Illinois Center for Wireless Systems

JOINT ICWS and COMMUNICATIONS Seminar

Information-theoretic and physical limits on the capacity scaling of wireless ad-hoc networks

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141 CSL

Abstract: By distributing uniformly at random an order of n nodes wishing to establish pair-wise independent communications inside a 2D domain of area of the order of n using electromagnetic waves, the per-node information rate must follow an inverse square-root of n law, as n tends to infinity. This scaling limit result is computed without postulating fading channel and path loss models, but applying directly Maxwell's physics of wave propagation in conjunction to Shannon's theory of information. Indeed, the upper bound is due to a limitation in the spatial degrees of freedom of the propagating field which can be rigorously proved via functional analysis. Broad conclusions are drawn from this result on the value of the spatial resource in wireless networks, and a description of different configurations of networks which can achieve in principle a much higher (i.e. constant) bit-rate will follow.

Joint work with P. Minero and M.D. Migliore.

Biography: Massimo Franceschetti is assistant professor in the Department of Electrical and Computer Engineering of University of California at San Diego. He received the Laurea degree, magna cum laude, in Computer Engineering from the University of Naples in 1997, and the M.S. and Ph.D. degrees in Electrical Engineering from the California Institute of Technology in 1999, and 2003. Before joining UCSD, he was a post-doctoral scholar at University of California at Berkeley for two years.

Prof. Franceschetti was awarded the C. H. Wilts Prize in 2003 for best doctoral thesis in Electrical Engineering at Caltech; the S. A. Schelkunoff award in 2005 (jointly with profs. J. Bruck and L. J. Shulman) for best paper in the IEEE Transactions on Antennas and Propagation; an NSF CAREER award in 2006, and an ONR Young Investigator award in 2007.

He has held visiting positions at the Vrije Universiteit Amsterdam in the Netherlands, the Ecole Polytechnique Federale de Lausanne in Switzerland, and the University of Trento in Italy.

He was on the guest editorial board of the IEEE Transactions on Information Theory, special issue on models, theory, and codes, for relaying and cooperation in communication networks; and of the IEEE Journal on Selected Areas in Communications, special issue on control and communications.

His research interests are in communication systems theory and include random networks, wave propagation in random media, wireless communication, and control over networks.

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