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SPEAKER: Shlomo Shamai (Shitz), Technion Israel Institute of Technology

DATE: Thursday, February 19th

TIME: 4:30 pm

TITLE: The Broadcast Approach in Communications Systems:
Overview, Applications and Perspectives

ABSTRACT: Traditional coded communication schemes for block fading channels, with channel state information (CSI) available at the receiving end only are based on fixed rate single level coding. The achievable throughput is known as the outage capacity, the average of is often optimized. We will focus on a more general approach based on multi-layered coded communications, termed the broadcast approach. This strategy facilitates to adapt the reliably decoded rate to the actual channel state without having any feedback link to the transmitter. This is obtained by using a multi-layer code where each layer is associated with a channel state. Emphasis will be placed on block fading channel models, in which the state is associated with the fading realization. Maximization of the expected throughput is achieved by optimally allocating power per layer. When the number of layers is unlimited, a continuous multi-layer upper bound can be formulated. We obtain this fundamental upper bound for channels with one degree of freedom, where the transmitter has imperfect CSI, or no CSI at all. For other multiple-input multiple-output (MIMO) channels only achievable rates are available, due to the non-degradedness nature of the MIMO channel. These rates are contrasted with the ergodic capacity upper bound. We extend the view of multi-layered channel coding to address a simple single server queuing model, and obtain tight bounds on the expected delay. Another setting considered, is source-channel coding. Specifically we address the transmission of a Gaussian source, subject to the mean squared error distortion measure. The source is assumed to be encoded in a successive refinement manner, and then transmitted over the channel using the broadcast strategy. We characterize analytically the optimal power allocation when the fading state is a continuum. Numerous other communication settings incorporating the broadcast strategy are considered; among these are hybrid ARQ protocols, and simple procedures of cooperative communications. An outlook of related open problems, where an analytic formulation of a broadcast approach is yet elusive or incomplete will be shortly described, followed by a general perspective of layered communications in multi-terminal communication systems.

The talk is mainly based on a series of works with Avi Steiner and other coauthors.

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