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User-Centric Content Sharing via Cache-enabled Device-to-Device Communication

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Abstract

Cache-enabled device-to-device (D2D) communication has emerged as a promising paradigm for caching popular contents at user devices and using D2D communication among adjacent users to relieve cellular traffic overload. To maximize traffic offloading, optimal content-selection for caching and helper-receiver matching are two key concerns. In this paper, we deal with the two key issues by leveraging user characteristics, which are crucial to D2D content sharing but often omitted by existing work in this field. We first propose a comprehensive model that profiles user characteristics including user preference, user activity degree, and user relationship. To provide an accurate estimation of user relationship, a new metric named expected correlation coefficient (ECC) is further proposed, which can reveal the potential offloading opportunities behind the contacts between users. We then design a novel user-centric caching policy that integrates the above-mentioned models into content caching policy to optimize the caching efficiency. Furthermore, we propose an online learning algorithm by leveraging the Combinatorial Multi-Armed Bandits (CMAB) method to achieve efficient helper-receiver matching among users. Experiments based on real-world traces and content requesting records were conducted. The results demonstrate that when compared with existing algorithms, our proposed algorithm improves the offloading ratio by nearly 10% and the system utility approximately by 20%.

Keywords: Cache-enabled device-to-device communication, content sharing, user characteristics, content popularity

1. Introduction

The continuous increase in content demand of mobile users imposes significant burden to existing cellular networks. Currently, a promising solution is to offload traffic via device-to-device (D2D) communication, where nearby mobile users may communicate directly to exchange desirable contents rather than being forced to communicate through cellular base stations (BSs), thus remarkably alleviating the heavy burden of backhaul links [1][2].

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