

## Chapter V

# A New Business Dimension: SDMA and Intelligent Antennas

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### ABSTRACT

*Space division multiple access (SDMA) is a promising technique useful for increasing capacity, reducing interference and improving overall wireless communication link quality. With a large-scale penetration expected for wireless Internet, the radio link will require significant reduction in cost and increase in capacity, benefits that the proper exploitation of the spatial dimension can offer. Market opportunities with SDMA are significant, as a number of companies have been recently formed to bring products based on this new concept to the wireless marketplace. The approach to SDMA is broad, ranging from “switched-beam techniques” to “adaptive-antennas.” Basically the technique employs antenna arrays and digital signal processing to achieve the necessary increases in capacity and quality needed in the wireless world.*

### INTRODUCTION

Wireless communications has long been linked to businesses. More precisely, it became an important enterprise when the Marconi Company was

founded in the early 1900s. Before that, the wireless subject was most confined inside academia. It started with Maxwell,<sup>1</sup> who formulated the theory of electromagnetic propagation and continued with Hertz,<sup>2</sup> who first demonstrated the phenomenon of radio waves in practice. However, neither Hertz nor early pioneers were able to start the radio revolution the way Marconi<sup>3</sup> did. Guglielmo Marconi was not only a scientist but also a businessman with a vision. He founded the Marconi Company that grew rapidly into a business embracing the globe, from Europe to South America (Marconi, 1931). Radio thrived initially with analogue amplitude modulation (AM) systems and subsequently with analogue frequency modulation (FM) stations.

Nowadays telecommunications has fused with computers and forged the modern information society. The association of computers with telecommunications, originally termed informatics, paved the way for businesses in such a scale that is comparable to the industrial revolution of the 19th century. Modern systems include the digital broadcast of radio and television channels, telemedicine, global positioning system (GPS), and the vast scenario of wireless Internet and wireless commerce (w-commerce), the latter being the equivalent of e-commerce in the wireless world (“Enabling a portable Web,” 2000). For certain, since information was first conveyed by radio, the subject of wireless has become a driving force in the world economy.

This chapter addresses basic concepts of space division multiple access (SDMA) and intelligent antennas as the way to increase capacity and quality of service (higher transmission data rate and lower system delay) in wireless communications. We focus on the applications side of SDMA rather than on discussions about the technical challenges related to the technique. SDMA can be deployed as an alternative to cable TV and for point-to-point or point-to-multipoint high-speed data broadcast amongst many other possibilities. As for the technical difficulties, they range from the prediction of the radio frequency (RF) channel (i.e., RF channel varies randomly with time) to the problems associated with modern cellular mobile phone services (i.e., co-channel interference, fading and the Doppler phenomenon, to name a few; (Yacoub, 1993; Lee, 1993). Although the enterprise is new and far from being firmly established, it has already proved feasible (Mogensen et al., 1997) with a potential solid marketplace. Other aspects of intelligent antennas include diversity and spatial equalisation. But contrary to diversity and equalisation, which are well known and used in industry, SDMA represents new grounds yet to be developed. Moreover, SDMA can be implemented with already proven methods (such as diversity) in order to achieve the highest performances.

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