Data Allocation in Wireless Networks Under the Constraint of the Memory Size

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Caching is considered as one of the strategies to keep up with the increasing demand of throughput in wireless networks to deal with various future applications such as high-definition video streaming [1], [2], data access in vehicular networks [3] and others. In order to guarantee good performance, it is important to ensure that data storage and data access algorithms within the caching protocol are highly inter-operable. This inter-operability functions through *data placement* over available network nodes.

Nowadays the data placement strategy should take into account a lot of constraints both on storage and access levels, mainly due to the nature of used erasure- and error-correcting codes, used during the data storage and data delivery phases. Today the codes are not limited to Maximum-Distance Separable (MDS) codes, and thus the storage/repair/delivery performance of a caching scheme is allocation-dependent in general. Therefore, after having decided what type of coding will be used to store the users data and what type – during the delivery process, one might ask what is optimum allocation strategy, ensuring the best Quality of Experience (QoE) for users under the minimum network communication cost. In fact, it happens to be a difficult optimisation problem, which is non-convex even for the simplest storage and delivery models (i.e. MDS codes for storage and a complete access to all nodes, with a simple cost function expressing the probability of a user to make a successful data download [4]). Note that the simplest case has been solved in [4] by using combinatorial methods. Unfortunately, even this first result cannot be generalised to more general cases, mostly due to its quite involved proof. Although many numerical results are available in the literature for various types of networks and topologies (see e.g. [2], [5]), the only systematic attempt made since 2012 is the work presented this year and treating a Poisson access model [6].

Our recent work. We have been able to greatly simplify the proof given in [4], which gives an open way to the solution of more interesting placement problems, involving more realistic constraints on the data storage or access. Our approach have been published in [7], together with one example of a possible extension, which is the case of limited memory volume, available in the network.

The aim of the visit to ETIS is to investigate the *optimal data placement and practical low-cost algorithms* to memory-limited DSN in the case of large file libraries. Today it is a relevant open problem in any large data storage network, especially in wireless ones, suffering from the throughput bottleneck. It is planned to define first the optimal placement strategies for the minimum delivery time using the game-theoretic framework, under realistic sotrage models which take into account such constraints as topology, bandwidth limitations and user mobility. Further, we are going to determine a practical placement algorithm of low communication cost and complexity. *Moreover, we would like to establish a collaboration with the ETIS researchers working in the domain of the game theory and the game-theoretic resource allocation (M. Le Trust, V. Belmega) in order to evaluate the relevance of game-theoretic tools in the context of the distributed storage allocation.*

Duration of the visit is expected to be 2+2 weeks (1 motnh in total) during the 2016-2017 scholar year.

References

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