NATIONAL UNIVERSITY OF SINGAPORE

School of Computing

PH.D DEFENCE - PUBLIC SEMINAR

Title: **Mitigating the Impact of Physical Layer Capture and ACK Interference in Wireless 802.11 Networks**

Speaker: Mr Wang Wei

Date/Time: 30 December 2014, Tuesday, 10:00 AM to 11:30 AM

Venue: Executive Classroom, COM2-04-02

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Abstract:

As both the deployment density and traffic volume of 802.11 networks are increasing rapidly, the interference among 802.11 devices is expected to become more and more serious, thereby adversely affecting the network performance. In this thesis, we address two major sources of interference that have received little attention in the literature: i) physical layer capture and ii) MAC Acknowledgment (ACK) frames.

Physical layer capture is a common phenomenon in wireless networks where the frames with stronger signal strength can still be decoded in the event of a collision. This is typically helpful, but it can sometimes cause MAC unfairness. Existing solutions that attempt to mitigate MAC unfairness either fail to correctly identify the sender that needs to be throttled or are too aggressive in reducing the sending rate. Our key insight is that the nodes that cause an unfair situation to arise and can act to remedy it are often distinct from the ones that can accurately assess the degree of unfairness. We developed a distributed CWmin adjustment protocol, called FairMesh, which is the first attempt at decoupling the detection and assessment of unfairness from the remedial action. In FairMesh, the nodes with accurate assessment of unfairness are distributedly elected as coordinators to slow down the nodes causing unfairness (called offenders) by adjusting their CWmin. FairMesh is shown to achieve approximate max-min fairness for arbitrary set of links in 802.11 mesh networks.

We also investigated a special case of physical layer capture for the 802.11n Message In Message (MIM) mechanism, which refers to the capability of a receiver to abandon ongoing reception and shift to receive another frame with a higher signal strength. While MIM is supposed to improve the robustness of receiver against interference, we showed that MIM could be detrimental to the reception of aggregate frames when the interference is stronger. We proposed and evaluated a simple yet effective method to dynamically toggle MIM to achieve near-optimal throughput. The key idea is to monitor the frame

receptions and to determine whether MIM should be enabled from the observed collision patterns.

The second source of interference we address in this thesis is the interference due to MAC ACK frames. While most existing works are exclusively focused on the interference due to data frames, we showed that the interference from the MAC ACK frames can potentially reduce throughput by several fold. We propose Minimum Power for ACK (MinPACK), a distributed MAC ACK power control protocol that can minimize ACK interference without affecting the original throughput. Starting from the default ACK power, MinPACK gradually reduces ACK power until the level just before the ACK success rate starts decreasing. In addition to mitigating ACK interference, MinPACK is complementary to existing data frames power control algorithms and adapts rapidly to dynamic environments.