BUCKNELL UNIVERSITY

UNDERGRADUATE RESEARCH PROPOSAL

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A MECHANISM FOR TRANSIENT DETECTION IN METRICS ESTIMATED WITH THE NS-3 NETWORK SIMULATOR

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PART A

PROJECT DESCRIPTION

As society continues to develop and grow, the ability to network has become a vital skill. Computer networks are a crucial means of sharing information and data. As the public become more dependent on information and connectivity, they demand more of computer networks.

The two types of computer networks are hard-wired and wireless. Although hard-wired are more reliable, they are not portable and conflict with the need for mobility while accessing and sharing information. Wireless networks have a weaker connection but continue to be developed and enhanced to be a more dependable source of communication. As these improvements of wireless networks progress, research to test and analyze the predicted behavior of these networks is essential. In order to determine the behavior and or performance of networks, simulations are necessary because it creates controlled environment. To predict network behavior, complicated mathematical processes and computer simulations must be used which stands as a road block on the way to successful simulation of network behavior. Therein lies a fundamental issue with networks, it is very challenging to correctly simulate network behavior.

Researchers use a wide range of methodology including a mix of simulations, and mathematics to compile and analyze results. Results of simulations often have "little credibility" due to their "random nature and the need for proper statistical analysis of simulation output data" [3]. Therefore, it has become increasingly difficult for data to be confirmed and standardized for dissemination of scientific results. On top of that, the collection process can be exhausting, consuming of time and resources, rendering few people able to compile trustworthy results. Researchers have lead to an influx of flawed results and conclusions. It is a research requirement that "any scientific activity should be based on controlled and independently repeatable experiments" but as researchers became more impatient they used a "brute force approach" to these simulations which leads to unacceptable results [1]. The combination of these issues has lead to a crisis of credibility in the network simulation field.

In response to this confusion, the ns-3 network simulator was created so that it could be widely used and applied as a standardized system. ns-3 is free software that is distributed, modified, and redistributed by any user allowing it to have a greater user base. Although the simulator has proven to be a big improvement in the research of computer networking, it is

complicated, especially for inexperienced users. Professor Perrone is developing an architecture that will allow novice users to create successful network simulation experiments, while also enhancing the capabilities of more advanced users [5]. He used an analogy to describe his research which I believe helps to explain its purpose. He said that NS-3is like a bike and although it moves relatively smoothly, the rider still needs training wheels to help keep them stable so they do not fall off and get hurt. I will help with the creation of those training wheels by focusing my efforts on the application of valid statistical methods for output data processing.

Transient data is data which does not follow the general trend of results. This data is not a accurate representation of the whole and therefore must be detected and discarded. It can create a greater bias in the results, skewing the findings and making them unreliable. This is one of the main causes of the credibility crisis in network simulations.

Although a reliable network simulator now exists, it doesn't include transient detection and deletion of the output data stream. Through the research I will to do with Professor Perrone, I will develop on the detection and deletion of transient data to improve the reliability of the simulator's results. By reducing the flaws in the data the results become viable as reliable simulations of networking systems. This research with Professor Perrone will be a unique opportunity to develop new skills in computer programming and enhance my ability as I continue with Bucknell's Computer Engineering degree program.

METHOD

To do this work I will use statistical processes and analyze the data generated. I will run simulations using ns-3and use its facilities for collecting data. I will use previously developed mathematical technology referred to as variance reduction techniques (VRT) [3] and other resources including stochastic steady-state simulation to create a program that will allow me to analyze data [1,3]. In addition to adding to my knowledge of statistics, I will be learning more computer programming languages to enhance my work. My goal is to create a program that will analyze that data to detect the end of the transient results to make the results a better representation of actual network systems. This program was once modeled for an earlier network simulator NS-2, but I will create a new program that works with the ns-3 simulation and which will be user-friendly and widely accepted in everyday experiments.

TIME LINE

Week 1: review of literature on statistical methods

Week 2 and 3: studying of programming languages use in the ns-3 simulator

Week 4 to 6: implementation of prototype

Week 7 to 8: validation and debugging of code

OUTCOMES

This project will aid in the continuation of Professor Perrone's research. We believe that my results will help to create a more stable method of analyzing and using network simulations in an effort to make the field more reliable and constructive. I will work on writing a computer program for the ns-3 simulator that will take a series of measurements, go through a statistical process, and tell the user whether or not a data point is part of the transient data. I will produce a program that will fit in the larger context of a framework to automate experiments in ns-3. Professor Perrone and I believe that my work will be beneficial to the entire user base of ns-3. We expect that this work will result in material that can be submitted as conference publication.

PART B

REASEARCH ENVIRONMENT

I will be working closely with Professor Perrone throughout my summer research. He believes strongly in what he refers to as an "open door" policy, allowing me to come speak with him about any questions or problems I may have while doing my work. I will be using standard computer science labs which have both Linux and Macintosh machines to develop code and execute experiments to evaluate results.

REFERENCES

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[5] L. F. Perrone, C. Cicconetti, G. Stea, and B. C. Ward. On the automation of computer network simulators. In *Simutools '09: Proceedings of the 2nd International Conference on Simulation Tools and Techniques*, pages 1-10, 2009.