User-generated video aggregation over 5G through collaborative routing and compression

One potential killer app for 5G networks is the aggregation of videos captured by mobile devices of the same major event (e.g. sports event or concert or after a major disaster) from different locations and angles, to enable a wide area view of the event as well as zooming-in of any particular area. One naïve solution is to have each user stream his/her own live video to the central server through their 5G cellular links and the server aggregate these videos to generate either a panoramic view or a collated video consisting of non-redundant views among all uploaded video. This solution does not exploit the inherent redundancy among the multiple videos captured in nearby locations. It is also vulnerable to the channel quality degradation on 5G cellular links of individual users. Furthermore, it does not make use of available strong mobile-to-mobile links among users.

To address the above problems, one solution is to utilize adhoc 5G links to deliver the videos. When a user experiences bad cellular channel quality, he/she might opt to seek help from his/her neighbors, who cooperatively relay the user's video to reach the video aggregation server. This will increase the robustness of the video delivery for individual users. However, this still does not exploit the redundancy among the videos. One way to make use of such redundancy is for a relay to compare its own video with the relayed video and send only the non-redundant part. With such redundancy removal (part of video compression) at the relays, relay routing needs to consider the redundancy between videos of nearby nodes, and the routing decision will influence the gain from redundancy removal at relay nodes. We propose to investigate the joint design of collaborative relay routing and compression, for user generated video aggregation. To the best of our knowledge, such problem formulation is novel and its solution can lead to significant improvement in bandwidth utilization and in the quality of the aggregated video.

The faculty advisors will be Yao Wang and Yong Liu. Two Ph.D. students Fanyi Duanmu and Eymen Kurdoglu will be working on this project. Fanyi has been working on 3D video processing and is doing intern at Huawei Media Lab in Santa Clara this summer. Eymen has been working on peer to peer video delivery [1]. We plan to engage several affiliates including Huawei, AT&T, Ericsson and CISCO.

[1] Eymen Kurdoglu, Yong Liu, and Yao Wang, "Dealing with User Heterogeneity in P2P Multiparty Video Conferencing: Layered Coding Versus Receiver Partitioning", in the Proceedings of IEEE INFOCOM Workshop on Communication and Networking Techniques for Contemporary Video, April, 2014