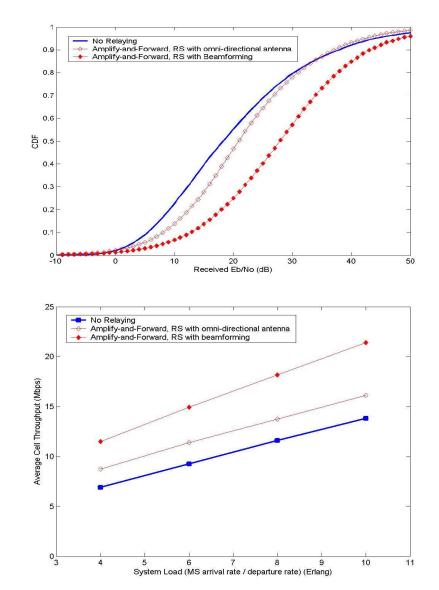
- Case I
 - **Decode-and forward** relaying
- Observations
 - Data rate coverage becomes more uniform by increasing the percentage of high order modulation usage
 - Throughput is reduced by time division for BS↔MS and RS↔MS transmissions
 - Beamforming on RS can further improve performances by <u>increasing antenna gain</u> and <u>reducing interference</u>



Simulation Results

• Case II

- <u>Amplify-and-forward</u> relay
- Observation
 - Data rate coverage becomes more uniform by increasing the percentage of high order modulation usage
 - Throughput is increased by higher percentage of high order modulation usage
 - Beamforming on RS can further improve performances by <u>increasing antenna gain</u> and <u>reducing interference</u>



Summary

- Different relay deployment scenarios may lead to various performances tradeoffs
 - Ex. When hop count increased, there may be a tradeoff between transmission rate and overall cell throughput.
 - Before choosing relay scenarios, the objective of relay deployment should be ensured first.
- **Interference avoidance** may provide substantial performances improvement in relay-augmented cellular systems
 - Up to <u>36%</u> throughput improvement was achieved in simulation results by applying beamforming on RSs
 - Cooperation on RSs transmission may be beneficial to reduce the interference from other cell RSs.