

Tutorial #2 — 2004 Nordic Radio Symposium (NRS 2004)
16th August, 2004

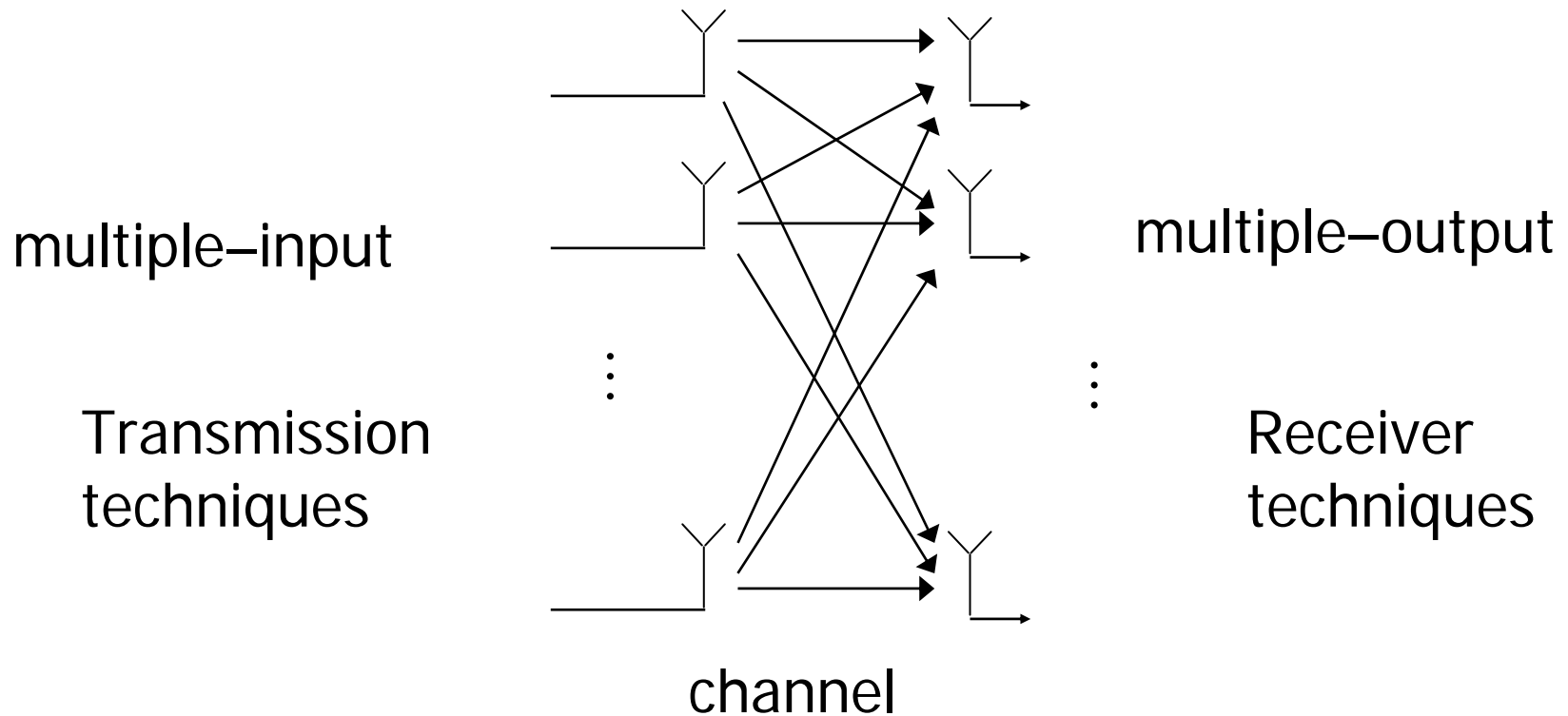
MIMO Communications with Applications to (B)3G and 4G Systems

Juha Ylitalo & Markku Juntti
Centre for Wireless Communications
University of Oulu, Finland

Centre for Wireless Communications
P.O. Box 4500
FIN-90014 University of Oulu
FINLAND

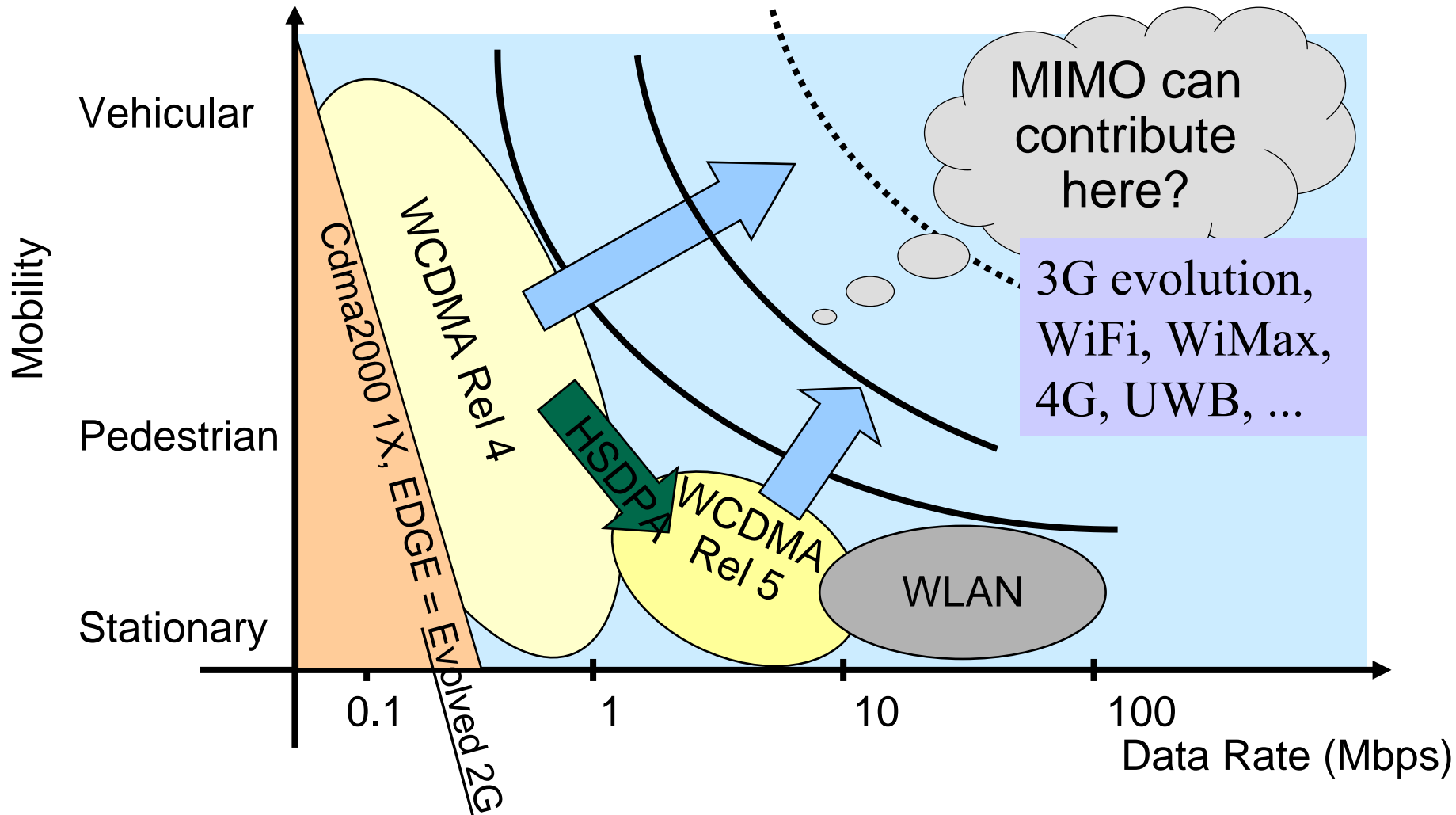
tel. +358 8 553 2834
fax +358 8 553 2845
markku.juntti@ee.oulu.fi
<http://www.cwc.oulu.fi/>

Scope: Communications in Multiple-Input Multiple-Output (MIMO) Channel



Channel models

Scope: Cellular System Evolution



Objectives

The main objective is to learn the basic concepts and possible techniques of multiple antenna and/or MIMO communication systems.

In particular, a participant should understand:

- The concept and the basic ideas of MIMO communications and B3G cellular communication systems.
- The basics of MIMO channel capacity.
- The basics of possible MIMO and multiantenna access solutions and transceiver algorithms:
 - beamforming
 - spatial diversity
 - spatial multiplexing.

Outline

1. Introduction
2. Capacity limits of MIMO channels
3. MIMO radio channel models
4. Beamforming and adaptive antennas
5. Spatial diversity
6. Spatial multiplexing
7. Comparisons and discussion
8. Summary and future prospects for MIMO

Further Reading

1. T. M. Cover & J. A. Thomas, Elements of Information Theory. John Wiley & Sons, 1991. ISBN: 0-471-06259-6
2. G. J. Foschini & M. J. Gans, On limits of wireless communications in a fading environment when using multiple antennas. *Wireless Personal Communications* , vol. 6, pp. 311-335, Nov.-Dec. 1999.
3. D. Gesbert, M. Shafi, D. Shiu, P. J. Smith, and A. Naguib, "From theory to practice: An overview of MIMO space-time coded wireless systems," *IEEE J. Select. Areas Commun.*, vol. 21, no. 3, pp. 281–302, 2003.
4. J. C. Liberti. and T. S. Rappaport, Smart Antennas for Wireless Communications: IS-95 and Third Generation CDMA Applications, Prentice Hall, Upper Saddle River, NJ, 1999.
5. A. J. Paulraj, D. A. Gore, R. U. Nabar, and H. Bolcskei, "An overview of MIMO communications A key to gigabit wireless," *Proc. IEEE*, vol. 92, no. 2, pp. 198–218, Feb. 2004.
6. E. Telatar, Capacity of multi-antenna Gaussian channels. *European Transactions on Telecommunications*, vol. 10, no. 6, pp. 585-595, Nov.-Dec. 1999.
7. B. Vucetic & J. Yuan, Space–Time Coding. John Wiley and Sons, 2003. ISBN 0-470-84757-3

MIMO Tutorial

Thank You!