CAREER: Social and Privacy Aware Mobile Core Network Offloading

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Project Summary

The wide-spread usage of mobile devices and increasing demand for mobile data access has triggered a tremendous load on cellular networks. Several approaches including WiFi and femtocell based offloading have been heavily studied targeting the offloading of mobile data traffic from cellular space. However, the mobile core network not only suffers from boosting mobile data traffic but also from the underutilized session resources. This project will fill the gap by proposing, analyzing, and validating a user cooperation based framework that provides solutions towards optimized usage of core network resources by several means within a trustworthy and cooperative mobile social network environment for users. We propose to build this transformative framework through following thrusts:

(1) **Redundancy detection and removal algorithms:** We will analyze spatial, temporal and contextual correlations between device usage (i.e., cellular data and battery consumption) patterns and pairwise user interactions to detect redundancy and opportunities for benefiting from trusted peers – by statistical analysis and distribution fitted modeling.
(2) **Social-aware clustering for Device-to-Device (D2D) and WiFi offloading:** We will invent new algorithms for clustering of user devices exploiting their social relations and D2D communication capabilities based on duration, and proximity - by adopting techniques from computational geometry and social network theory.
(3) **Multi-aspect trust preservation:** We will develop new models for trusted peer selection based on several aspects including device status (i.e., charging, low battery), user profiles (i.e., friend, family), and location types (i.e., work, home, cafe) as well as historical relations - by supervised and reinforcement learning techniques.
(4) **Test-bed development and assessment:** We will develop a comprehensive test-bed of proposed system architecture with hardware and software components to validate, evaluate, and improve the proposed algorithms. Further, we will leverage our unique connections with Cisco Systems to apply our techniques in practice.

Intellectual Merit. This project aims to optimize the mobile core network resources. The proposed research will study previously not focused aspects of mobile core network offloading. We will develop new algorithms and models providing session aggregation based mobile traffic management with a simultaneous goal of reducing the traffic load on cellular networks. The research will utilize a comprehensive schema for a deep understanding of users' social relations in the context of mobile data usage patterns and opportunities for cost reduction through user collaboration. We will exploit a subsystem that will allow trusted peer discovery and selection by taking into account the properties of all entities in the mobile ecosystem.

Broader Impacts. *Societal:* The proposed research will take the essential steps to promote sustainable mobile networking solutions and foster opportunities for new business models. It will have direct significance to service providers by increasing the system capacity, to society by making reducing mobile data usage costs and to government oriented goals such as increasing population with mobile broadband access, and better spectrum utilization specified in National Broadband Plan. We will build a web-based platform to host datasets, developed algorithms and tools. Broad dissemination of project outputs will be achieved via publications, and presentations in conferences. *Educational*: The PI has already organizing roles in several outreach activities including a high school programming contest and a hackathon event among undergraduate students. The developed testbed will be integrated into these activities as a new infrastructure to develop new hands-on projects related to mobile networks. The PI will also integrate the development process of the project into the newly established mobile application development course. Underrepresented minority groups and women will be given priority for the selection of graduate students that will work throughout the project.