



# Multi-Carrier and Spread Spectrum Systems

*K. Fazel, S. Kaiser*

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Frequency spectrum is a limited and valuable resource for wireless communications. A good example can be observed among network operators in Europe for the prices to pay for UMTS-frequency bands. Therefore, the first goal when designing future wireless communication systems (e.g. 4G - fourth generation) has to be the increase in spectral efficiency. The development in digital communications in the past years has enabled efficient modulation and coding techniques for robust and spectral efficient data, speech, audio and video transmission. These are the multi-carrier modulation (e.g. OFDM) and the spread spectrum technique (e.g. DS-SS), where OFDM was chosen for broadcast applications (DVB, DAB) as well as for broadband wireless indoor standards (ETSI HIPERLAN-II, IEEE-802.11) and the DS-SS was selected in mobile communications (IS-95, third generation mobile radio systems world wide, UMTS/IMT 2000). Since 1993, various combinations of multi-carrier (MC) modulation and the spread spectrum (SS) technique have been introduced and the field of MC-SS communications has become an independent and important research topic with increasing activities. New application fields have been proposed such as high rate cellular mobile, high rate wireless indoor and LMDS. It has been shown that MC-SS offers the high spectral efficiency, robustness and flexibility that is required for the next generation systems. Meanwhile, different alternative hybrid schemes such as OFDM/OFDMA, MC-TDMA, etc. have been deeply analysed and adopted in different international standards (ETSI-BRAN, IEEE-802 and MMAC). "Multi-Carrier and Spread-Spectrum: Analysis of Hybrid Air Interfaces" draws together all of the above mentioned hybrid schemes therefore providing a greatly needed resource for system engineers, telecommunication designers and researchers in order to enable them to develop, build and deploy several schemes based on MC-transmission for the next generation systems (which will be an integration of broadband multimedia services covering both 4G mobile and fixed wireless systems). This book offers a complete treatment of multi-carrier, spread-spectrum (SS) and time division multiplexing (TDM) techniques. It provides an in-depth insight into hybrid multiple access techniques based on multi-carrier (MC) transmission. It presents numerous hybrid multiple access and air interface architectures including OFDM/CDMA, MC-CDMA, MC-DS-SS and MT-SS. It covers new techniques such as space-time coding and software radio. Telecommunications engineers, hardware and software system designers and researchers as well as students, lecturers and technicians will all find this an invaluable addition to their bookshelf.

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