Abstract

Social media traffic constitutes the highest percentage of Internet traffic. This social media traffic is largely facilitated by mobile devices, which imposes a huge traffic load on backhaul links in 5G networks, and can in turn affect the quality of service. This traffic load can be alleviated by using vehicular networks as a traffic offloading platform. In particular, vehicles can act as a resourceful asset for edge caching, which enables data acquisition from nearby caching nodes rather than the remote backhaul servers. However, caching in vehicular networks encounters many challenging issues. These include the highly dynamic nature of vehicles, which can lead to instability in caching decisions. Also, despite being equipped with storage resources, relying on static roadside units for caching might not always be feasible. This is due to the large investments that their wide deployment requires. Another challenge is prompted by the high delay and low packet delivery ratio often associated with accessing data from distant content providers in vehicular networks, which makes it imperative to take the quality of service into consideration during caching.

In this thesis, we propose a caching framework that aims at maximizing cache hit ratio, as well as improving the quality of VANET-based Internet services. To do so, we consider two types of users; users who exhibit a predictable behavior resulting from their daily routine during driving from one place to another, and those who do not

have such a routine. We exploit the predictable behavior of the first type of users in order to pre-cache the data at roadside parked vehicles for requesters to proactively acquire as they pass by. In order to promote informed proactive cache placement decisions that consider the spatiotemporal availability of replicas, we propose a travel time prediction scheme to be incorporated into the caching process.

For the second type of users, we use the static and mobile nature of parked and moving vehicles, respectively, to leverage the use of cooperative caching within the context of VANETs. This solution involves a content discovery module and a cache placement module. The former enables the nodes to dynamically locate replicas that are close to the requester during the request-forwarding process. The latter facilitates making informed caching decisions to decide where and what to cache. Our cooperative caching solution involves extending the search space and the cooperation range beyond the neighborhood scope in order to increase cache hits. We also cope with the dynamic nature of vehicles by proposing a vehicles' trajectory prediction scheme. Extensive simulations demonstrate the ability of the proposed approaches to achieve significant improvements in their targeted objectives compared to other prominent caching and prediction schemes in VANETs.