WLAN Performance Measurement Report {February 11, 2013} 42 points

Evaluating the Performance of a WLAN in the WPI Recreation Center
Due: Tuesday, February 18, 2013 at 4 p.m.

Introduction

Assume the following scenario:

Your programming team has been hired by FEMA (the Federal Emergency Management Agency) as a consultant to evaluate Wireless Local Area Networks (WLANs) consisting of two access point (APs) and up to 45 wireless nodes made up of approximately 75% PC's and laptops and 25% cell phones or smart phones all equipped for Internet access via Wifi APs.

FEMA wants to improve its preparedness at providing quickly for disaster evacuees who might be housed temporarily for up to two months in high school gymnasiums. In addition to providing food and shelter, FEMA desires to quickly deploy a WLAN at these locations that would connect to the Internet via a single broadband cable or FiOS connection already available at the high schools.

FEMA wishes to provide the displaced families with the ability to access several specially designed 'disaster evacuation' application tools plus a few standard Internet services to improve the morale of the evacuees. Particular applications to consider in your study include: access to Internet games, instant messaging, downloading government forms that need to be filled out and returned electronically, streaming movies (especially government assistance films) from a FEMA controlled multimedia server, streaming of cartoons for small children, and the ability to talk to relatives over a VoIP application such as Skype.

FEMA has hired your team to conduct a preliminary prototype WLAN measurement study in WPI's new Recreation Center. Your team is free to select two off-the-shelf AP's that support 802.11n, purchase 15 wireless nodes of various types and one wireless sniffer. Using the specific layout of the WPI Recreation Center, your assignment is to provide a design proposal that provides a detailed plan of **exactly** which WLAN measurements you would conduct that includes specifics concerning the equipment that your team recommends purchasing for the prototype measurement and the use of publicly available measurement tools and traffic generators. (Assume for this discussion that you will be provided with free access to all the wireless measurement tools developed by the WPI CS Department Wireless Streaming Mulitmedia Lab (WSML) (see http://perform.wpi.edu/wsml/) and discussed in the [Li et al.] and the [Gretarsson et al.] papers.)

WLAN Performance Measurement Design Assignment

Each team is to submit a Design Report (not to exceed 25 pages) providing the details for your prototype WLAN measurement tests to be conducted in the WPI Recreation Center. Emphasis in your final grade will be placed on your specific justification for how the performance results derived from your proposed measurement study would be used to determine: the limitations of using one AP versus two APs, the

number of wireless clients that can be reasonably supported by one AP, location considerations for the APs and the wireless client nodes and whether some of the Internet applications proposed by FEMA need to be restricted or dropped from the list of applications to support.

Requirements List

Your measurement design report must include:

1. A preliminary list of hypotheses that you expect to test via your measurement experiments in the WPI Recreation Center.

2. A proposed list (including prices) of equipment to purchase for the prototype measurement that includes AP and client nodes.

3. An itemized list of measurement experiments that your team proposes to conduct. This list must have a minimum of **four** distinct experiments and may have more but assume WPI will give your team total access to the basketball court area of the Recreation Center for only three days between the last day of the D13 term and the May 2013 graduation. Discuss the traffic generation tools that will be used during the proposed experiments.

4. An itemized list of all network performance metrics that you propose to measure. Group these metrics by which layer in the protocol stack the measurement tool will operate. Discuss which specific tools will be employed to measure each individual performance metric. Decide which metrics are the most important for each experimental situation.

5. A detailed discussion of your `exact` experimental methodology that includes: applications to run, the number of times to repeat each experiment, duration of experiments, schedule of measurements over a 72 hour period, location and movement of the APs and the client nodes during experiments, the number of people needed to conduct the experiments, preliminary thoughts on software tools that might need to be developed to automate the experiments and provide an organized scheme for storage of all experimental results.

6. Provide and discuss **five** distinct graph layouts that you expect to produce from your experiments with a brief discussion of the value of each graph to the WLAN measurement study objectives.

When making your choices with respect to your design report, keep in mind the robustness of your design such that your procedures could easily deployed in different configurations that might include temporary cubicle barriers for families, larger or small gym floors and the ability to compare the performance of all the top recommended access points within the framework of your experimental procedures.

Questions {12 of the 42 points}

The following questions are designed to help your team think about some of the details needed in your proposed measurement study design. Please provide **specific answers** to these questions as an Appendix to your design report. While the expectation is that some of the answers will influence your design, the answers provided in the Appendix will be the only component of the report graded for the 12 points allocated for the answers to these questions.

1. Consider an 802.11n AP with 200 Mbps connecting speed. If you were to stream a one-hour video of the Survivor television show at 600kbps through this AP, in principle, what is the maximum number of concurrent video streams that this AP can support? Explain why the design of the DCF restricts the actual capacity to significantly lower than 124 Mbps and what would cause the realistic number of concurrent video streams to less than the maximum estimate.

2. Name the specific types of wireless frames that you expect to capture in your study. What type of interference do you expect to encounter during your measurement and how do the measurements get more difficult when you are dealing with two or more cooperating APs?

3. Discuss what experimental procedures you will employ to reduce the number of independent variables and the sources of interference that your experiments may encounter.

4. Explain the differences in the impact on application performance for:

   a. a video frame being dropped at a wireless client due to jitter.
   b. a web object downloaded as TCP packet being lost or dropped.
   c. an interactive game UDP packet being lost or dropped.

5. Postulate on what are the ***worst*** locations for wireless nodes on the basketball courts in the WPI Recreation Center. Identify the proposed experiment(s) that address the variability in the quality of wireless client connectivity to the AP(s).

6. Assume that your research shows a generic VoIP application that is compressed using an 8kbps codec. Given that conversations usually required a delay less than 150ms, explain what you need to measure and how you would measure it to insure that Quality of Service is adequate when a large number of concurrent VoIP applications are running over the WLAN in the WPI Recreation Center.

References

[Akella et al.] A. Akella, G. Judd, S. Seshan and P. Steenkiste, "Self-Management in Chaotic Wireless Deployments", ***The 11th International Conference on Mobile Computing and Networking (MobiCom05)***, Cologne, Germany, September 2005, pp. 185-199.

[Gretarsson et al.] J. Gretarsson, F. Li, M. Li, A. Samant, H. Wu, M.L. Claypool, and R.E. Kinicki, "Performance Analysis of the Intertwined Effects between Network Layers for 802.11g Transmissions", ***The First ACM Workshop on Wireless Multimedia Networking and Performance Modeling (WMuNeP05),*** Montreal, Canada, October, 2005**.**

[Ihmig and Steenkiste] M. Ihmig and P. Steenkiste, "Distributed Dynamic Channel Selection in Chaotic Wireless Networks", ***The 13th European Wireless Conference***, Paris, April 2007.

[Li et al.] F. Li, J. Chung, M. Li, H. Wu, M.L. Claypool, and R.E. Kinicki, "Application, Network and Link Layer Measurements of Streaming Video over a Wireless Campus Network", ***The Sixth Passive and Active Measurement Workshop (PAM05)***, Boston, April 2005.

[Yarvis et al.] M.Yarvis, K. Papagiannaki and W.S. Conner, "Characteristics of 802.11 Wireless Networks in the Home", ***The First Workshop on Wireless Network Measurements (WinMee05)***, Riva del Garda, Italy, April 2005.