IEEE 802.11n Performance Assessment in Noisy Channel

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Abstract

The IEEE 802.11 (Wi-Fi) is now the de-facto standard for the overwhelming majority of Wireless Local Area Networks (WLANs). The standard is under actively development, and with each new version the throughput significantly increases. Nevertheless, maximum achievable throughput and goodput are essentially lower than maximum theoretical values of these parameters due to the data transmission environment with its noises of various nature and weak noise immunity.

The maximum achievable throughput and goodput for the 802.11n standard are unknown at the moment. Assessment of these values is an important task, because the comparison of goodputs of 802.11g and 802.11n standards allows to determine the real benefit of using the latter standard for data transmission. Determination of the optimum modulation schemes and coding rates is also an important problem, because its decision allows more efficient implementations of algorithms used by Wi-Fi drivers and devices.

At the moment our research concerns the 802.11n standard, which maximum theoretical throughput is 150 Mbps per one antenna. Within the current project we concentrated on carrying out on-site verification test, gives rather precise results, although requires much efforts for its implementation.

The idea of test bench development, where each and every client could be a sender, a receiver, or a sender and a receiver simultaneously, was proposed in [1]. The test bench is a complex of hardware and software. Using the test bench, different types of traffic (TCP, UDP, VoIP, Video, etc.) could be generated in both saturation or not. The traffic analyzer provides the possibility to estimate major network characteristics, such as throughput, delay, collision probability, etc.

The first steps of implementation of the test bench were described in [2]. By now, the test bench supports for a base case including only one transmitter, one receiver, and an access point (see Fig.1). We use Linux-based PCs and laptops with ath9k [3] Open Source Wi-Fi driver installed. The original driver contains a mechanism of automatic rate control, which is not suitable for carrying out control measurements. So, the functionality allowing manual setting of a rate and modulation scheme was added into the driver.

The accurate experiments require access to the system parameters, such as Packet Error Trace (PET) and packet arrival time. To record Packet Error Trace the corresponding functionality was added to the driver. For PET analysis we implemented a utility, which calculate total number of transferred packages, number of successful and unsuccessful transfers, probability of errors.

The traffic for the test bench is generated with iperf utility. Wireshark sniffer and air-crack utilities were used for calibration of changes in the driver and reliability estimation.

As the probability of error emergence at a good signal is rather small, it was necessary to worsen quality of a signal, to a certain level. For these purposes we installed metal shields between the transmitter and the access point and directly on the antennas.

We conducted the experiments as following. We started PET recording on a client computer and started the process of UDP traffic generation with a given size of packages. Packages were transferred to the server having the iperf utility started. From the client to the access point the packages were transferred via Wi-Fi channel, and then via Ethernet channel to the server.

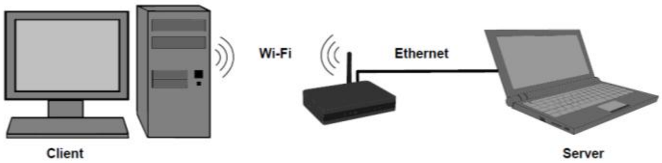

Fig. 1. Scheme of the test bench

As a result of the experiments, we gathered statistics reflecting probability of emergence of a package transfer error depending on the size of transferred packages.

At the moment, we extend the test bench for a case of a greater number of receivers and transmitters and for a case of external nodes i.e. Internet.

Index Terms: 802.11, Wi-Fi, Test Bench, On-site Verification Test, ath9k, Driver Modication, Rate Control, Packet Error Trace, PET, Experiment.

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