

Chapter 1

MIMO Techniques and Applications

Mário Marques da Silva and Américo Correia

Contents

| | | |
|---------|--|----|
| 1.1 | Evolution of Cellular Systems and the New Paradigm of 4G | 2 |
| 1.1.1 | Evolution from 3G Systems into Long-Term Evolution..... | 5 |
| 1.1.2 | WiMAX—IEEE802.16..... | 7 |
| 1.1.3 | LTE-Advanced and IMT-Advanced..... | 9 |
| 1.2 | MIMO Techniques | 10 |
| 1.2.1 | Space-Time Coding..... | 12 |
| 1.2.1.1 | Space-Time Block Coding for Two Antennas | 13 |
| 1.2.1.2 | Space-Time Block Coding for Four Antennas..... | 14 |
| 1.2.2 | Selective Transmit Diversity | 16 |
| 1.2.3 | Multilayer Transmission | 17 |
| 1.2.4 | Space Division Multiple Access..... | 20 |
| 1.2.5 | Beamforming..... | 21 |
| 1.2.6 | Multiuser MIMO | 23 |
| 1.3 | Advanced MIMO Applications..... | 24 |
| 1.3.1 | Base Station Cooperation..... | 25 |
| 1.3.1.1 | Coordinated Multipoint Transmission | 26 |
| 1.3.1.2 | Macro-Diversity..... | 28 |
| 1.3.2 | Multihop Relay..... | 31 |
| 1.3.2.1 | Adaptive Relaying..... | 31 |
| 1.3.2.2 | Configurable Virtual Cell Sizes | 32 |
| 1.3.2.3 | Multihop Relay in 3GPP | 33 |