Web caching is an important technology for improving the scalability of web services. This dissertation investigates some key problems for coordinated en-route web caching, such as (multimedia) object caching, (transcoding) proxy placement, cache replacement. The main contributions of this dissertation are outlined as follows:

- We address the problem of coordinated en-route web object caching for tree networks (i.e., determining the locations where a copy of the same object should be cached in a network such that the specified objectives are achieved). A dynamic programming-based optimal solution and its analysis are presented. We also extend this solution to solve the problem of coordinated en-route object caching for autonomous systems and the problem of proxy placement for coordinated en-route web caching in tree networks and autonomous systems (i.e., determining the locations where a cache/proxy should be placed in a network such that the specified objectives are achieved). Extensive simulation experiments are conducted to evaluate our proposed solutions over a wide range of performance metrics in comparison with existing solutions proposed in the literature.
- We address the problem of coordinated en-route multimedia object caching for transcoding proxies for linear and tree networks (i.e., deciding the locations where an exact version of the same multimedia object should be stored in a network so that the specified objective is arrived). Dynamic programming-based optimal solutions and their analysis are also presented. We further extend these solutions to solve the problem of proxy placement for coordinated en-route transcoding proxy caching (i.e., deciding the locations where a transcoding proxy should be placed in a network so that the specified objective is arrived). We compare the performance of our solutions with other solutions over various performance metrics through extensive simulation experiments. The simulation results show that our solutions outperform existing solutions proposed in the literature.
- We address the problem of multimedia object placement for transparent data replication, i.e., choosing a specific version of the same multimedia object to be cached at each node in a network such that the specified objectives are reached. The performance objective is to minimize the total access cost by considering both transmission cost and transcoding cost. We present optimal solutions for different cases for this problem. The performance of the proposed solutions is evaluated with a set of carefully designed simulation experiments for various performance metrics over a wide range of system parameters. The simulation results show that our solution consistently outperforms existing solutions in terms of all the performance metrics considered.
- We address the problem of cache replacement for transcoding proxy caching (i.e., selecting the objects that should be removed from the cache to accommodate a new object to be cached when the cache space is not enough). We first present a cache replacement algorithm for transcoding proxy caching that computes the aggregate profit of caching multiple versions of the same multimedia object with considering cache consistency, which has not been widely considered in the literature. We also address coordinated cache replacement in transcoding proxies by formulating this problem as an optimization problem which determines cache replacement candidates on all candidate nodes in a coordinated fashion for the objective of minimizing the total cost loss. Moreover, we conduct extensive simulation experiments to compare the performance of our algorithms with some existing algorithms. The results show that our algorithms outperform others in terms of various performance metrics.