

Cooperative Caching for Scalable Video Transmissions Over Heterogeneous Networks

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Abstract—We investigate a cooperative video caching problem in heterogeneous networks (HetNet). In cellular networks with limited backhaul capacity, by equipping the small-cell base stations (SBSs) with caches, more data can be offloaded. The backhaul data is reduced and user equipment (UE) can enjoy a low latency. We formulate the total transmission delay (TTD) minimization problem as a nonlinear integer programming. To solve the NP-hard problem, we relax the constraints and propose a greedy algorithm for a feasible solution. We prove that the greedy algorithm is asymptotically optimal. Simulation results demonstrate that the proposed cooperative caching algorithm can significantly reduce the TTD.

Index Terms—Cooperative caching, heterogeneous network, integer programming, scalable video transmission.

(SVC) [3], each video is encoded into one base layer (BL) and several enhancement layers (ELs). Higher video quality can be achieved by receiving more layers. This way, the dynamically varying wireless link bandwidth can be fully utilized based on user's different perceptual experiences on different kinds of video files. In HetNet, a macro base station (MBS) is deployed to provide a wide coverage of users in the macro cell, while small cell base stations (SBSs) located in the macro cell enable high data rates for subscriber UEs. This HetNet structure helps to improve system spectrum efficiency.

However, there are several challenges in this HetNet edge caching architecture for scalable videos. Compared with wired caching strategy in traditional content distribution networks (CDN) [4], the small capacity of the SBS is not sufficient