Title: Sign-Compute-Resolve for Tree Splitting Random Access

Speaker: Jasper Goseling

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Abstract:

A framework for random access is presented that is based on three elements: physical-layer network coding (PLNC), signature codes and tree splitting. In presence of a collision, physical-layer network coding enables the receiver to decode, i.e. compute the sum of the packets that were transmitted by the individual users. For each user, the packet consists of the user's signature, as well as the data that the user wants to communicate. As long as no more than K users collide, their identities can be recovered from the sum of their signatures. This framework for creating and transmitting packets can be used as a fundamental building block in random access algorithms, since it helps to deal efficiently with the uncertainty of the set of contending terminals. In this paper we show how to apply the framework in conjunction with a tree-splitting algorithm, which is required to deal with the case that more than K users collide. We demonstrate that our approach achieves throughput that tends to 1 rapidly as K increases. We also present results on net data-rate of the system, showing the impact of the overheads of the constituent elements of the proposed protocol. We compare the performance of our scheme with an upper bound that is obtained under the assumption that the active users are a priori known. Also, we consider an upper bound on the net data-rate for any PLNC based strategy in which one linear equation per slot is decoded. We show that already at modest packet lengths, the net data-rate of our scheme becomes close to the second upper bound, i.e. the overhead of the contention resolution algorithm and the signature codes vanishes.

Bio:

Jasper Goseling received the M.Sc. degree with honors from the University of Twente, The Netherlands, in 2003 and the Ph.D. degree from Delft University of Technology, The Netherlands, in 2010, both in electrical engineering. Currently, he is an assistant professor in the department of applied mathematics at the University of Twente. His research interests are in information theory and stochastic operations research with a focus on communication systems.