



# Performance Evaluation of a Cross-layer based Wireless Interface Dynamic Selection on WPAN/WLAN Heterogeneous Environments: An Experimental Approach

*L. Sánchez, J. Lanza, L. Muñoz*

*Network Planning and Mobile Communications Lab.  
University of Cantabria*

6th International Workshop on Applications and Services in Wireless Networks  
Berlin, May 2006

## Outline

- ❑ Introduction
- ❑ Protocol Architecture and Implementation Aspects
- ❑ Measurement Campaign Scenario
- ❑ Selection of Optimal Interface
- ❑ Conclusions



# Introduction

## Wireless Communications Heterogeneity

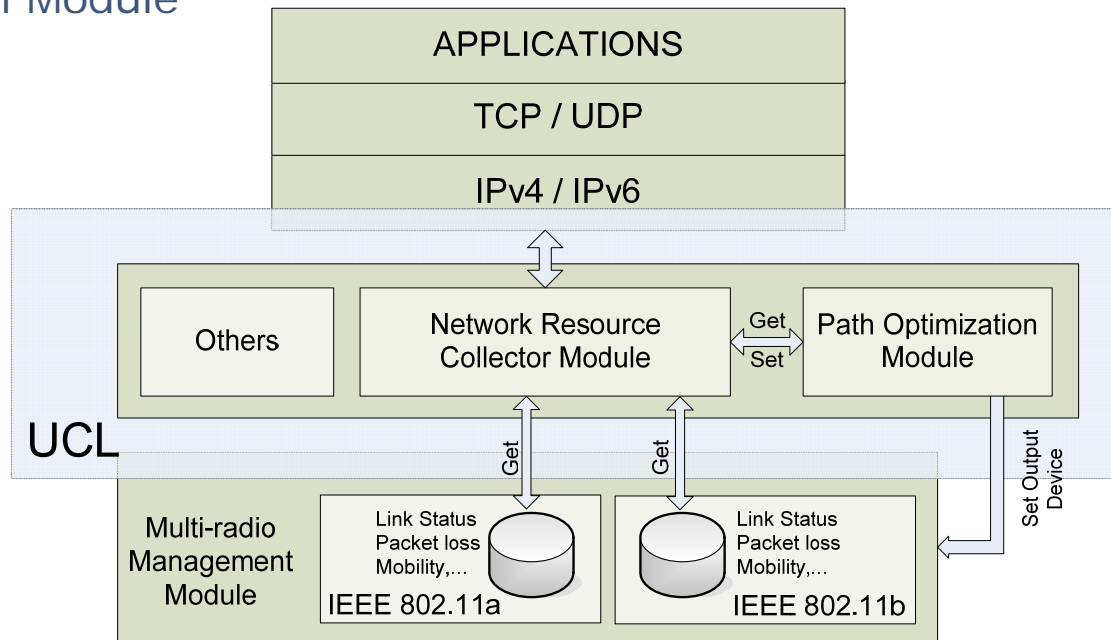
- ❑ A large number of wireless access technologies are envisaged to coexist in future wireless communication spaces
- ❑ The concept of isolating the upper-layers from underlying wireless technologies and thus providing real multi-mode can be achieved by introducing a Universal Convergence Layer (UCL)
- ❑ The different wireless access technologies will present a different behavior depending on the channel conditions
- ❑ It has been implemented within the UCL a mechanism to dynamically select the most appropriate air interface to use for communicating with another device whenever multiple choices are possible.
- ❑ The selection has been based on the status of the channel and the maximum available bandwidth following a cross-layer optimization approach



# Protocol Architecture and Implementation Aspects

## High-Level Architecture

- ❑ Multi-radio management module
  - common interface towards the network layer
  - hiding the complexity of the different wireless access technologies
  - providing the mechanisms to handle data transmission over different interfaces
- ❑ Network Resource Collector
  - specialized on collecting and translating data to make it available to the rest of the modules thus enabling the cross-layer optimization
- ❑ Path Optimization Module



## Implementation details

- ❑ Linux based developments
- ❑ Working over laptops/desktops and PDA-like devices
- ❑ Kernel level programming
- ❑ In spite of the shortcomings of current available off-the-shelf technologies

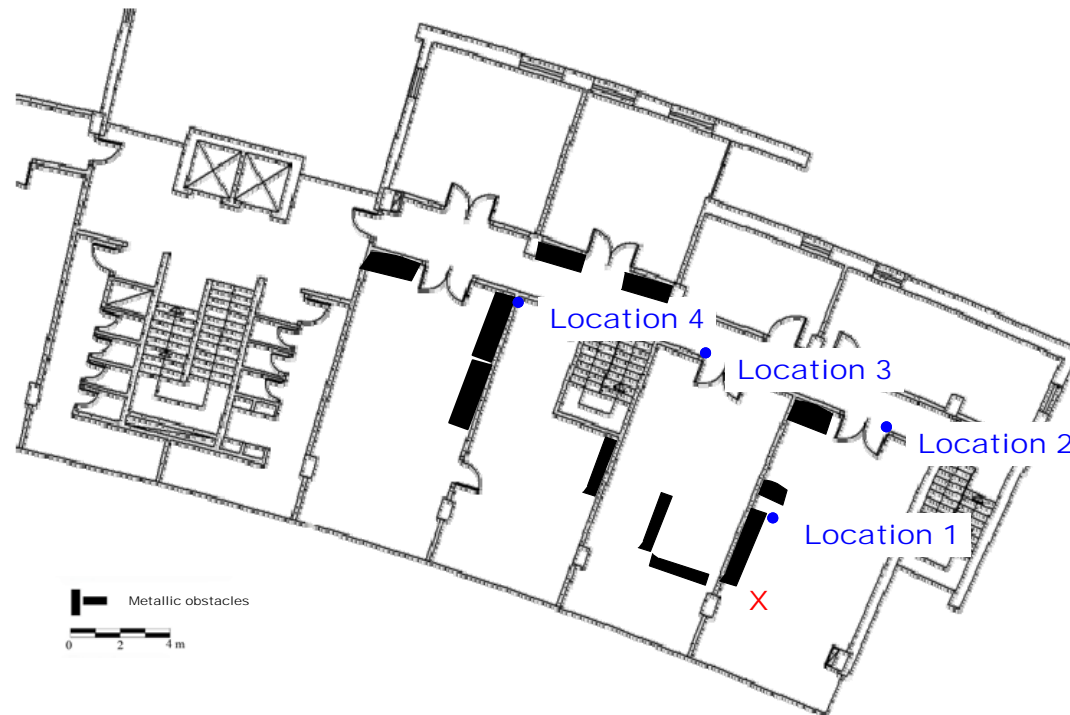


## Measurement Campaign Scenario

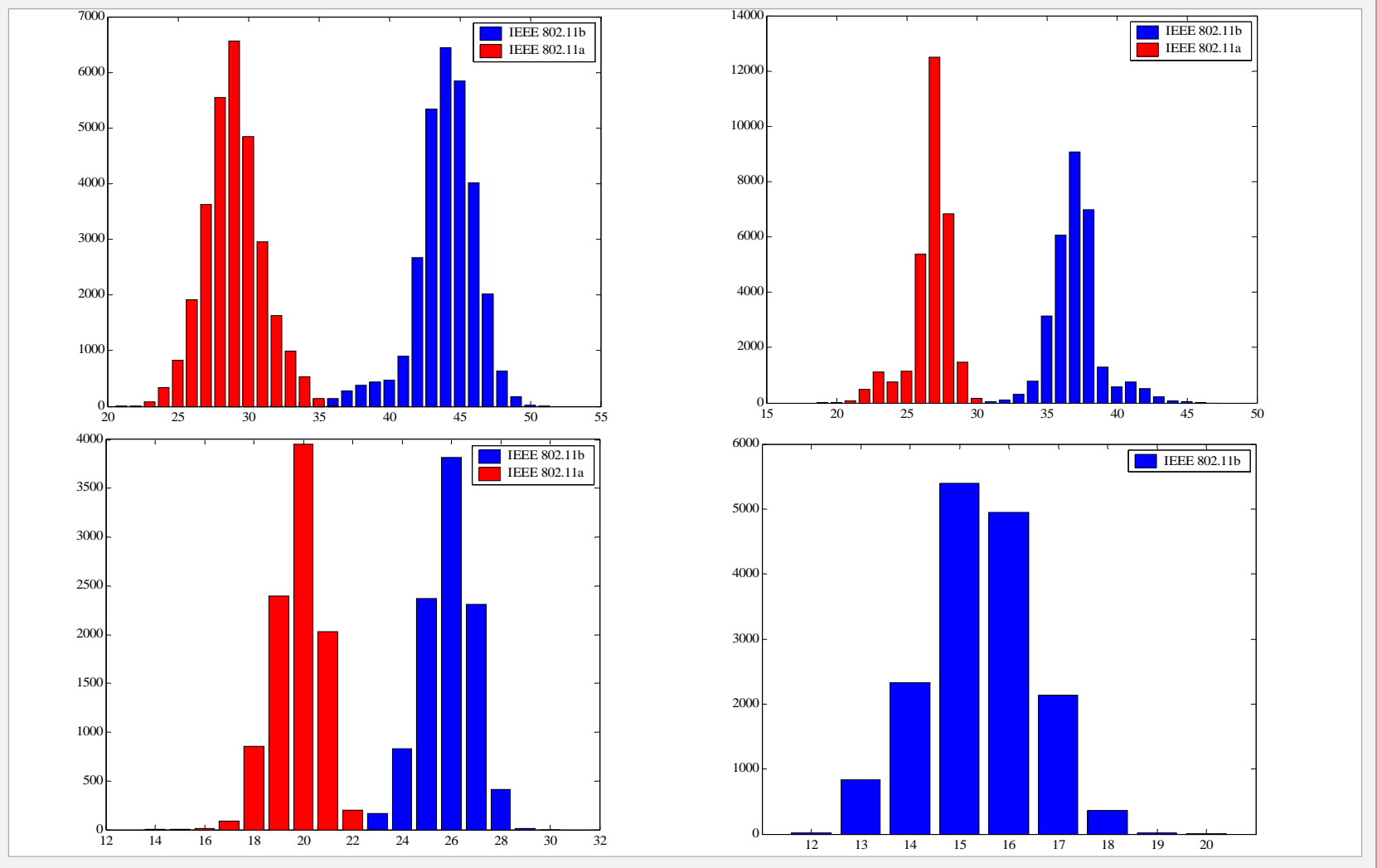


## Real world scenario, real world technologies

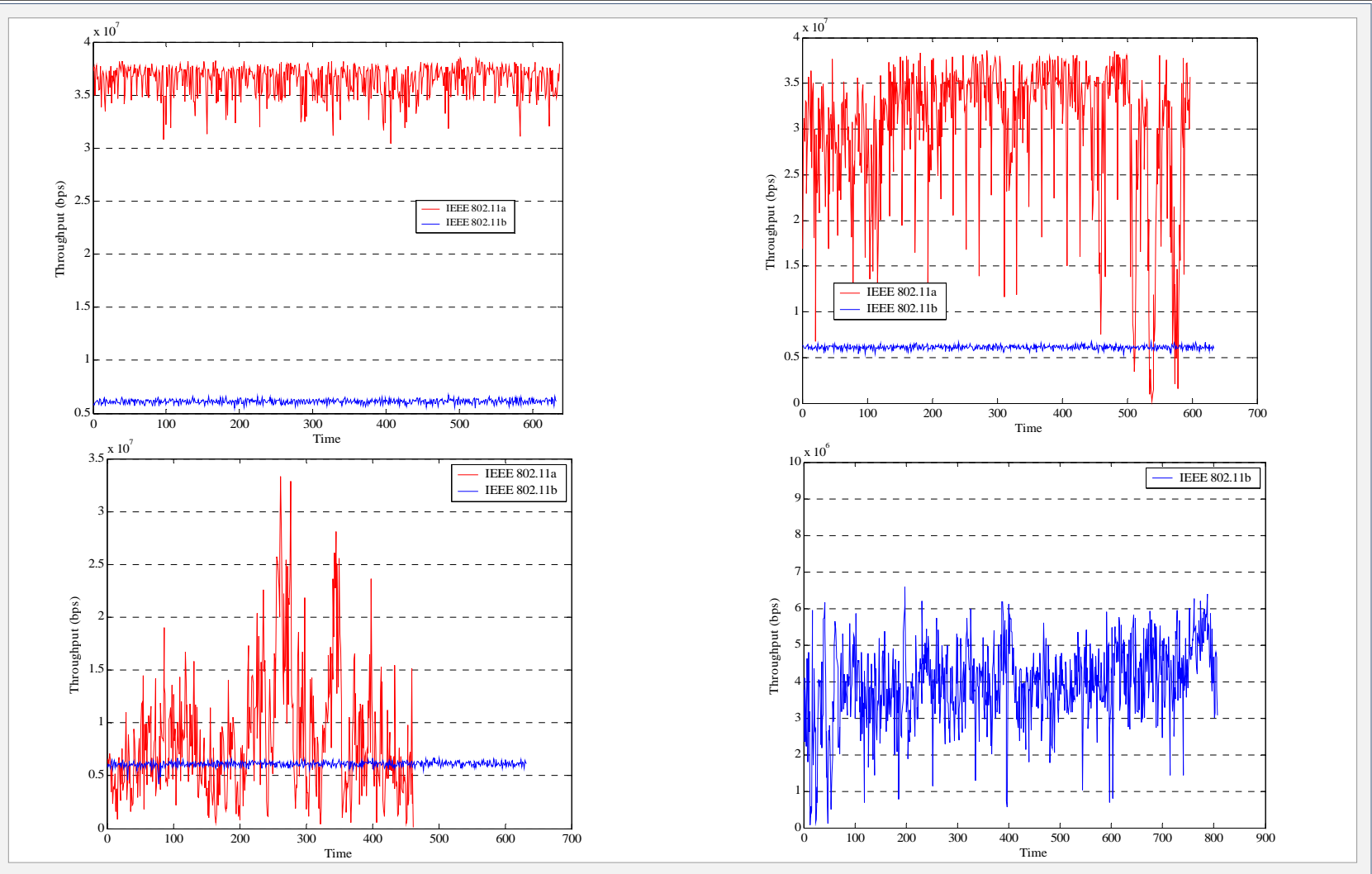
- ❑ IEEE 802.11b – Intel chipset
- ❑ IEEE 802.11a – Atheros chipset
- ❑ 4 locations with 4 representative channel conditions



## Channel conditions



## UDP Performance

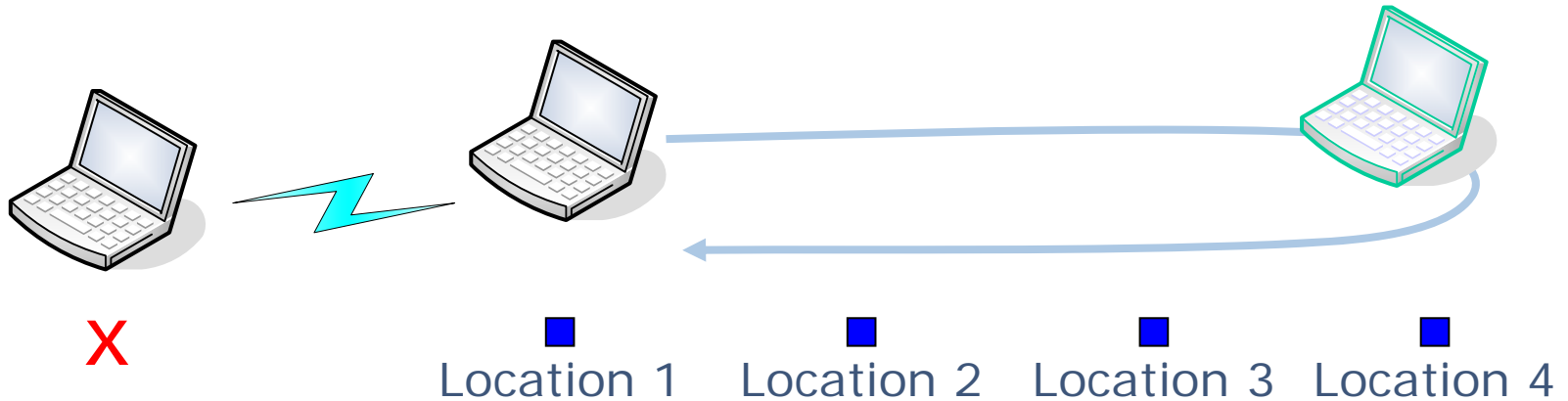




## Selection of Optimal Interface

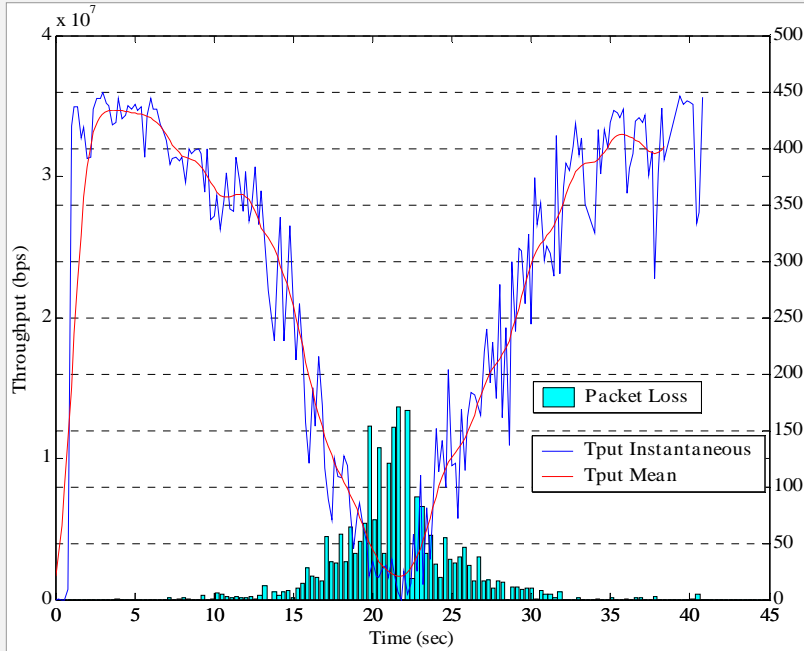
## Experimental case

- 40 seconds run

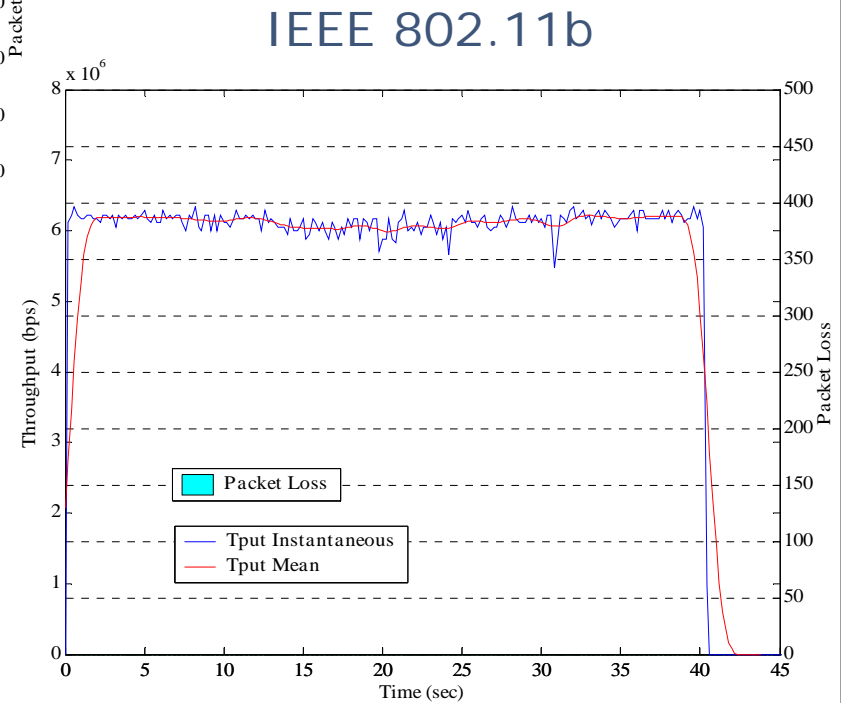


- 1500 bytes UDP packets
- 5 repetitions per case

## Optimal Interface Selection disabled

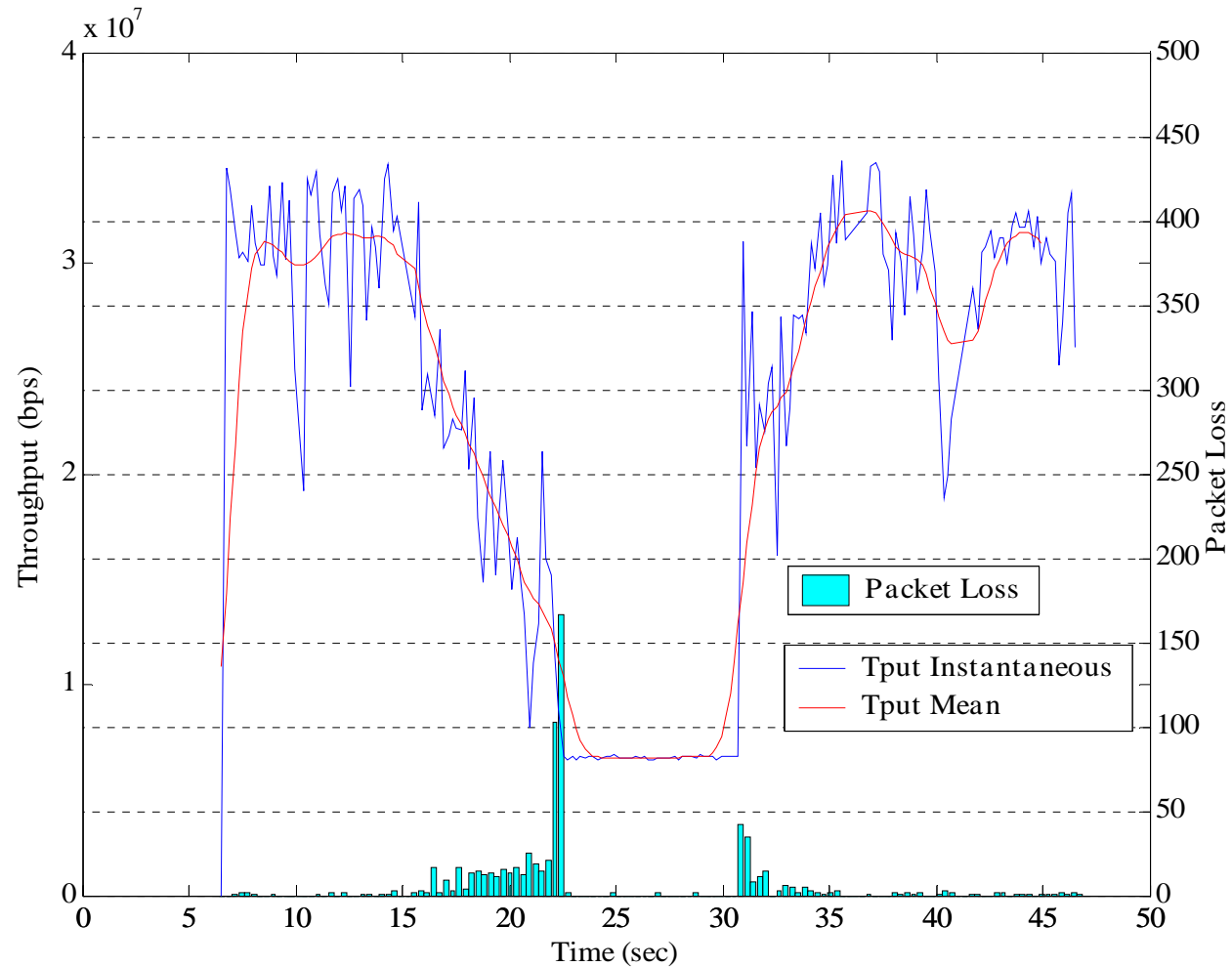


IEEE 802.11a



IEEE 802.11b

## Optimal Interface Selection enabled





## Conclusions



## Work Assessment

- ❑ This work has presented a complete experimental assessment of the benefits that a cross-layer optimization approach can bring up in the field of wireless communications
- ❑ It has been proven how the UCL enables the dynamic adaptation to the channel conditions resulting on a substantial performance enhancement
- ❑ Although the SNR has proven to give interesting results, future work will add new parameters to the decision process
- ❑ Additional studies has exploited UCL advantages
  - Simultaneous transmission over several wireless technologies
  - Similar study using TCP suite



**MAGNET**  
My personal Adaptive Global NET

This work has been done within the project "My Adaptive Global NET; MAGNET", running under the 6th framework program performed by IST under the contract no 507102

# Performance Evaluation of a Cross-layer based Wireless Interface Dynamic Selection on WPAN/WLAN Heterogeneous Environments: An Experimental Approach

*L. Sánchez, J. Lanza, L. Muñoz*

*Network Planning and Mobile Communications Lab.  
University of Cantabria*

6th International Workshop on Applications and Services in Wireless Networks  
Berlin, May 2006