SDN based Distributed Content Caching System in WLAN

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I. Research Area

Our research currently focuses on the design and implementation of a distributed content caching system in a wireless local area network (WLAN), and the evaluation of its feasibility and performance.

II. Background

Global mobile data traffic is expected to increase nearly eightfold between 2015 and 2020. Also, mobile and wireless devices will account for two-thirds of the global IP traffic by 2020 [1]. The major serving points of these mobile and wireless devices are cellular base stations and WiFi access points (APs).

Video traffic is the major component of IP traffic over mobile and wireless networks. It constitutes more than half of the mobile and wireless data traffic already [1]. The popularity of videos can be estimated by tracking user activity, and this can be used to identify the contents in demand. This may apply to other types of non-voice traffic as well. We can exploit this information to help reduce congestion in the backhaul links of today's network by caching video and other non-voice data on the edge of the networks, close to mobile and wireless devices.

Wireless technology has dominated the access networks with WiFi APs at the last hop. More than a billion APs were shipped in the last decade and this number is expected to increase [2]. The latest WiFi APs either come equipped with storage capacity or have the option to add it on. This makes WiFi APs capable of storing considerable amount of contents. With storage becoming cheaper and WiFi APs present abundantly in homes and workplaces, a natural proposition would be to use the WiFi APs to cache contents and serve users' requests locally from the AP-caches. This will help reduce the frequency of fetching contents from remote content servers, and thus mitigate congestion in the backhaul links.

A distributed caching system would generally implement the following functions [3]:

1) Cache content placement - this includes the initial content placement in the caches, and an algorithmic cache content update based on users' requests, content demand, etc. The initial content placement could be either random or based on an initial estimate of the content popularity.
2) Content delivery to a client - this includes routing of the content request, and delivering the requested content. Routing of the content request involves determining a cache, which would serve the client. Delivery of a content involves setting up a connection with a client, and transferring the requested content.

Optimizing a distributed caching system would require a joint optimization of the content placement and content delivery functions.

III. Implementation

Our prototype implementation, and the evaluation of its feasibility and performance is based on Odin, an open source Software Defined Networking (SDN) framework for enterprise WLANs. It currently has the following capabilities:

1) Add and delete contents in WiFi AP-cache.
2) Deliver requested contents from WiFi AP-caches to mobile devices.
3) Minimize interruptions due to client mobility during content delivery.
4) Balance the load of content delivery across WiFi APs.

Also, due to increasing security concerns, the global IP traffic is moving towards end-to-end encryption. HTTPS, which was once limited to a few applications is predicted to be used by 70 percent of web traffic by 2016 [4]. End-to-end encryption ensures a unique session which makes caching inapplicable. There are a few works in the literature which focus on designing protocols which enable caching of encrypted contents [5] [6]. Our research also currently focuses on caching encrypted contents on distributed caches.

References

[1] C. W. Paper, "Cisco visual networking index: Global mobile data traffic forecast update, 2015-2020."
[2] "Cisco vni report 2016."
[3] G. Xylomenos, C. N. Ververidis, V. A. Siris, N. Fotiou, C. Tsilopoulos, X. Vasilakos, K. V. Katsaros, and G. C. Polyzos, "A survey of information-centric networking research," *IEEE Communications Surveys Tutorials*, vol. 16, no. 2, pp. 1024–1049, 2014.
[4] S. Report, "Global internet phenomena spotlight encrypted internet traffic," 2016.
[5] J. Leguay, G. S. Paschos, E. A. Quaglia, and B. Smyth, "Cryptocache: Network caching with confidentiality," in *2017 IEEE International Conference on Communications (ICC)*, May 2017, pp. 1–6.
[6] N. M. G. Eriksson, J. Mattsson and Z. Sarker, "Blind cache: a solution to content delivery challenges in an all-encrypted web. ericsson white paper," 2016.