

# Wireless Network Measurements using Harpoon

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## 1. Introduction

In this project we are using Harpoon traffic generator in order to evaluate the models presented in [1], in a real testbed. The rest of this report is organized as follows. In section 2 we introduce Harpoon. In section 3 we describe the testbed. In section 4 we describe our methodology in detail. In section 5 we present the results of the experiment. Finally, in section 6 we conclude this report.

## 2. Harpoon

Harpoon is a flow - level traffic generator. It uses a set of distributional parameters that can be automatically extracted from traces to generate flows that exhibit the same statistical qualities present in measured Internet traces, including temporal and spatial characteristics [3].

The connection level of Harpoon's architecture model is made up of two components that have measurable distributional properties. The first component is the size of the file transferred, and the second component is the time interval between consecutive file transfer requests, the inter-connection time. Harpoon makes requests for files with sizes drawn from an empirical distribution *PFileSize*. Connection initiations are separated by time intervals drawn from an empirical distribution *PInterConnection*.

Each of the parameters *PFileSize*, *PInterConnection* are configured using XML tags `<file_sizes>`, `<interconnection_times>` respectively. Whitespace-separated values for each distribution should be written between start and end tags for the respective element. There is no required order among these tags. For the TCP scenario, servers expect `<file_sizes>`. File sizes values are given in bytes. Clients expect `<interconnection_times>`. Interconnection times are given in (floating point) seconds.

Both endpoints require `<address_pool>` tags which contain source and destination IPs [4].

### 3. Testbed

For the purposes of this experiment we extract the flow sizes and interconnection times from the synthetic and real traces of access point 442, format them as a list of numbers and save them in .xml files using the tags `<file_sizes>` and `<interconnection_times>` respectively. We used the sessions and flows that occur during the first 8000 seconds of those traces. The sessions were assigned to each client in a round robin manner. The number of flows from the real or synthetic traces is used along with interconnection times in order to calculate harpoon's warp factor.

The experimental data reported are a result of measurements we have taken on a 5 node wireless testbed. Our testbed is located in an office of the I.C.S. FORTH. The nodes have fixed locations and did not move for the duration of the experiment. Our testbed consists of three laptops, one desktop and one access point. Each laptop is connected wirelessly to the access point which in turn is connected to FORTH's subnet and the internet. The desktop has a wired connection to the same FORTH's subnet. The desktop computer can communicate using a wired connection with the access point via one of FORTH's edge routers. The laptops are two Sony Vaio and one IBM ThinkPad and all have 802.11b compatible radios. Specifically one Vaio is using its embedded 802.11b/g radio interface and the other Vaio and the ThinkPad use 802.11b and 802.11g PCCARDS respectively. The access point is a Cisco Aironet 1200 series and is set to 802.11b (11 Mbps).

A harpoon client runs on each of the laptops and connects to one of the three harpoon servers that run on the desktop respectively. Each server sends files to its respective client via the wireless channel. Every 300 seconds both laptops and desktop synchronize their clocks with the NTP server `ntp.ubuntu.org`. Packet transfers on transport layer are monitored by `tcpdump` running on all four computers.

## 4. Methodology

application layer. The delay per flow is the average delay of a packet in the flow, which is the difference of the time required for the packet to be delivered at the receiver from the time it was enqueued at the sender. The jitter expresses the delay variability

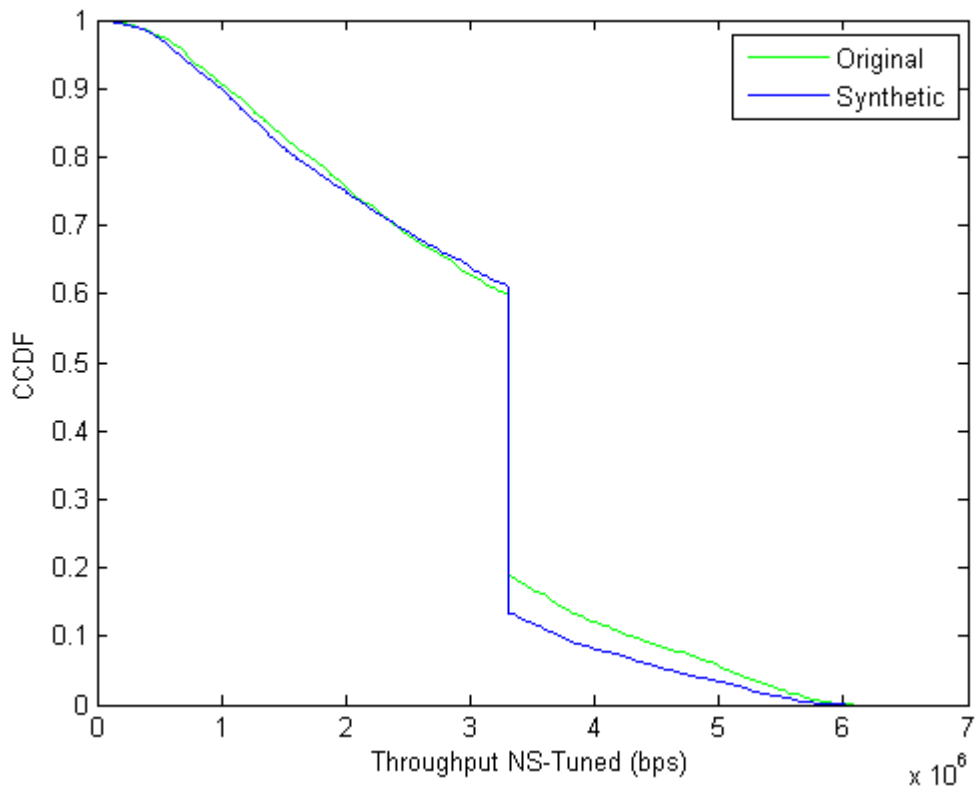


Figure 2: NS Tuned per Flow Throughput

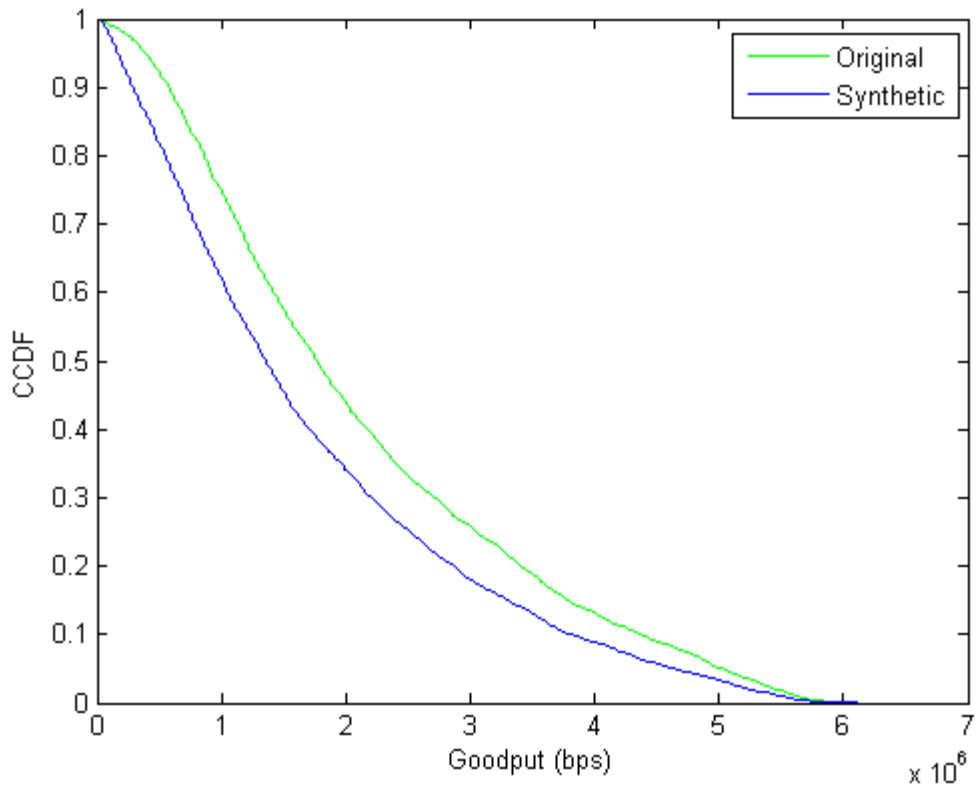


Figure 3: Per Flow Goodput

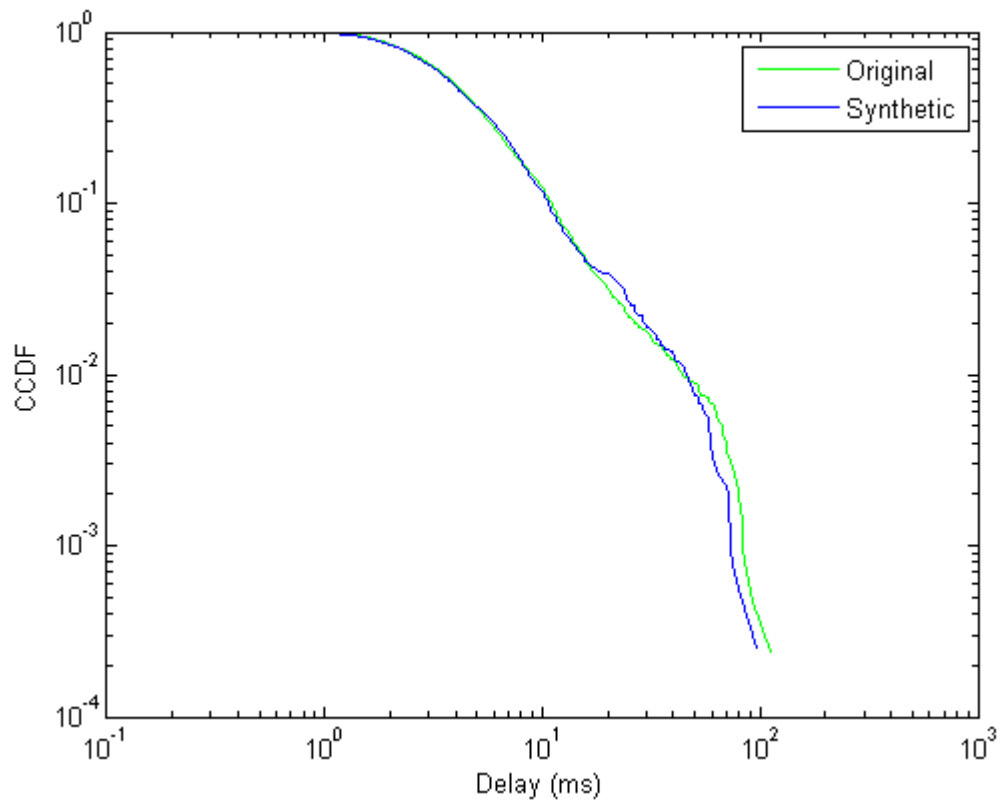


Figure 4: Average per Flow End-To-End Delay

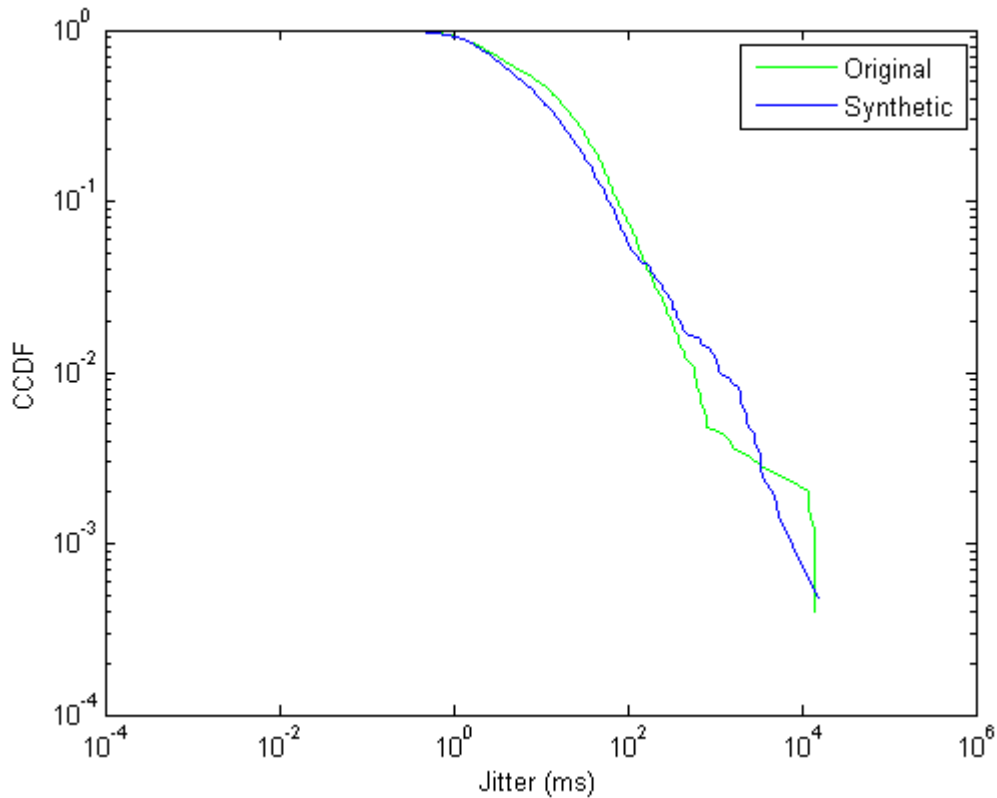


Figure 5: Per Flow Jitter

## 6. Conclusion

In this project we used Harpoon traffic generation in order to evaluate the models presented in [1]. Using real traces and synthetic traces, created by these models, we performed a series of experiments in a real testbed and calculated a set of benchmarks. The plots presented in this report show that the traffic created by harpoon was identical for real and synthetic traces.

## Acknowledgement

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## References

[1] <sup>a</sup>Spatio-Temporal Modelling of Traffic Workload in a Campus WLAN<sup>o</sup>, F. Hernandez-Campos, M. Karaliopoulos, M. Papadopouli, H. Shen, University of North Carolina, University of Crete, WICON 06

[2] <sup>a</sup>Peer-to-Peer Computing for Mobile Networks: Information Discovery and Dissemination<sup>o</sup>, M. Papadopouli, H. Schelzrinne, April 9, 2008 draft

[3] <sup>a</sup>Harpoon: A Flow Level Traffic Generator for Router and Network Tests<sup>o</sup>, J. Sommers, H. Kim, P. Barford, University of Wisconsin, SIGMETRICS Performance 04

[4] <sup>a</sup>Harpoon: A Flow Level Traffic Generator, User Manual<sup>o</sup>