

Large-Scale Antenna Systems: The Future of Wireless

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Large-Scale Antenna Systems (LSAS) - also called "Massive MIMO", "Large-Scale MIMO", or "Hyper-MIMO" - feature multi-user MIMO transmission of data, unprecedented numbers of service-antennas with a high ratio of service-antennas to terminals, and channel-state information derived from up-link pilots and time-division duplex (TDD) reciprocity. The scale of LSAS confers immense advantages over existing wireless schemes: huge spectral-efficiency, cheap single-antenna terminals, the replacement of expensive ultra-linear power amplifiers with many low-power low-precision units, simple but near-optimal multiplexing pre-coding and decoding, freedom from the "rich scattering environment" assumption, and effective power-control based on slow-fading only. There is no obvious evolutionary path from LTE to LSAS and wireless standards committees are often resistant to radical innovations. For this reason the best initial opportunities for the commercial introduction of LSAS may be dedicated systems for communication tasks that have heretofore been considered impossible or impractical for wireless. A dedicated LSAS would use specially-designed hardware with no back-compatibility requirements, and it could operate in unlicensed spectrum which would minimize issues of standards. LSAS is likely to be very "green" compared with existing wireless technology in terms of the number of bits delivered per Joule expended.

Thomas L. Marzetta was born in Washington, D.C. He received the PhD in electrical engineering from the Massachusetts Institute of Technology in 1978. His dissertation extended, to two dimensions, the three-way equivalence of autocorrelation sequences, minimum-phase prediction error filters, and reflection coefficient sequences. He worked for Schlumberger-Doll Research (1978 - 1987) to modernize geophysical signal processing for petroleum exploration. He headed a group at Nichols Research Corporation (1987 - 1995) which improved automatic target recognition, radar signal processing, and video motion detection. He joined Bell Laboratories in 1995 (formerly part of AT&T, then Lucent Technologies, now Alcatel-Lucent). Within the former Mathematical Sciences Research Center he was director of the Communications and Statistical Sciences Department. He specializes in multiple-antenna wireless, with a particular emphasis on the acquisition and exploitation of channel-state information. He is the originator of Large-Scale Antenna Systems which can provide huge improvements in wireless spectral-efficiency and energy-efficiency over 4G technologies.

Dr. Marzetta was a member of the IEEE Signal Processing Society Technical Committee on Multidimensional Signal Processing, a member of the Sensor Array and Multichannel Technical Committee, an associate editor for the IEEE Transactions on Signal Processing, an associate editor for the IEEE Transactions on Image Processing, and a guest associate editor for the IEEE Transactions on Information Theory Special Issue on Signal Processing Techniques for Space-Time Coded Transmissions (Oct. 2002), for the IEEE Transactions on Information Theory Special Issue on Space-Time Transmission, Reception, Coding, and Signal Design (Oct. 2003), and for the IEEE JSAC Special Issue on Large-Scale Multiple Antenna Wireless Systems (Feb. 2013). He is currently the lead guest editor for the JCN Special Issue on Massive MIMO (Aug. 2013).

Dr. Marzetta was the recipient of the 1981 ASSP Paper Award from the IEEE Signal Processing Society. He was elected a Fellow of the IEEE in Jan. 2003.