Performance Measurement of Wireless LAN Using Open Source

Vipin M

Communication Research Group

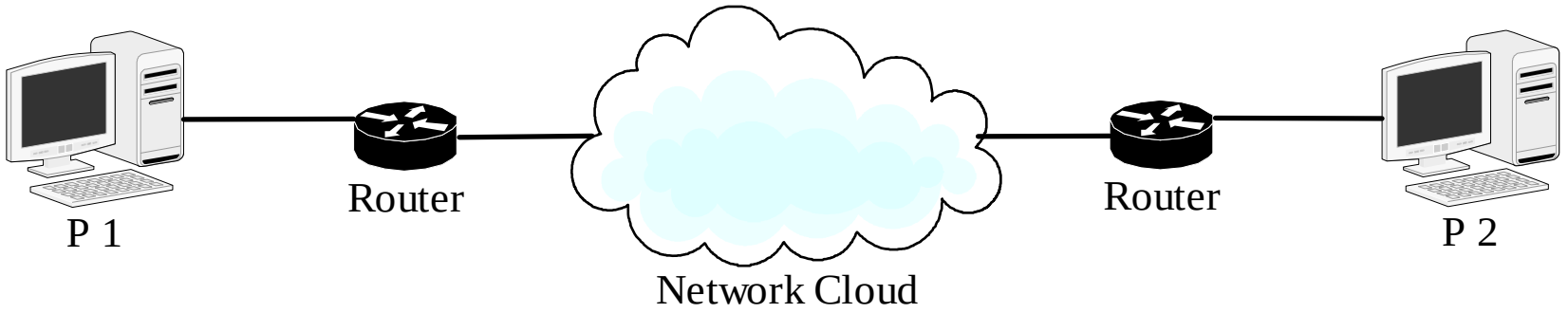
AU – KBC Research Centre

http://comm.au-kbc.org/

Overview

- General Network
  - Why Network Performance Measurement ?
  - Network Performance Metrics
  - How Network Performance is Measured ?
  - Measurement Methods
    - Ex: Packet Streams & Pair Packet
  - Active Probing Tools
    - Ex: Iperf
- Wireless Network
  - Performance Measurement In Wireless LAN
  - PHY / MAC / Higher layer Measurement
  - Measuring Methods and setups
- Effect in Wireless
  - Effect of these Metrics
  - Some Results

Why Network Performance Measurement ?

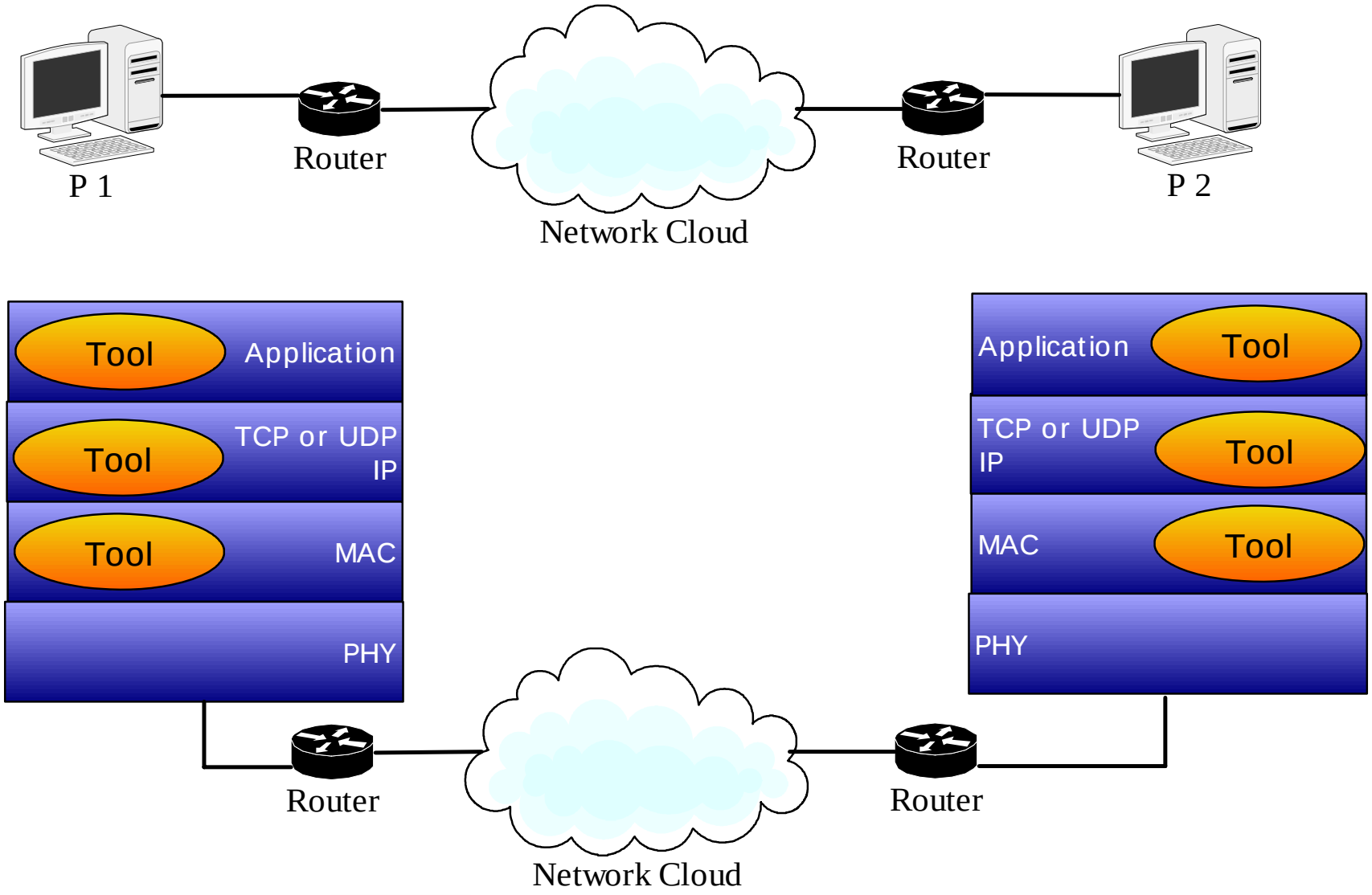


- The factors affecting network Performance
- How this factors are affecting the Performance
- Impacts for a User / Application because of these

Network performance metrics

- **One-Way Delay (OWD)**
  - Serialization Delay
  - **Propagation Delay**
  - Queuing Delay
  - Forwarding Delay
- Round-Trip Time (RTT)
- **Delay Variation (Jitter)**
- **Packet Loss**
  - Congestion
  - **Errors**
- Packet Reordering
- Maximum Transmission Unit (MTU)
- **Available Bandwidth (Throughput)**
- Link Capacity
- Bandwidth Delay Product (BDP)

How Network Performance is Measured



Measurement Methods

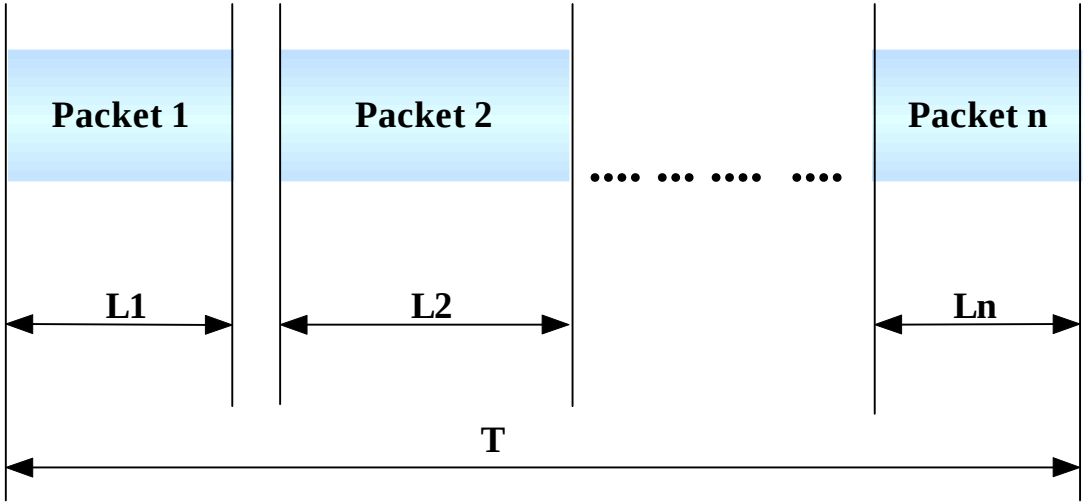
Metric

- Distance
  - Per-hop
  - End-to-End
- Values
  - Bulk Transfer
  - Achievable
  - Bottleneck / Minimum

Methods (Ex: for IP layer)

- Variable Packet Size
- Packet Pairs / Trains
- Self – Loading Periodic Streams
- Parallel Connection

Packet Streams



n Packets are received at destination
With in the time period of **T**
With Sizes of **L1,L2 …… Ln**

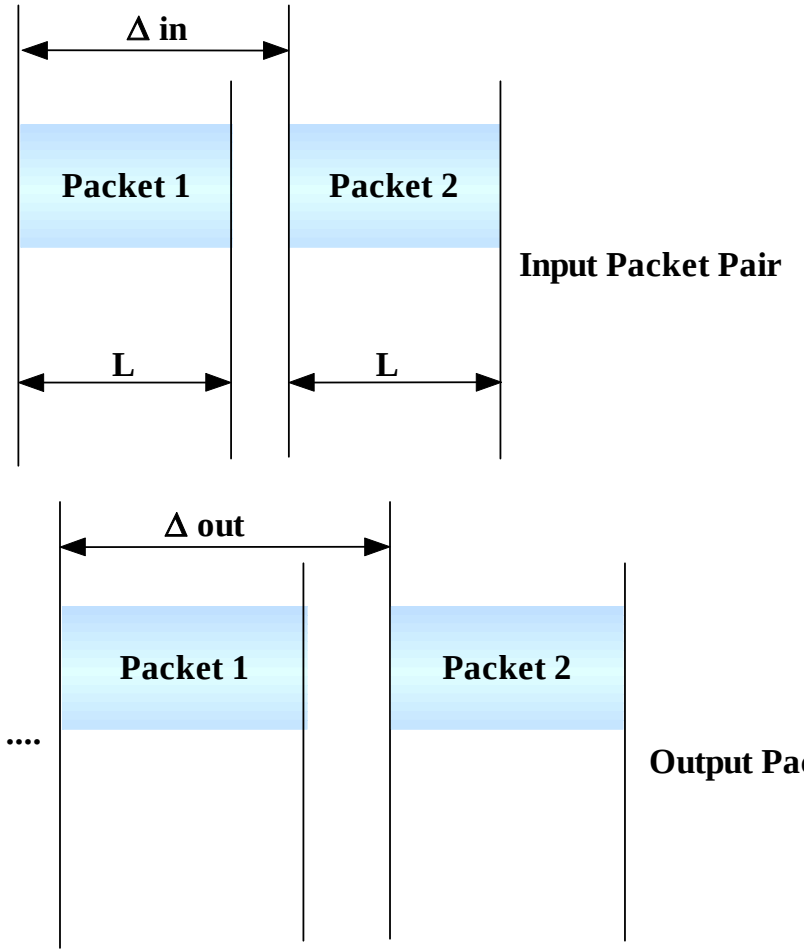
Total Size

L = L1 + L2 + …. + Ln

Throughput

C = L / T

Pair Packet



- Two packet of size L send back to back
- Packets receive with ∂ time space dispersion

Time = Size (L) / Capacity (C)

C = L / T

Δout = L / C0

Δout = Max(Δin, L/Ci)

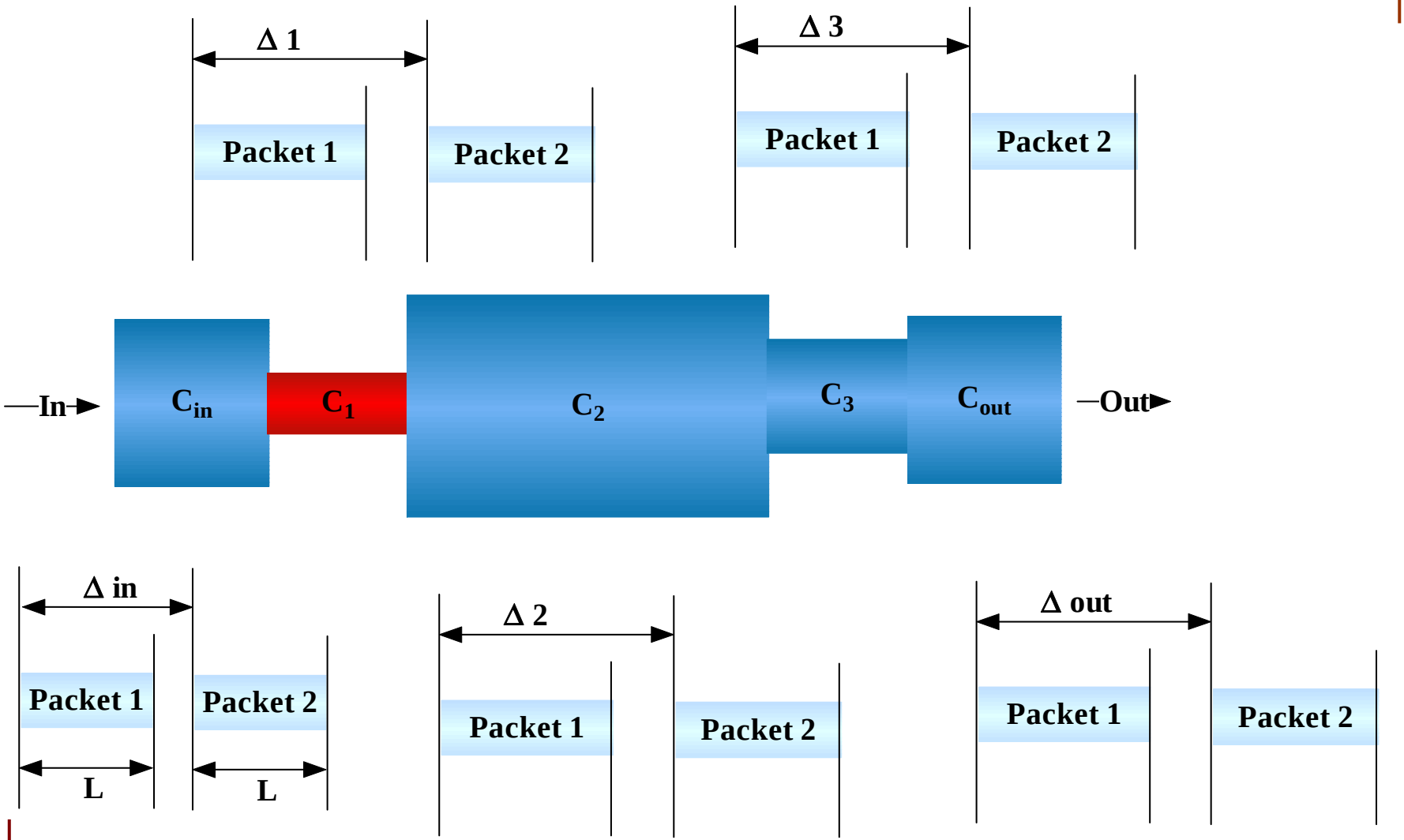
Dispersion ∂ = Δout - Δin

Dispersion ∂ = Max (L/Ci)

Min(Ci) -> end-to-end Capacity

Capacity C = L / ∂

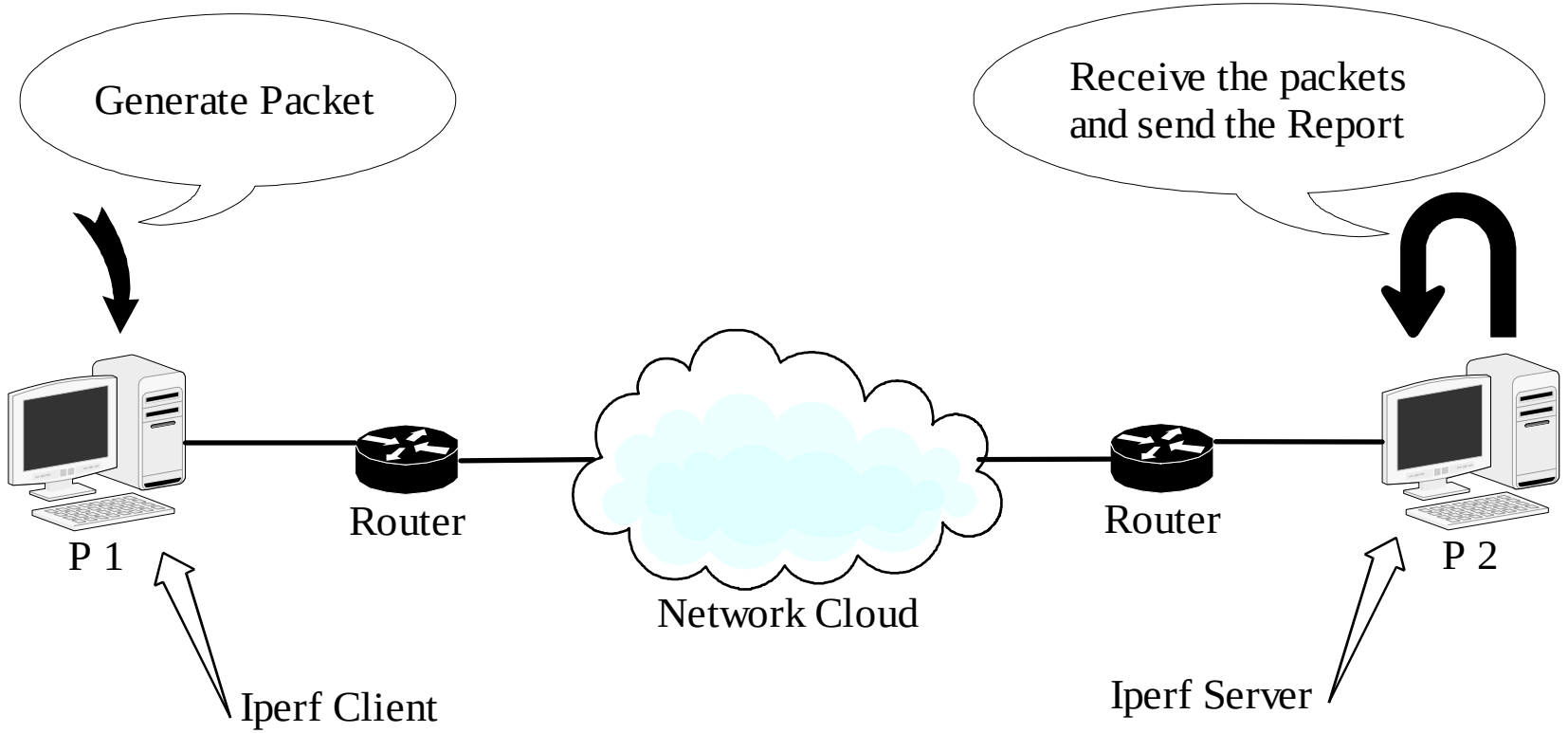
Bottleneck Capacity



Active Probing Tools

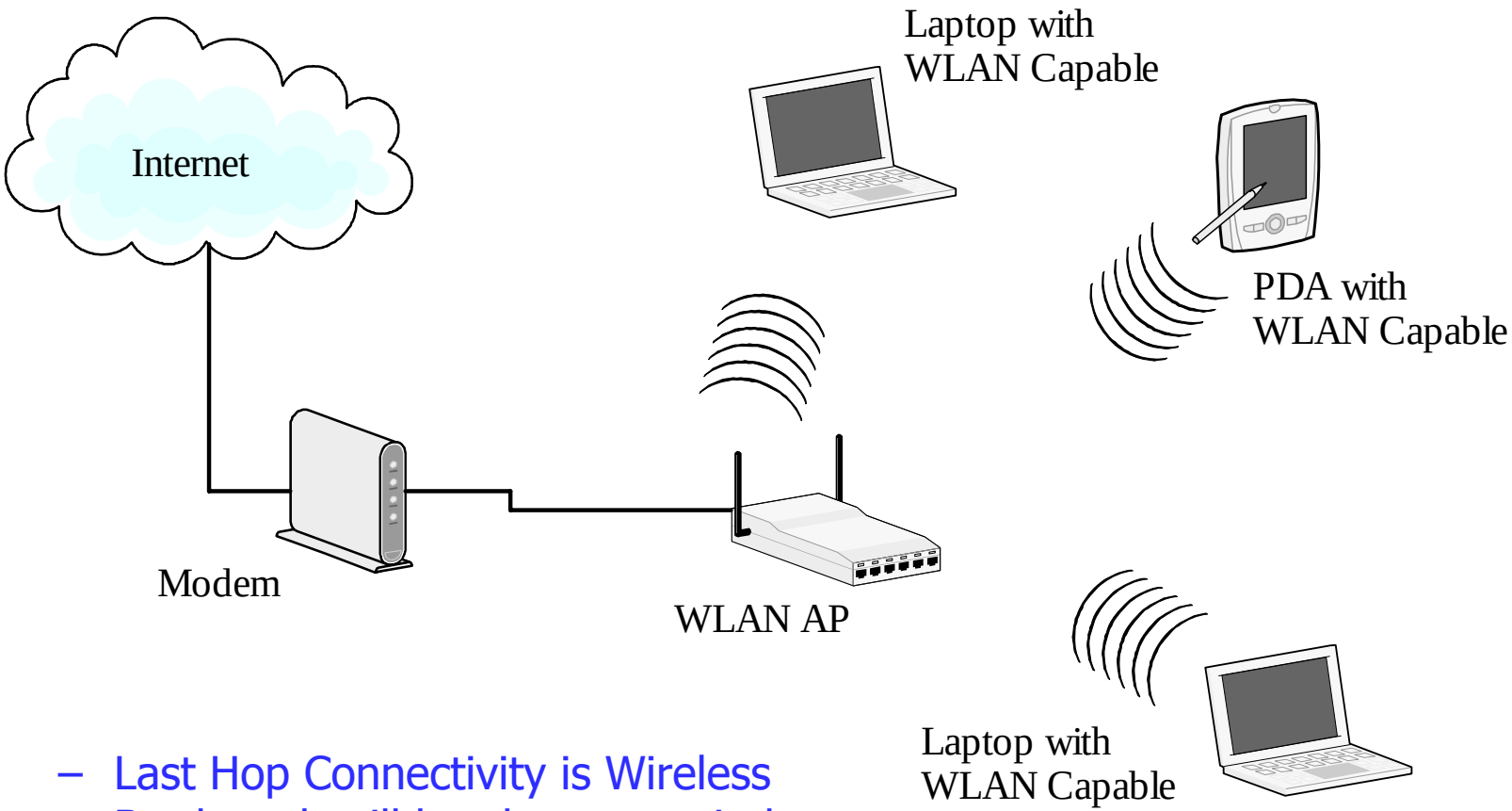
- Throughput & Delay Measurement Tools
  - Ping
  - Traceroute
  - **Iperf**
  - Thrulay
- Path Characterization & Bandwidth Estimation
  - pathChirp
  - Pathload
  - ABwE
  - Netperf
  - Nettest

Iperf



- **Modes**
  - **TCP**
  - **UDP**
- **Components**
  - **Server**
  - **Client**

Wireless LAN



- Last Hop Connectivity is Wireless
- Bottleneck will be always at wireless

- What are the Network Parameters that make major effects ?
- How it is effecting ?

Performance Measurement in WLAN

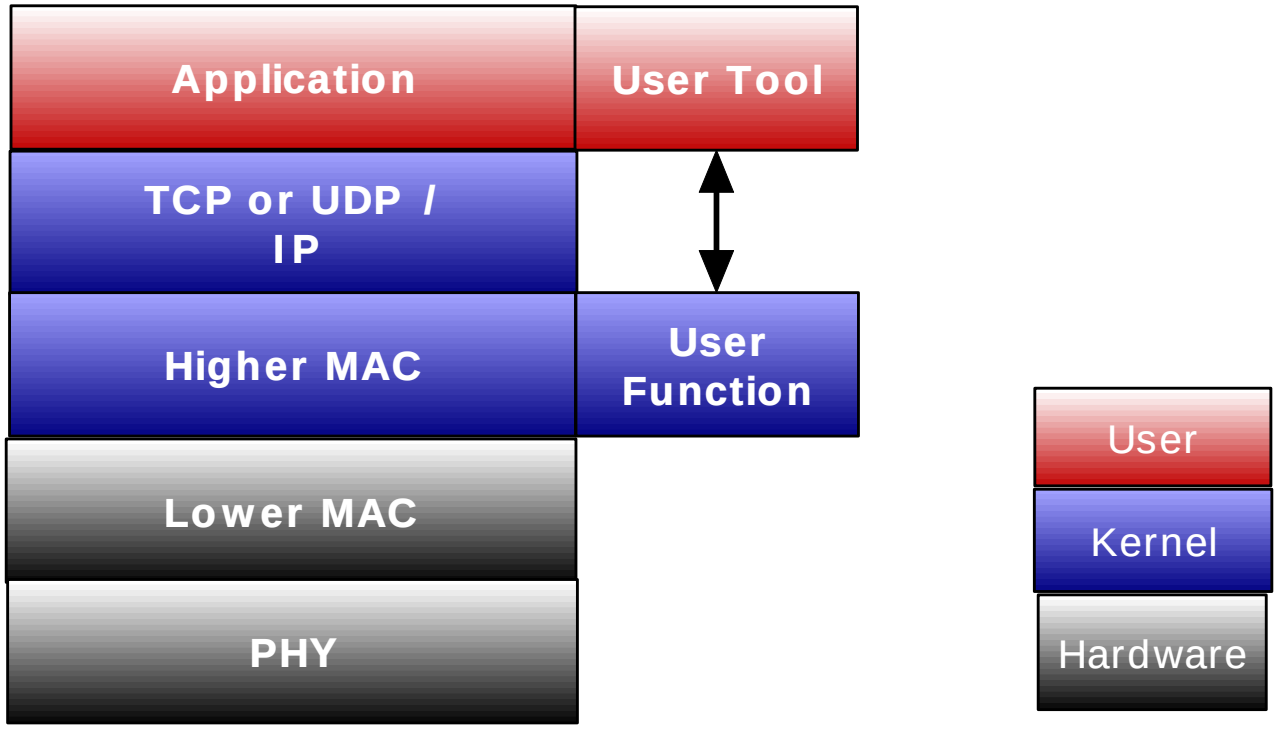
PHY Layer

- Received Signal Power
- Signal To Noise Ratio
- Bit Error Rate
- Throughput
- Interference

MAC Layer

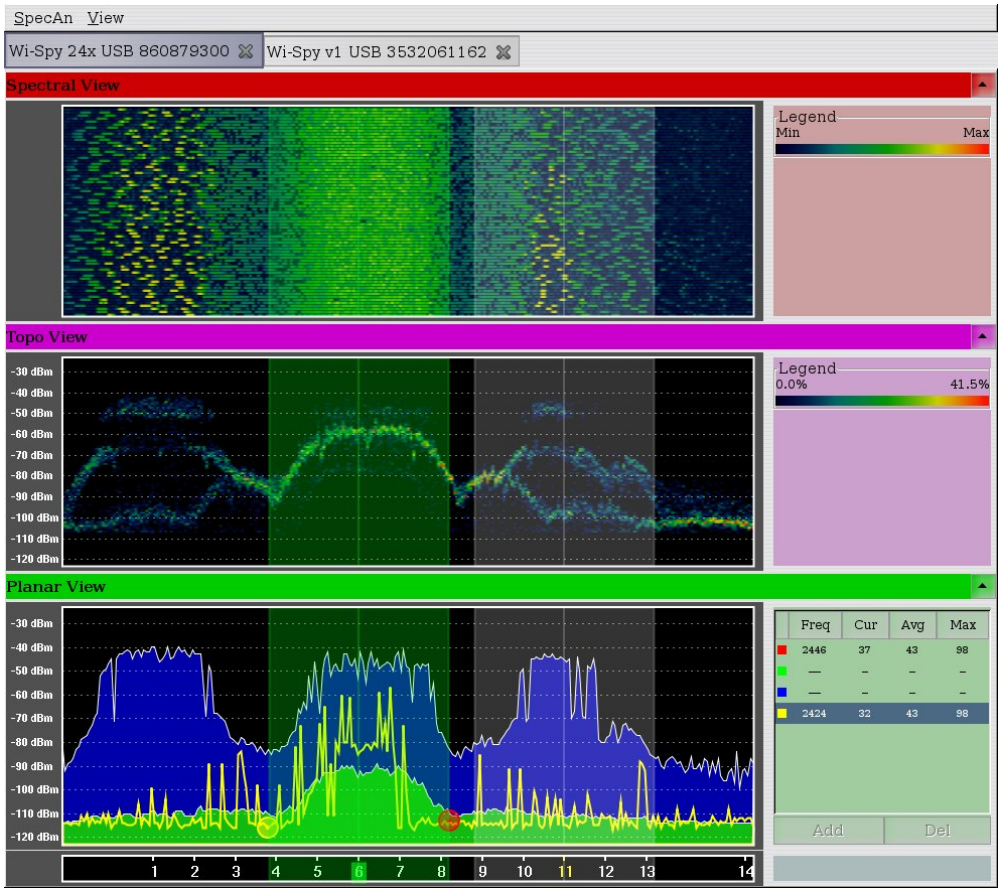
- Throughput
- Retries
- Received Data Rate
- Queuing Delay
- Packet Error Rate
- Power Consumption

WLAN PHY / MAC Measurement



- Using MAC Packet injecting / and process Tools
  - Approximate PHY and MAC Parameters can be Measured
  - Depend on the implementation of hardware
- Tools like libmac, netlib 80211b injecting etc.

WLAN Phy Signal Measurement



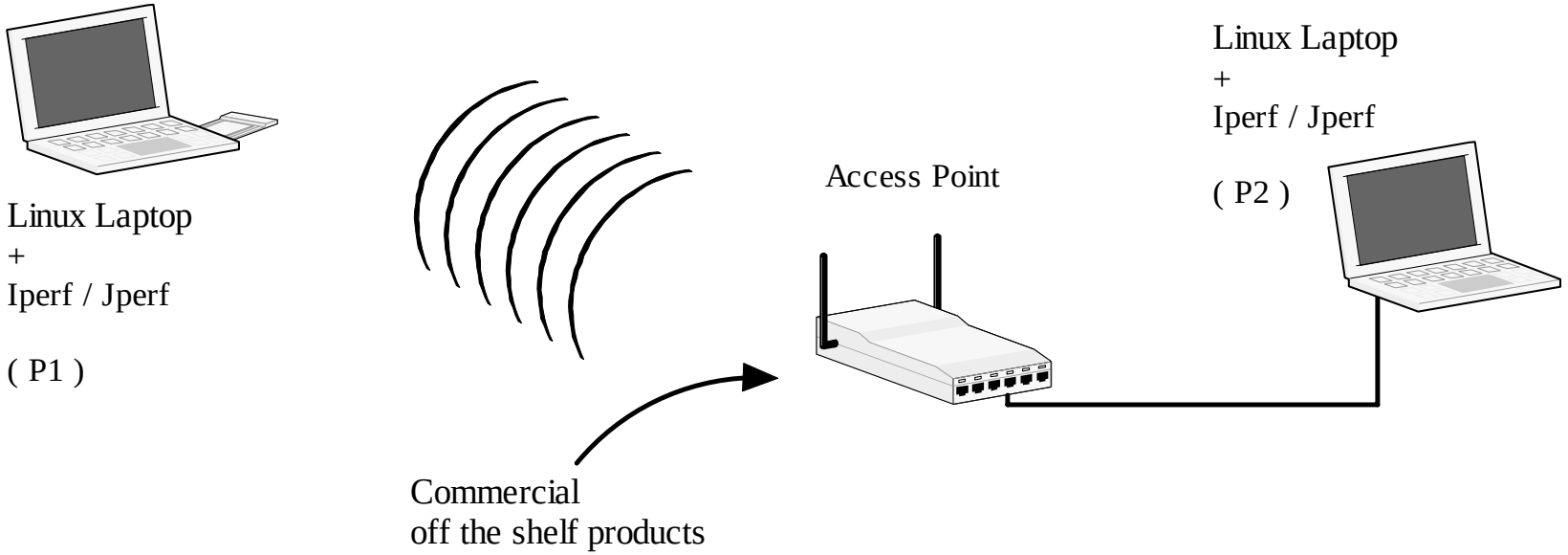
Courtesy : Kismet

- Wispy + Spectool-GTK (Kismet)
- Information from lower layer (Modified driver)

WLAN Higher Layer Measurement

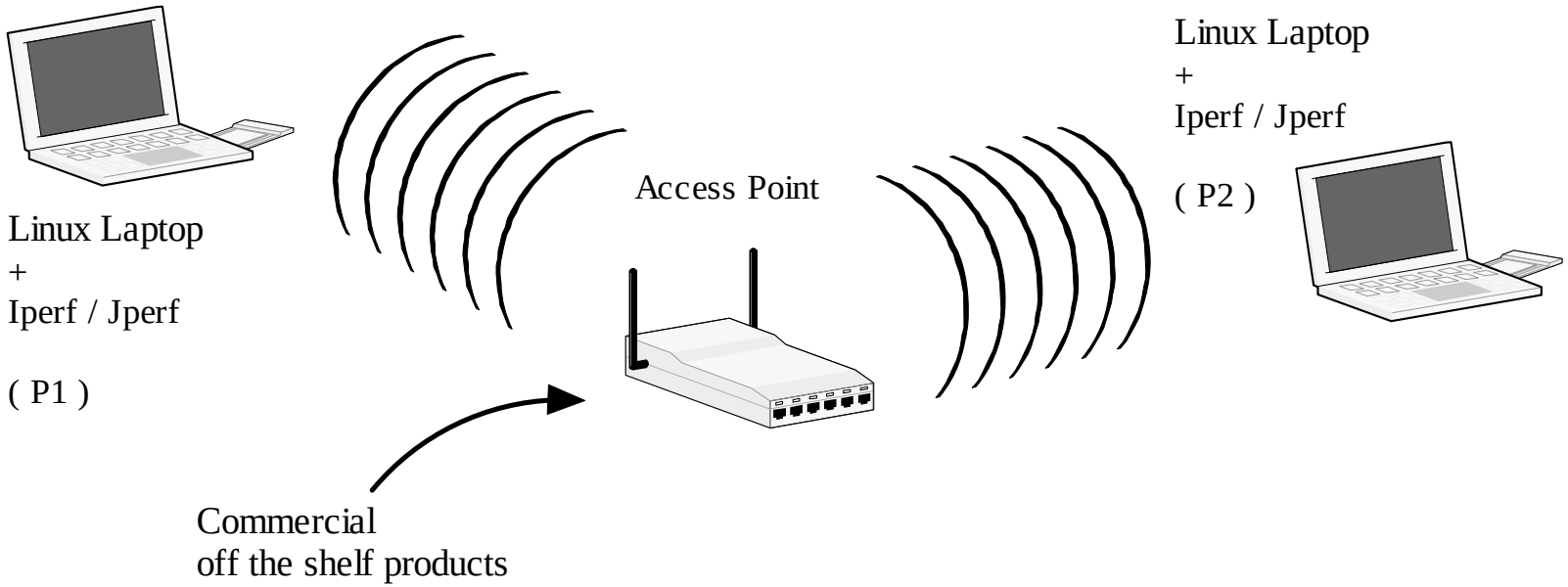
- This is as similar as the normal wired network
- Then what is the difference ?
- Parameters
  - Jitter
  - Throughput
  - Distance
    - Propagation delay taken as parameter in design

Performance Measurement in WLAN



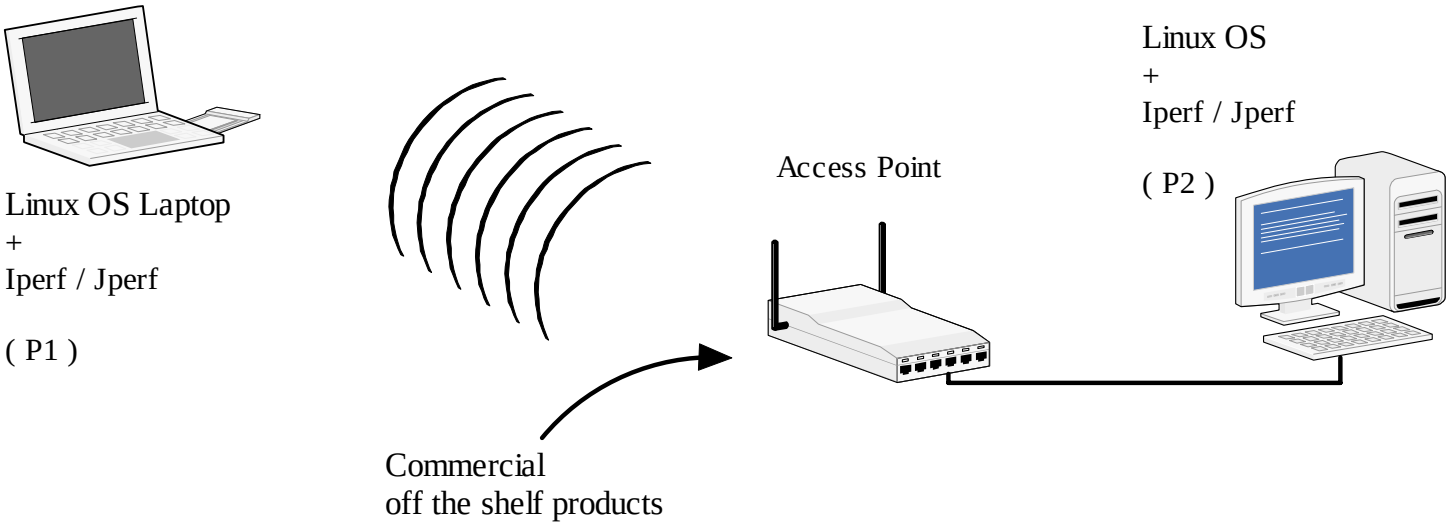
- Performance Measurement
  - P1 in Wireless and P2 in Wired Network

Performance Measurement in WLAN



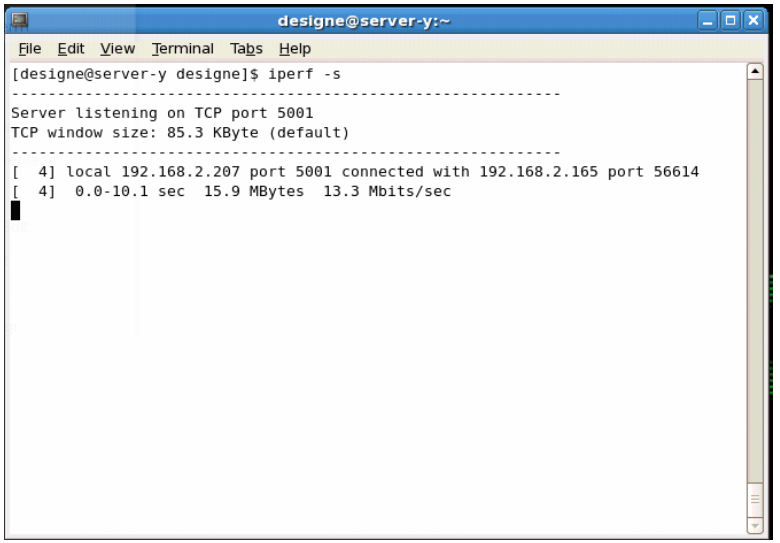
- Performance Measurement
  - P1 in Wireless and P2 in Wired Network
  - Both P1 and P2 in Wireless

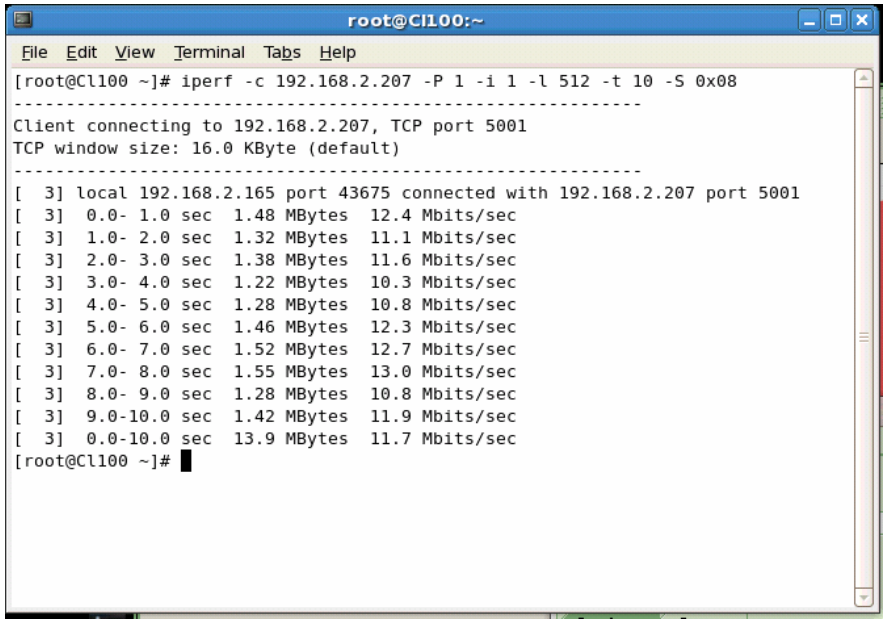
Test Setup



“Iperf –c <host>” Iperf -c 192.168.2.73	“Iperf -s -D > iperfLog ” Iperf -s -D /var/log/iperfLog
-p <num_streams> test with parallel TCP streams -w <buffer_size> set socket buffer size	Iperf can run as a daemon

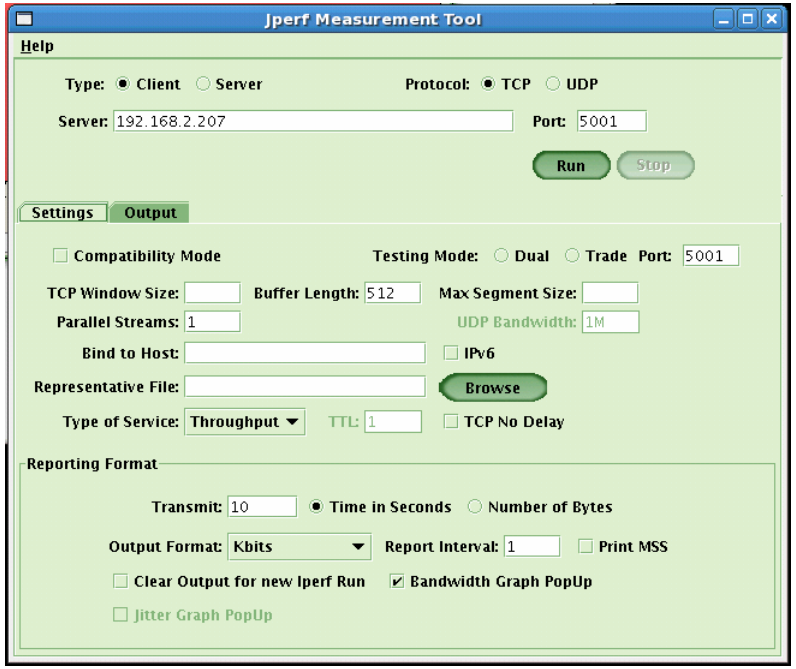
Server





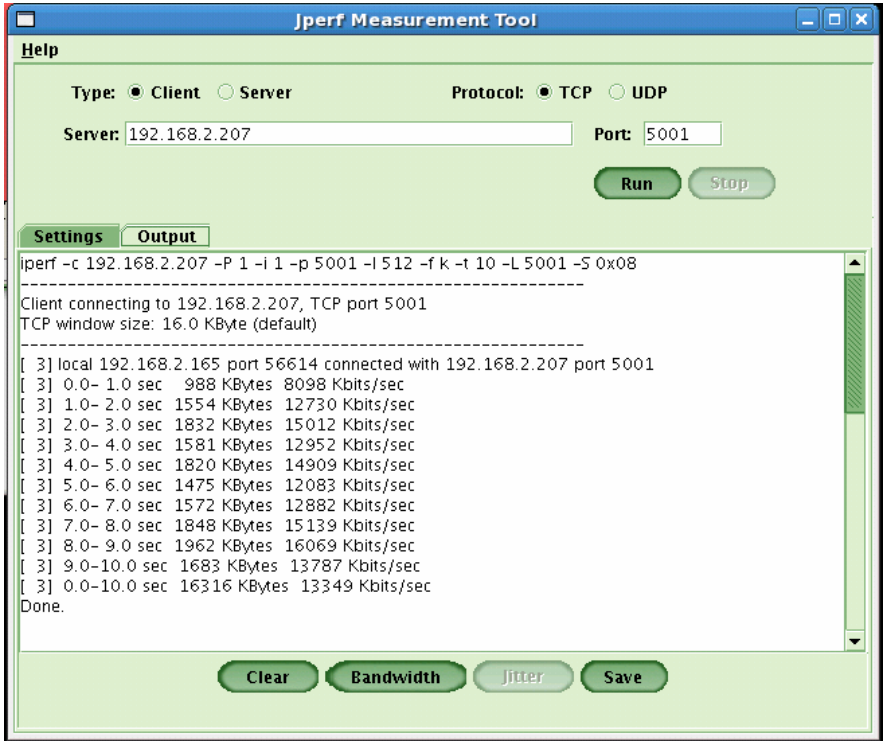
Client

Jperf (GUI for Iperf)

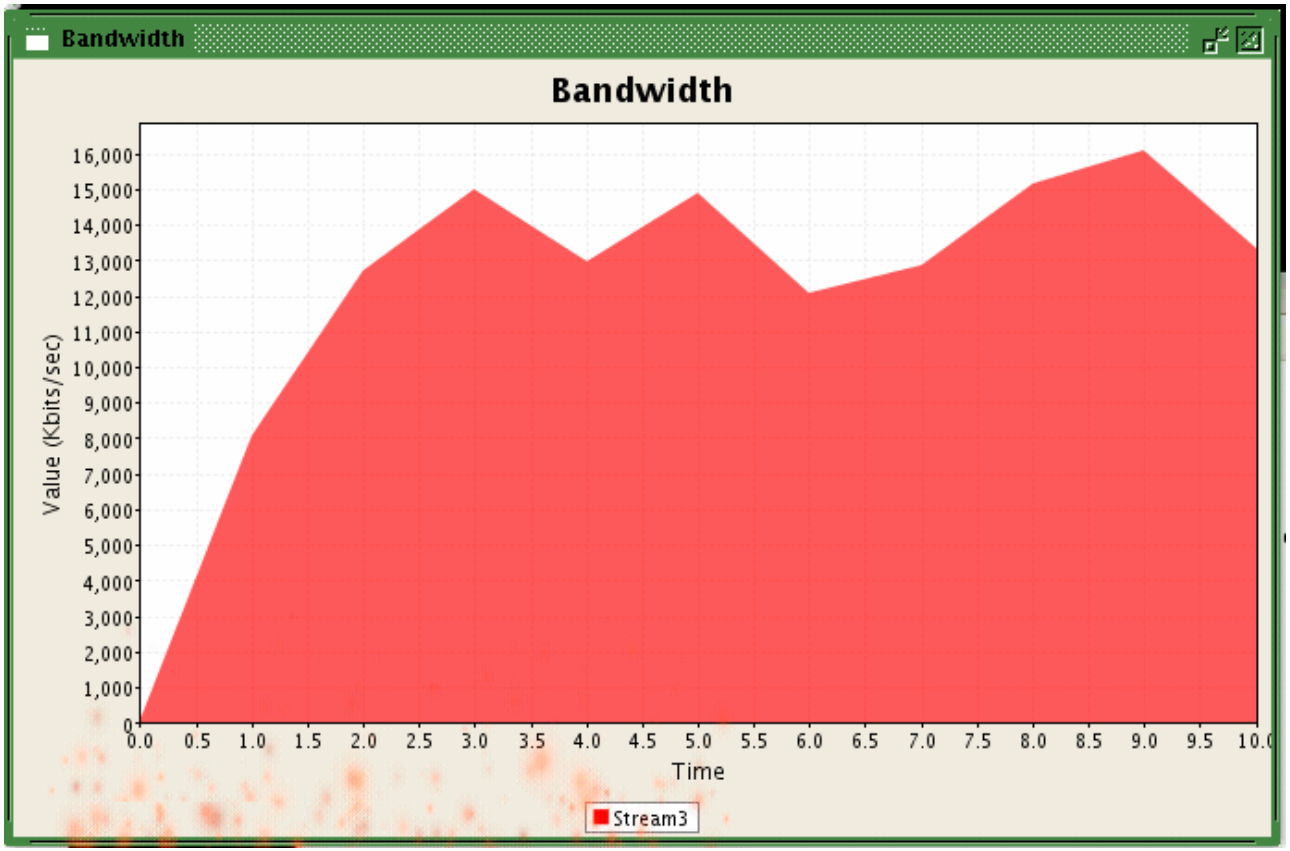


Test Settings

Test output



Bandwidth Graph

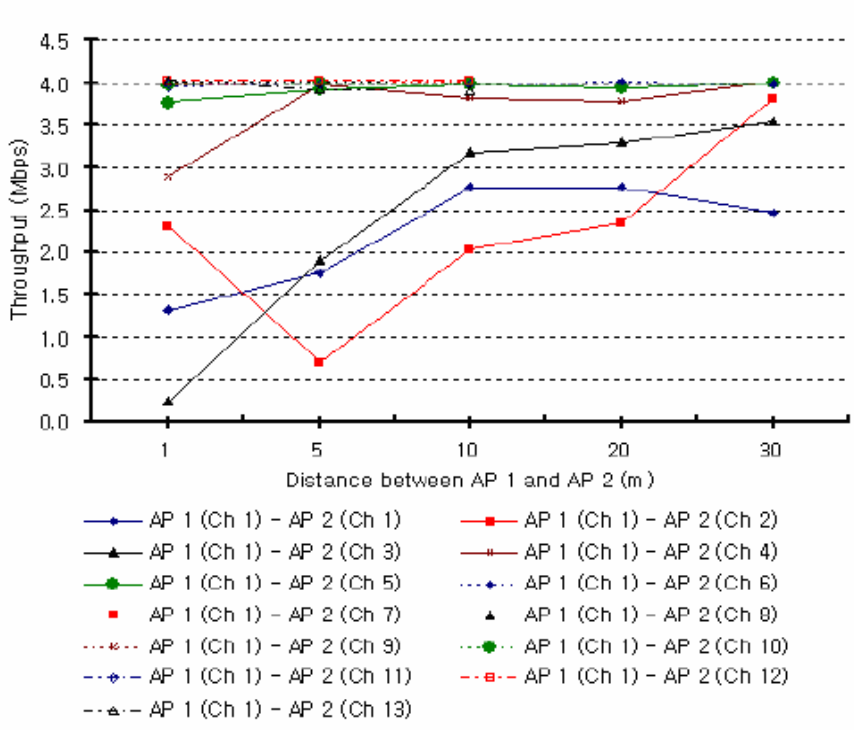


TCP Throughput for 512 bytes

Effect of these Metrics

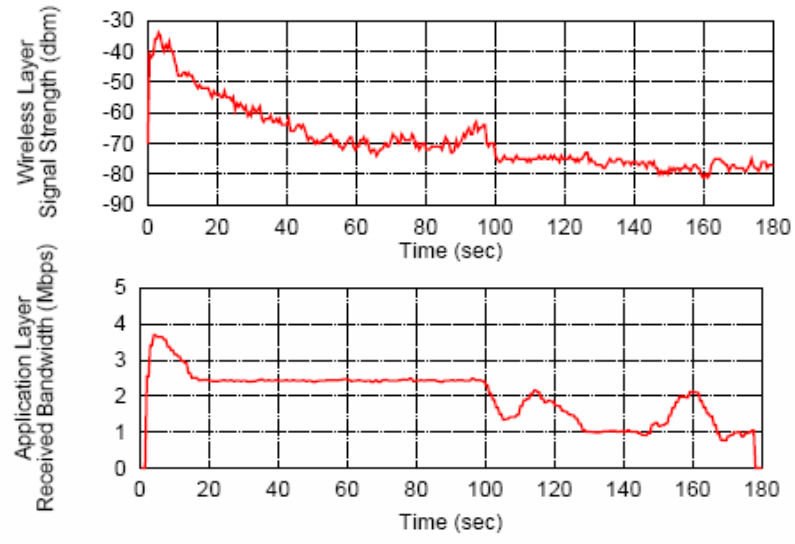
- Major parameters effecting the WLAN
  - PHY
    - Interference
    - RSSI
    - SNR
    - Data Rate
  - MAC
    - Queuing Delay
    - Packet Loss / Errors
    - Available Bandwidth (Throughput)
  - IP
    - Delay Variation (Jitter)
    - Available Bandwidth (Throughput)

Channel Interference



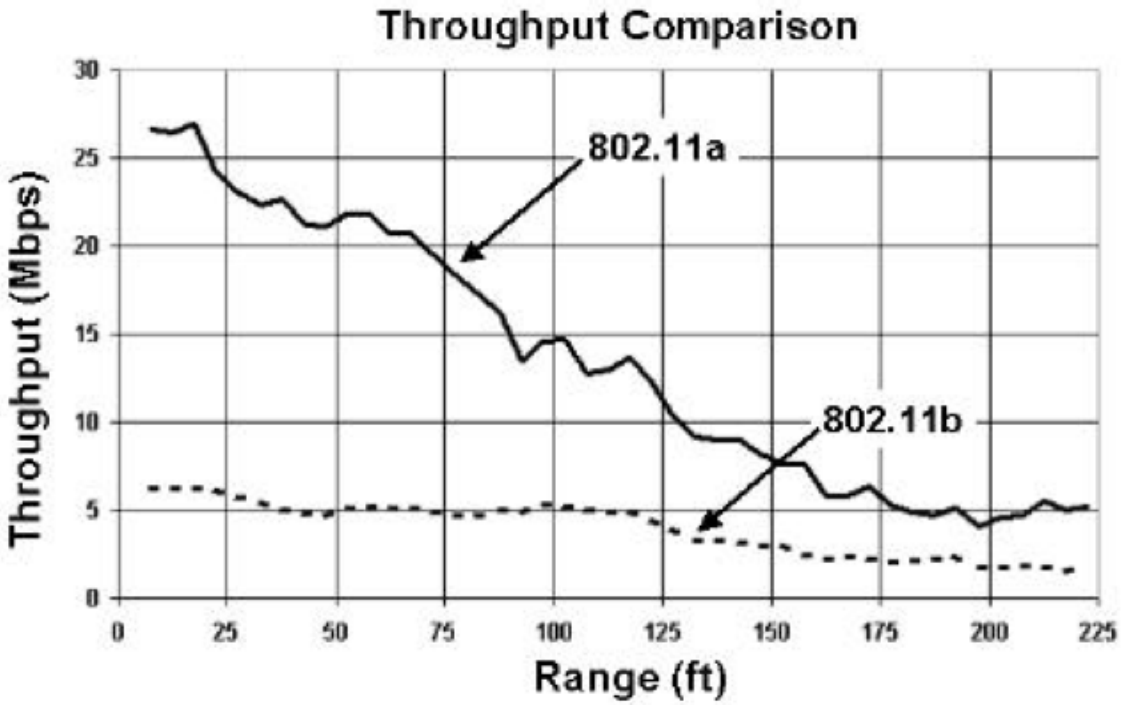
Courtesy : [3]

Signal Strength Vs Received Rate



Courtesy : [2]

Distance Vs Throughput



Courtesy : Atheros

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Thank You

Questions ?

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