

**Distributed Packet Forwarding and Caching Based on Stochastic Network Utility Maximization**

**Abstract:**

Cache-enabled network architecture has great potential for enhancing the efficiency of content distribution as well as reducing the network congestion. This, in turn, has called for joint optimization of traffic engineering and caching strategies while considering both network congestion and content demands. In this paper, we present a distributed framework for joint request/data forwarding and dynamic cache placement in cache-enabled networks. Specifically, to retrieve the information about content demands and network congestion over the network, we establish a dual queue system for both requests and data, and define a dynamic mapping between the two queues with the help of dummy data such that the nodes can determine packet forwarding and caching strategies based only on local information. As the local objective function associated with Lyapunov optimization is time-varying due to the stochastic evolution of request/data queues, we develop a low-complexity distributed forwarding and caching algorithm via stochastic network utility maximization. We also prove the proposed algorithm achieves queue stability, and derive its region stability property for time-varying local optimization to demonstrate the convergence behavior. The simulation results verify queue stability and shows the proposed algorithm outperforms the existing ones.

**Existing System:**

A large wireless caching network is investigated with a hierarchical tree structure of transmissions to derive the scaling results on the capacity region. Distributed caching at macro BSs is introduced to improve the network capacity. In caching is adopted at BSs and mobile devices to reduce the traffic. The access delay performance is improved by caching at relay stations in cellular networks. In the energy consumption is minimized by appropriately caching popular contents in a proactive manner. In the content caching is studied to balance the tradeoff between content dissemination delay and energy consumption. However, most of the existing work designs caching strategies

according to the known content demands only without considering data-forwarding issues, such as link sharing by multiple content objects and network congestion due to heavy traffic.

**Proposed System:**

The above efforts where the data transmission is initiated by source nodes, in the cache-enabled networks, the data transmission is usually initiated by data requesters (content consumers), and the nodes which cache the contents do not maintain a long queue to provide the pressure for data forwarding. As a result, the back-pressure algorithm operating on data queues cannot account for dynamic content demands. To overcome this problem, a back-pressure algorithm operating on request queues is proposed, where the local request queue information is adopted for providing the demand information for data forwarding and content caching. However, our problem is different due to the consideration of the mutual coupling between forwarding and caching, where the information about network congestion is implied in the data queues. To this end, we construct a quantitative dynamic mapping between data and request queues, such that the combined effect of network congestion and content demands can be captured from the local queue information.