

# Secure Communication in the Low-SNR Regime

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Secure transmission of confidential messages is a critical issue in communication systems and especially in wireless systems. This article addresses the issue of secure communications using multiple transmit and multiple receive antennas using low power in a wireless system with eavesdroppers. One measure of security is the secrecy capacity, which is the maximum data rate that can be obtained without an eavesdropper being able to decode the communications. This paper derives the fundamental limits on the secrecy capacity in the low signal-to-noise ratio regime, showing the minimum energy required to send bits reliably and securely, which is important to conserve the battery life of wireless devices. The paper also identifies the best transmission techniques, showing how to effectively use the multiple antennas and when just using beamforming, i.e., a single spatial channel versus multiple spatial channels, is optimal.

The paper's results can be used as fundamental benchmarks to compare against the performance of practical systems. They also can be used to obtain design guidelines for energy-efficient, secure wireless communications, which is of great importance with the increasing use of wireless devices.

For an overview on wireless secure communications, see the articles in the Special Issue on Information-Theoretic Security, *IEEE Trans. on Inf. Theory*, June 2008, (<http://ieeexplore.ieee.org/xpl/tocresult.jsp?isnumber=4529261&punumber=18>).

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