Bandwidth Estimation over WLANs
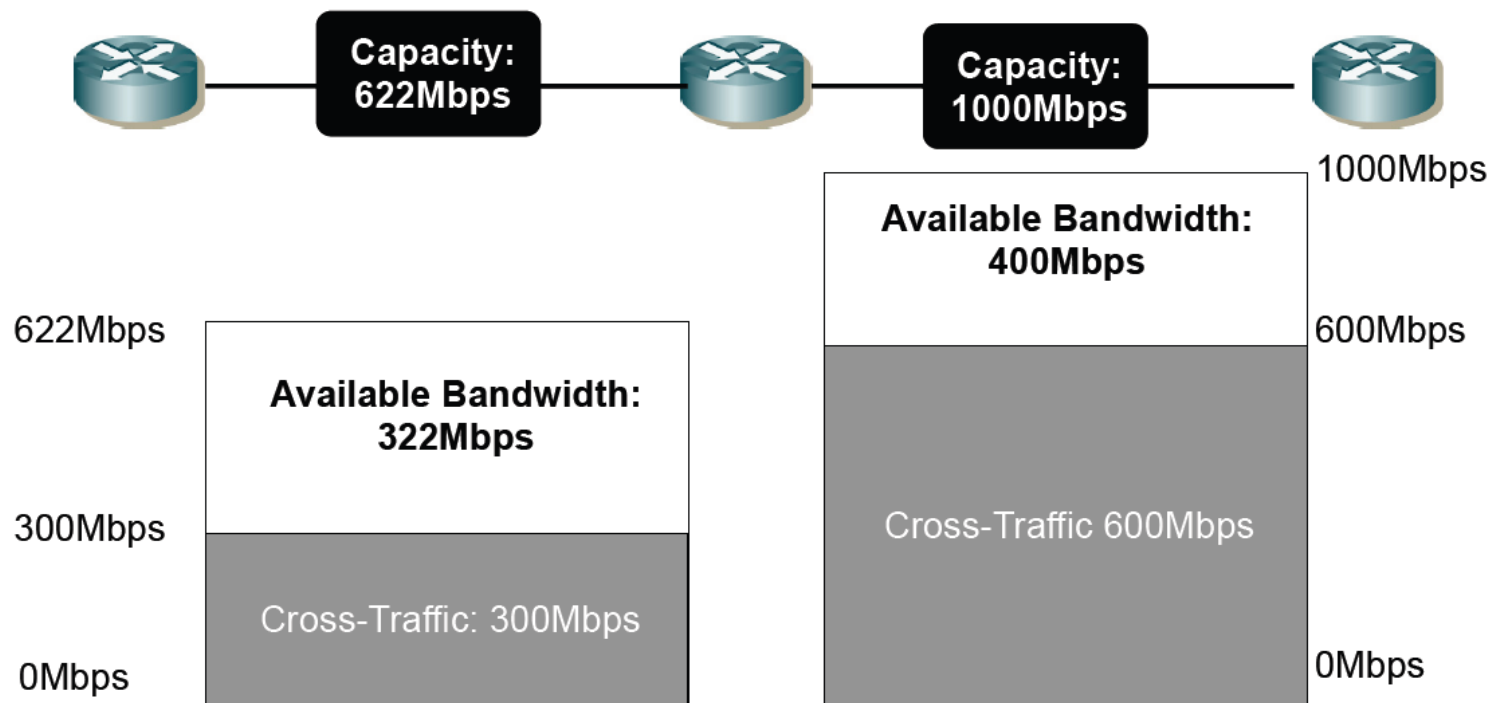
Albert Cabellos-Aparicio

acabello@ac.upc.edu

Workshop on Video Streaming over MANETs
Barcelona 18-19th of December of 2008

What is the Available Bandwidth?

Available Bandwidth at the E2E Path: 322Mbps

What is the Available Bandwidth?

- The Available Bandwidth is the remaining capacity of a path = The amount of traffic that can be sent without congesting the path

$$A = \min \left[C_{i_{i=0\ldots H}} (1 - u_i) \right]$$

Applications of the Available Bandwidth

- Origins of bandwidth measurements are related to the development of congestion control algorithms e.g. - Keshav (89), Bolot (93), Jacobson (97) -

- Today used in
  - Routing protocols (e.g. WMN)
  - Transport protocols (e.g. TCP)
  - Applications (e.g. Windows Media Server)
  - Network diagnosis (e.g. Agilent Monitoring box)
  - …

# Overview of bandwidth estimation tools

- Black box view of the network
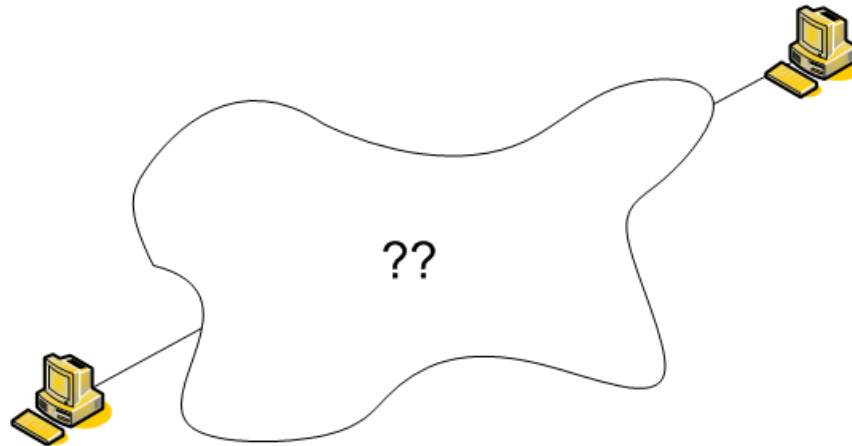
- Observations of the end-to-end evolution of probing packets
- Objective here: measurement of end-to-end bandwidth properties

Overview of bandwidth estimation tools

- Mostly existing tools are based on periodic probing processes
  - Accurate but intrusive
  - Fail applied to WLAN links[1]

Rate-Response Curve
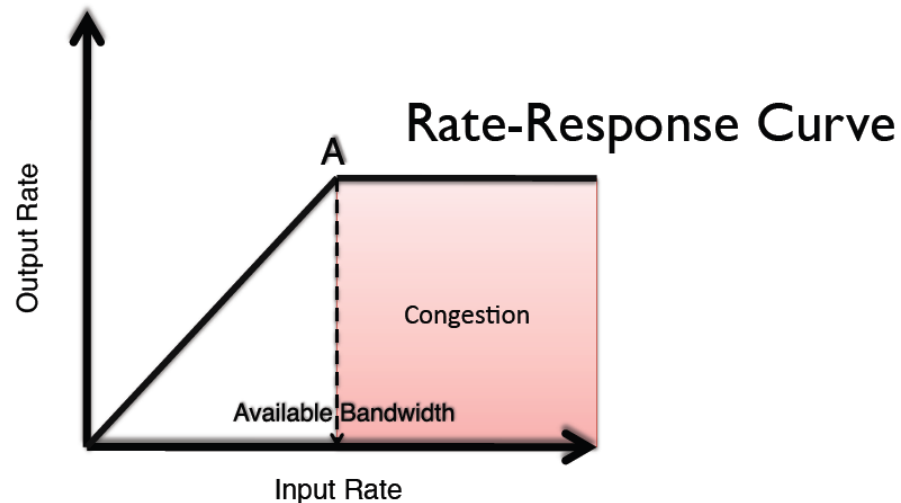
(1)Karthik Lakshminarayanan et al. "Bandwidth Estimation in Broadband Access Networks"
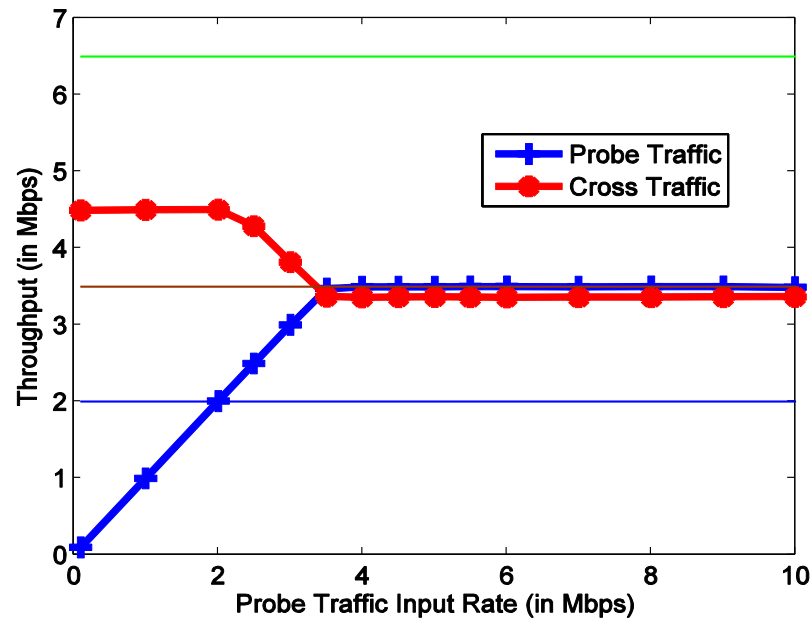ACM IMC 2004

Analysis

- Analysis of such processes measuring a IEEE 802.11 link:
  - Analytical Model (fluid and non-fluid assumption)
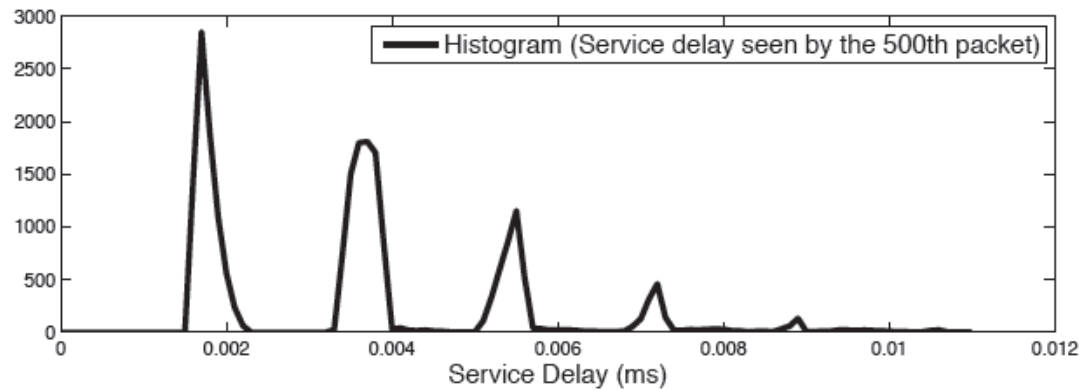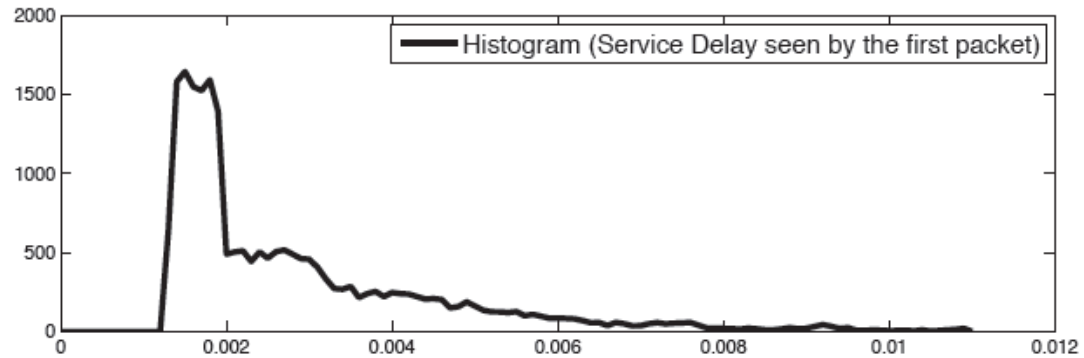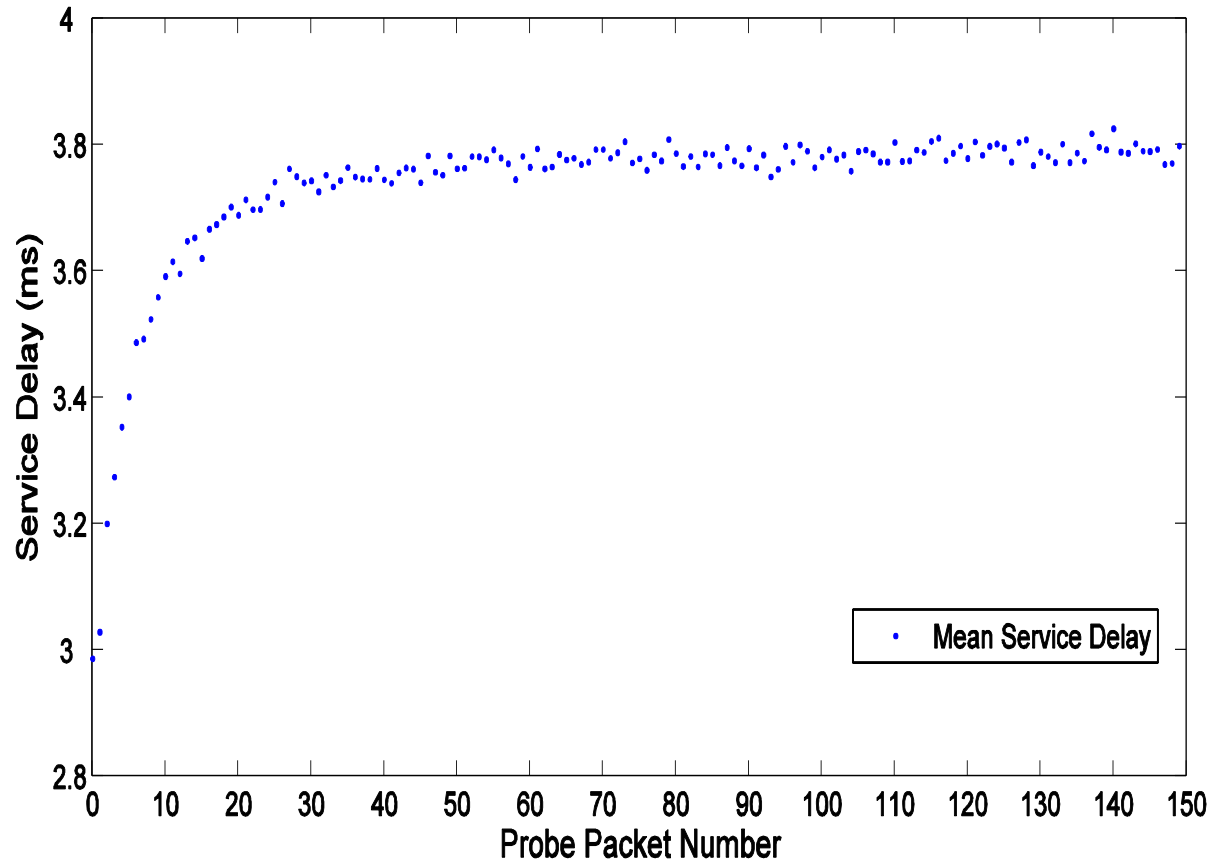 - Validation by simulation and experimentation
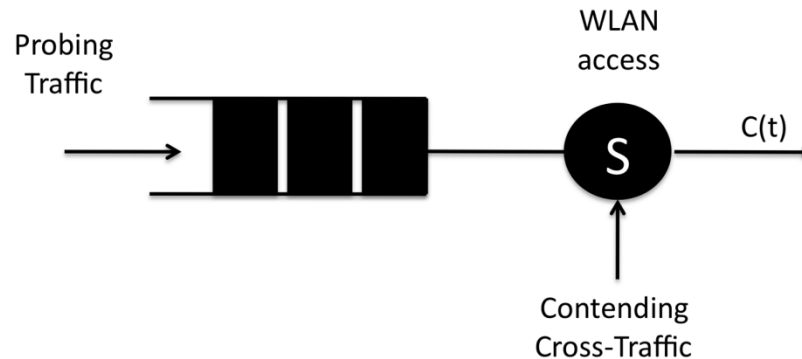
Fluid Analysis

- Existing methodologies and tools target the **achievable throughput rather than** the **available bandwidth**
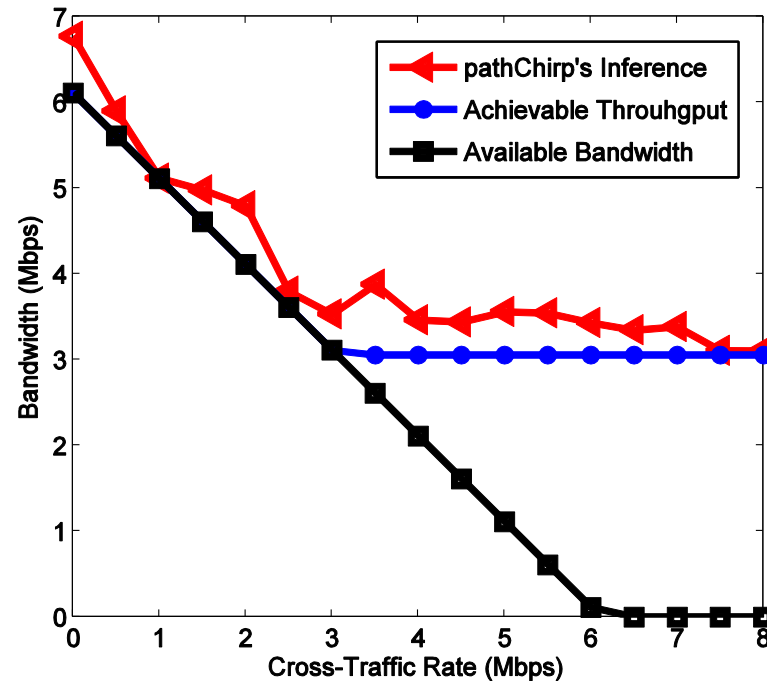
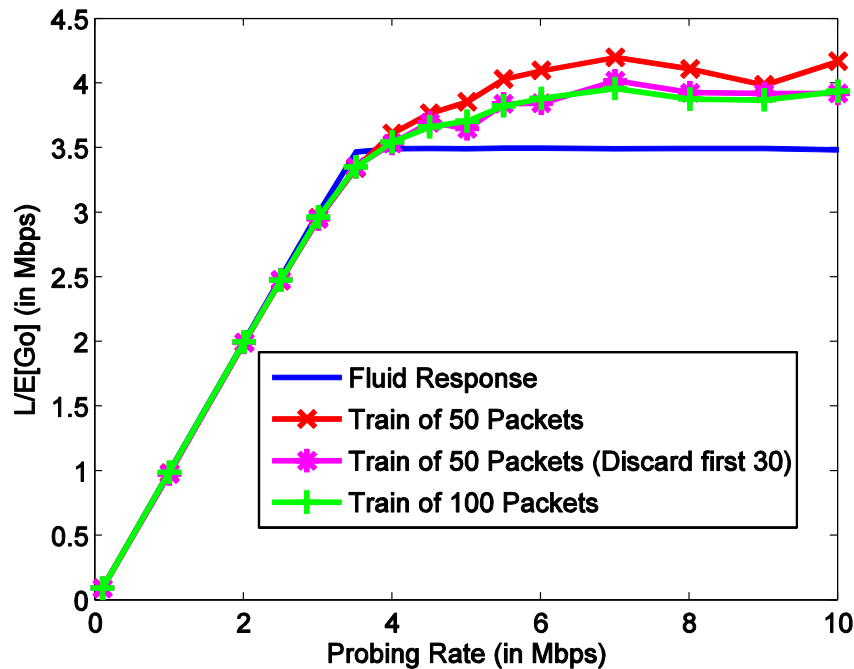# Non-fluid analysis

Non-fluid Analyisis

Consequences

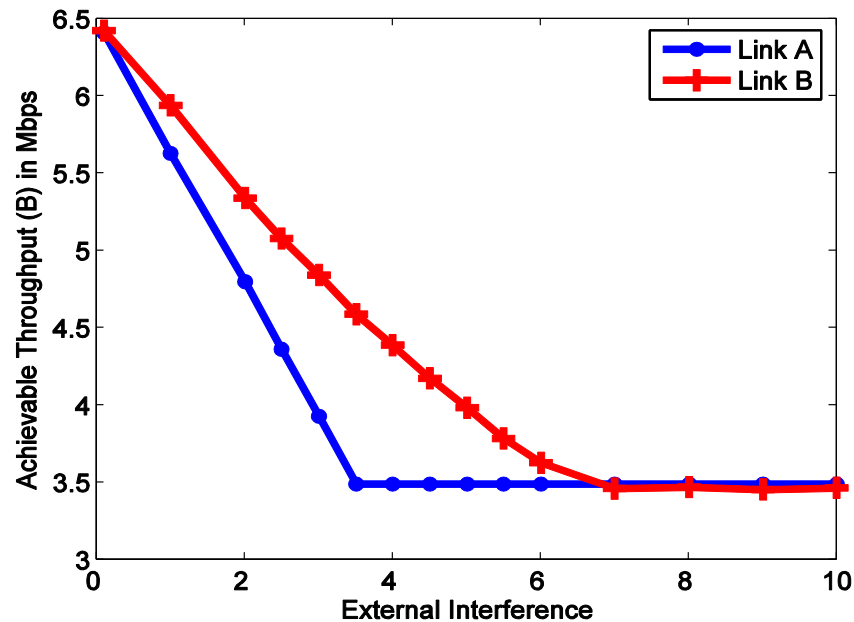- Existing methodologies target the achievable throughput

Consequences

- Existing methodologies over-estimate the achievable throughput
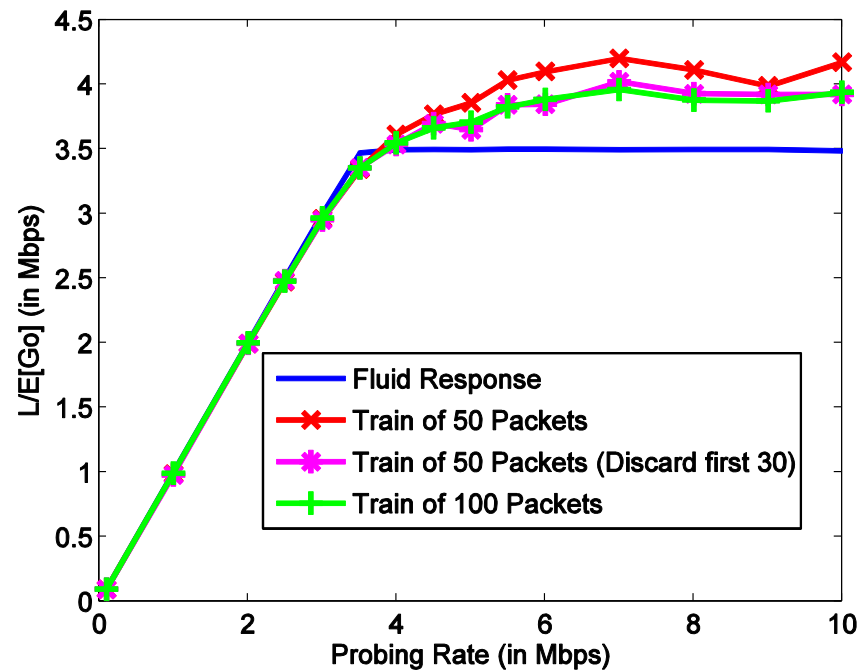
Consequences

- Optimization of routing metrics in WMN
- Dispersion of Packet Pairs (back-to-back) is affected by passing traffic
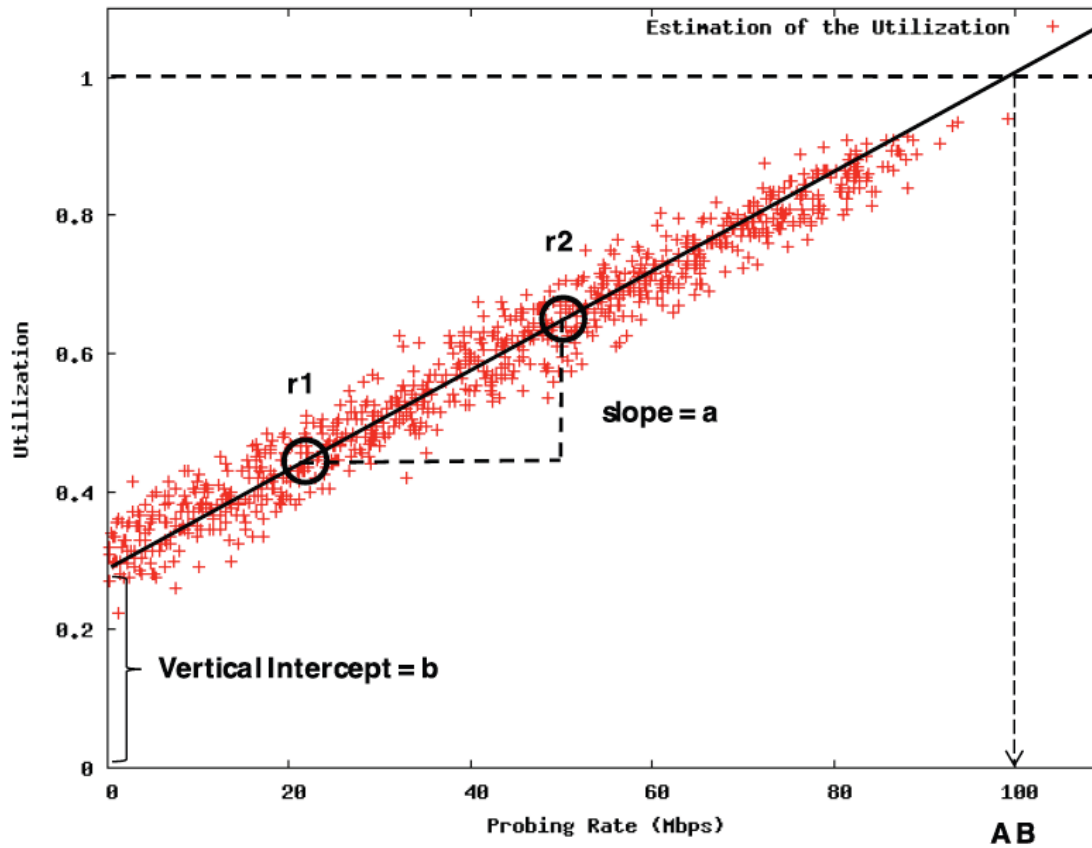
Consequences

- Simple mechanism to remove the bias

How we can estimate the Available Bandwidth in WLAN links?

- Explore poisson probing processes
  - Show an exploitable linear relation
  - Can be used to estimate the available bandwidth in wireless networks
- As accurate as periodic-based tools
- Ligth tools

Poisson Probing

Summary

- The Available Bandwidth is an interesting metrics with many applications
- Existing methodologies operating over WLAN links:
  - Infer the achievable throughput
  - Bias → Over-estimation
  - Packet Pairs target the achievable throughput (over-estimation) not the capacity
    - Affected by existing traffic