

**MOTOROLA****Assignment Description**

No: AD001

Rev: 1

Author: Motorola Mobile Devices,
Silicon Technologies - 4G Protocol Stacks
Date: 01-10-07Subject: **Sensitivity of TCP to MAC layer latencies in a wireless communications system.****1. BACKGROUND**

Mobile WiMAX is an emerging cellular technology for high-speed wireless Internet access. The goal: providing global high-speed internet access (including VoIP) to mobile devices such as PDAs and cellphones. The air interface protocol is specified in the IEEE 802.16e-2005 standard, which makes use of advanced data communications principles such as 1024 subcarrier Orthogonal Frequency Division Multiple Access (OFDMA), Multiple Input Multiple Output (MIMO), Beamforming, frequency-selective scheduling, Quality of Service differentiation, and power savings algorithms.

At the development facility of Motorola Mobile Devices in Nieuwegein we are developing the physical layer (DSP hardware) and the MAC layer (software), which are combined in a System-on-Chip (SoC). The first chip was released in the fall of 2007; it will be applied in Motorola's WiMAX enabled mobile phones.

Wireless mediums tend to have a larger packet latency than wired mediums. Reason for this is the retransmission mechanisms that are required to keep the packet error rate to an acceptable level, and the latencies due to the frame structure on the medium and the bandwidth allocation delays. It is well known in the literature that the Transport Control Protocol (TCP) of the Internet Protocol stack is particularly sensitive to these latencies: the congestion avoidance algorithm assumes that the latencies are due to queueing delays, and as a result it reduces the packet send rate in an attempt to reduce the congestion. Obviously this effect contradicts with the WiMAX goal of providing high speed internet access.

2. GOAL

The goal of this assignment is to study the relationship between TCP throughput and latency.

3. DESCRIPTION

The student is expected to:

- perform a literature study on the effect of latency on TCP (for various TCP flavors);
- familiarize him/herself of the IEEE 802.16 protocol and Motorola's MAC design to understand the source of the latencies;
- develop design alternatives and analyze the relative performance of these alternatives by one or more activities of the following:
 - perform simulations (using the ns-2 network simulator)

- perform measurements and experiments to be performed on a working system in the lab, to study the impact of design alternatives
- create a theoretical model and analysis of the problem
- make practical recommendations to improve TCP performance.

The outcome of this study will be used to enhance the current MAC design, and if applicable to propose protocol enhancements to the IEEE 802.16 standardizations body.

4. PRACTICAL INFORMATION

Duration	TBD wks
Start Date	TBD
Location	Motorola Mobile Devices, Silicon Technologies 4G Protocol Stacks group Marconibaan 57 3439MR Nieuwegein
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