

# Multi-beam Physical Security Scheme: Security Assessment and Impact of Array Impairments on Security and Quality of Service

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**Abstract**— Massive multiple-input multiple-output (mMIMO) with perfect channel state information (CSI) can lead array power gain increments proportional to the number of antennas. Despite this fact, constraints on power amplification still exist due to envelope variations of high order constellation signals. Although, power amplification constraints of multilevel constellations can be overpassed by a transmitter with several amplification branches where each one is associated to a component signal that results from the decomposition of a multilevel constellation as a sum of several quasi constant envelope signals that are sent independently. Under these conditions, both physical security and higher power amplification efficiency could be attainable by a transmission structure based on multiple amplification branches transmitting signal components of the constellation symbol. When combined with antenna arrays at the end of each amplification branch, the security due constellation shaping becomes increased due to the energy separation achieved by beamforming. In a mMIMO scenario several structures could be used to achieve energy separation as well as to increase the security among different users. However, for each user, all the beams related with the signal components should be directed in same direction to avoid distortion on the signal that results from the combination of all components at channel level. In such conditions it is crucial to assess the security level achieved by these structures, as well as the impact of impairments in the alignment of the several beams related with the signal components associated to each user. This solution for this problem is the purpose of this work. The set of results presented here show that physical security comes with good tolerance against misalignment of the beam components, which can be also used to increase the physical security achieved by these transmission structures.