ET4394 Wireless Networking Paper Review - WiFi Goes to Town: Rapid Picocell Switching for Wireless Transit Networks (Group-WN9)

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Everything connected, anywhere, anytime - this is the soon-to-come future. At times like these, it becomes crucial to have a high-capacity wireless network that would allow the users to work or relax on-the-go. So far, the reduction in the cell sizes covering a geographical area has been the factor driving the major capacity gains over the years. This however presents a very undesirable situation where a trade-off has to be made between capacity and range. The current standards set for roaming between WiFi Access Points (APs) make it too slow to cater to the demand for high speed network connectivity. The handover from one AP to the next is time consuming. The paper presents a solution that will maintain a larger cell size and involve a network of APs communicating with each other and switching amongst themselves to provide the best possible user experience.
The commercial WiFi APs support 802.11r standard and as per the standard, the switching between the APs doesn't occur until atleast 5s of RSSI (Received Signal Strength Indicator) is collected. As a result, the 802.11r could support only lower speeds like 5mph and not higher speeds like 20mph. The design consideration includes the following:

- Downlink Packet Flow: This includes a range of mechanisms/algorithms like AP selection, queue management and a protocol for implementation.
- Uplink Packet flow: This includes techniques like block acknowledgement forwarding and packet de-duplication.

The paper compares the outcome of the proposed WiFi Goes to Town (WGTT) model with a combination of the IEEE 802.11r and 802.11k protocols. This combination of two protocols is referred to as the Enhanced 802.11r. The following two scenarios were considered and the observations were made that followed them:

- Single Client: Higher throughput was achieved in WGTT than the Enhanced 802.11r at both lower (5mph) and higher speed(35mph) of the vehicle. WGTT is more efficient at switching APs even at higher speeds.
- Multiple Clients: Considering three clients, WGTT still continued to perform better than Enhanced 802.11r. The paper clearly explained the reason behind the increasing throughput gap between the two. Dynamic multipath and in turn, a higher packet loss rate occurs due to the movement of multiple vehicles.

The case studies included three most common real-life scenarios (at two speeds 5mph and 15mph) that were as follows:

- Online Video: The videos are cached in the local server in order to minimize the latency and provide the best quality of experience(QoE) to the user. It uses a metric called the video rebuffer ratio.
- Remote Video Conferencing: This was tried out using both Skype and Google Hangouts. WGTT performed considerably well at both speeds.
- Web Browsing: The webpage is stored on the local server to reduce latency, thus proving the efficiency of WGTT.

The paper diligently explains every aspect of the experiment carried out in detail. With the continual development of Smart Cities, the proposed system could be a true game changer. There are a few companies that are capable of performing the fast switch over between AP's but they are expensive. This could be a first step in towards utilizing meter sized picocells for roadside hotspot networks bearing in mind the cost effectiveness of the system and thus, making it suitable for large scale deployment.
WGTT presents a city scenario. It will be intriguing to see if the project can be implemented along highways where the vehicular speeds will be much higher. Also, its performance at peak hours (when there are many clients crammed up in a smaller space due to traffic) will need to be tested to prove its effectiveness. Furthermore, the concept of driverless cars is a hot topic. It would be quite interesting to see how the idea presented in the paper can be integrated with driverless cars. [1]

References

[1] Z. Song, L. Shangguan, and K. Jamieson. Wi-fi goes to town: Rapid picocell switching for wireless transit networks. In *ACM Special Interest Group on Data Communication (SIGCOMM)*. ACM, ACM, 2017. doi: 10.1145/3098822.3098846. URL `http://dl.acm.org/authorize?N49839`.