

**Congestion Avoidance and Load Balancing in Content Placement and Request Redirection for Mobile CDN**

**Abstract:**

With the development of network function virtualization and software-defined network standards, the mobile network operators are interested in integrating content delivery network (CDN) functionalities into the mobile network to enhance their capability for supporting content oriented services. We consider a *mobile CDN* system, where Base Stations (BSs) are equipped with storage for replicating content. In such a system, BSs cooperation in replying user requests through backhaul links is a widely adopted mechanism. Blindly redirect user requests upon content placement can cause traffic congestion. As a result, congestion avoidance and load balancing is an important issue to be tackled in this scenario. We investigated the joint optimization problem of content placement and request redirection for the BS-based mobile CDN. Specifically, each BS maintains a transmission queue for replying requests issued from other BSs. Network congestion and BSs load balancing can be jointly considered through guaranteeing network stability.

We employ the *stochastic optimization model* to minimize the long-term time-average transmission cost under network stability constraints. By using the Lyapunov optimization technique, we transform the long-term problem into a set of linear programs solved in each short time duration, and we develop an on-line algorithm to efficiently decide content placement and request redirection without requiring *a priori* knowledge on the random network state information. Through our theoretical analysis, the performance of the algorithm on optimality and network stability is given. The evaluation confirms that our solution can achieve low transmission cost, whilst avoiding congestion and balancing traffic loads.

**Existing System:**

The Content Providers (CPs) and the MNOs can benefit from such an implementation of a mobile CDN system. The availability of content near the end-users improves the Quality of Experience (QoE) of users regarding the multimedia services that require low latency and stable network connections. In

the meantime, mobile CDNs mitigate the traffic burden on the mobile core network and thus reduce transmission cost for MNOs. The recent ETSI Mobile Edge Computing (MEC) group aims to support the implementation of mobile CDN by offering storage and computing capabilities at the edge of mobile network, e.g. on Base Stations (BSs). In this paper, we consider a mobile CDN system in which mobile BSs implement storage units for content replication and are able to reply the request from mobile users.

**Proposed System:**

We propose a joint content placement and user request redirection mechanism to avoid network congestion and to provide load balancing in the Mobile CDNs, while minimizing the overall transmission cost incurred by the redirection traffic. Specifically, we utilize a *stochastic optimization model* to cope with evolving network environments. We aim at minimizing the long-term time-average transmission cost while at the same time at ensuring network stability to avoid congestions. We use the *Lyapunov optimization* framework to transform the long-term optimization problem into a set of linear programming (LP) problems, which are solved in each short time slot.

We model a Lyapunov optimization, where the quadratic Lyapunov function and drift reflect network congestion and balance traffic loads respectively. Then, for each time slot, we decompose and solve the content placement and user request redirection problem.

Based on our model, we propose an on-line algorithm to jointly decide content placement and request redirection without requiring any a-priori knowledge on network parameters, while at the same time guaranteeing network stability.

We theoretically analyze the performance of our proposed algorithm and prove the network stability and the transmission cost performance. Simulation results confirm that our proposal avoids network congestion and balances traffic load among BSs.