UNIVERSITY of GUELPH

COLLEGE of ENGINEERING AND PHYSICAL SCIENCES

SCHOOL OF COMPUTER SCIENCE

PhD Seminar 2

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A novel QoS-aware cross-layer framework for adaptive routing in MANETs

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Abstract:

Infrastructure-less wireless networks and mobile ad hoc networks have received a lot of attention from the scientific community and industry due to advancements in mobile and wireless communication technologies and their potential applications. Mobile ad hoc networks (MANETs) are formed by an autonomous group of mobile devices such as smartphones, laptops, and tablets that communicate with each other through wireless links (such as Wi-Fi or Bluetooth) without the use of any pre-installed infrastructure. That is, this infrastructure-less network type is designed to be both self-organized, and self-configured, and without any central administration. This means that they do not impose any initial cost for setting up base stations or maintenance costs compared to standard networks that have both. However, the highly dynamic topology of a MANET leads to significant routing challenges that can affect quality of service (QoS). Specifically, the dynamic topology affects the reliability of the network and can hinder continuous communication between devices.

Routing is the process of finding a path through linked intermediate nodes between a source and destination node for transmitting data packets. The routing process is comprised of two main components: route discovery and route maintenance. The route discovery process relies on broadcasting or blind flooding which involves producing routing overhead (or non-data traffic) over the network. Because of limitations in network resources, employing blind-flooding leads to broadcast storm issues. This has a negative impact on network performance such as throughput, packet loss, end-to-end delay, etc. Furthermore, congestion is another performance-limiting factor in mobile ad hoc networks. Congestion occurs when a network node or a link carries more traffic than its capacity which causes a reduction in QoS. Congestion causes increased transmission delay and packet loss in large-scale communication scenarios. Therefore, the network performance is degraded due to congestion.

In this study, we proposed novel improvements to reactive routing protocols. We developed a framework for routing that considers network density and path selection to achieve high scalability and high-quality routing that could be used to support communication using mobile ad hoc networks. We employed fuzzy logic and reinforcement learning (Q-learning) techniques to develop our adaptive, QoS-aware routing framework with a cross-layer design approach. We applied our methods to the Ad Hoc On-Demand Distance Vector (AODV) protocol and Ad-hoc On-demand Multipath Distance Vector (AOMDV) which are two of the most popular reactive routing protocols for mobile ad hoc networks (MANETs).