

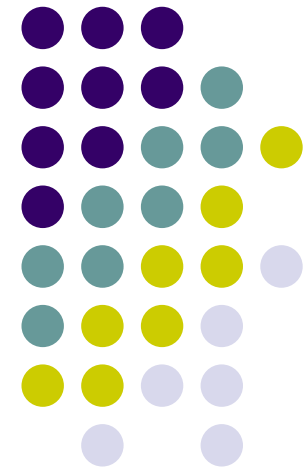
Measuring TCP over WiFi: A Real Case

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Rationale

- Evaluate the performance of TCP connections in a 802.11b WiFi Network
- Focus on the relation between TCP parameters and perceived throughput
 - Congestion Window size
 - Retransmitted segments
 - Round Trip Time



Tools

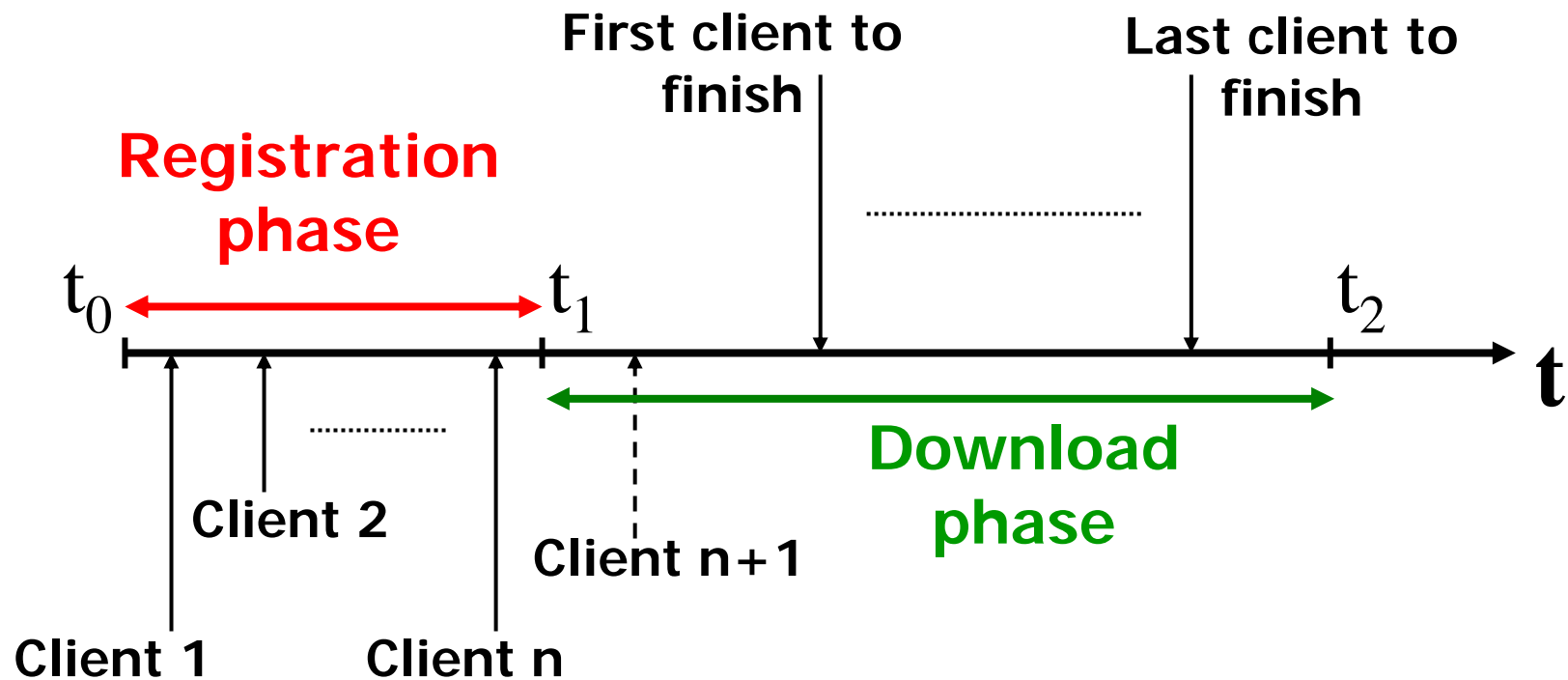
- Synthetic TCP traffic generator (**GenTraGen**) developed to load the network with controlled traffic
 - Client-Server architecture
 - Clients (*slaves*) require transfers according to the server specifications
 - The server (*master*) transfers bulk data to the clients
- **Tstat** used to measure TCP level traffic performance

Generated synthetic traffic



- Clients generate traffic in subsequent *cycles*
- Each cycle consists of two different phases:
 - **Registration phase.** Clients are allowed to reserve their participation to the next download phase
 - **Download phase.** Each previously registered client alternates the following actions: request for a file, download, wait for a while

Generated synthetic traffic





Traffic Profile

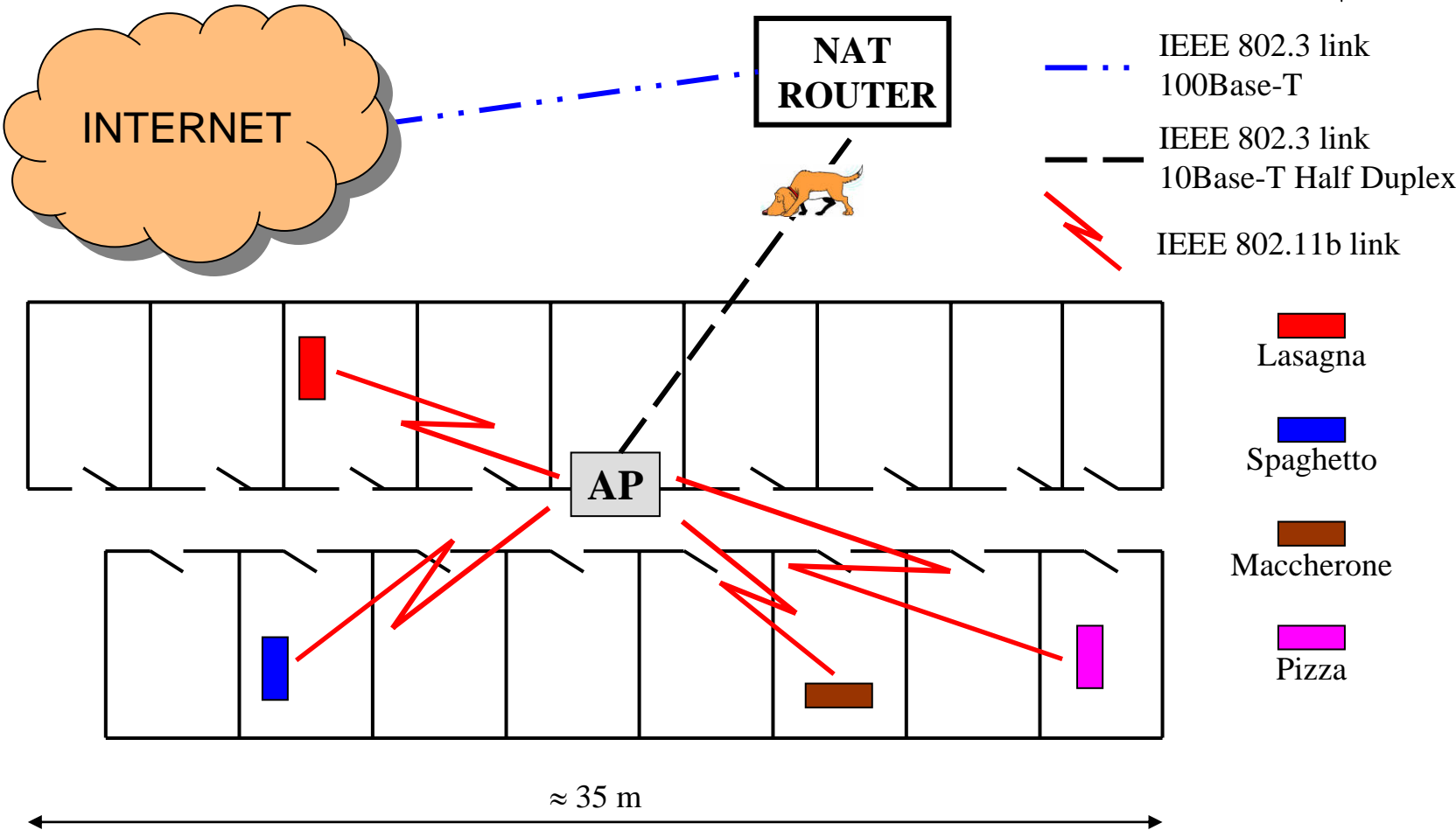
- The nature of client-server interaction is described in a *traffic profile file* the clients get from the server during the registration phase
- The traffic profile file contains informations about:
 - *Trials*: the number of file requests the client will send
 - *Datasize*: file size extracted according to a given pdf
 - *Offtime*: idle time between two file transfers extracted according to a given pdf



Network Setup

- Departmental 802.11b WLAN
 - Four laptops located in various offices, one Access Point
 - WEP encryption and MAC filtering
 - RTS/CTS disabled
 - Homogeneous laptop configuration
 - Orinoco Silver PCMCIA cards
 - Knoppix 3.3 O.S (Linux 2.4.24 Live-CD)
 - Linux-based NAT/Router for Internet access

Network Setup



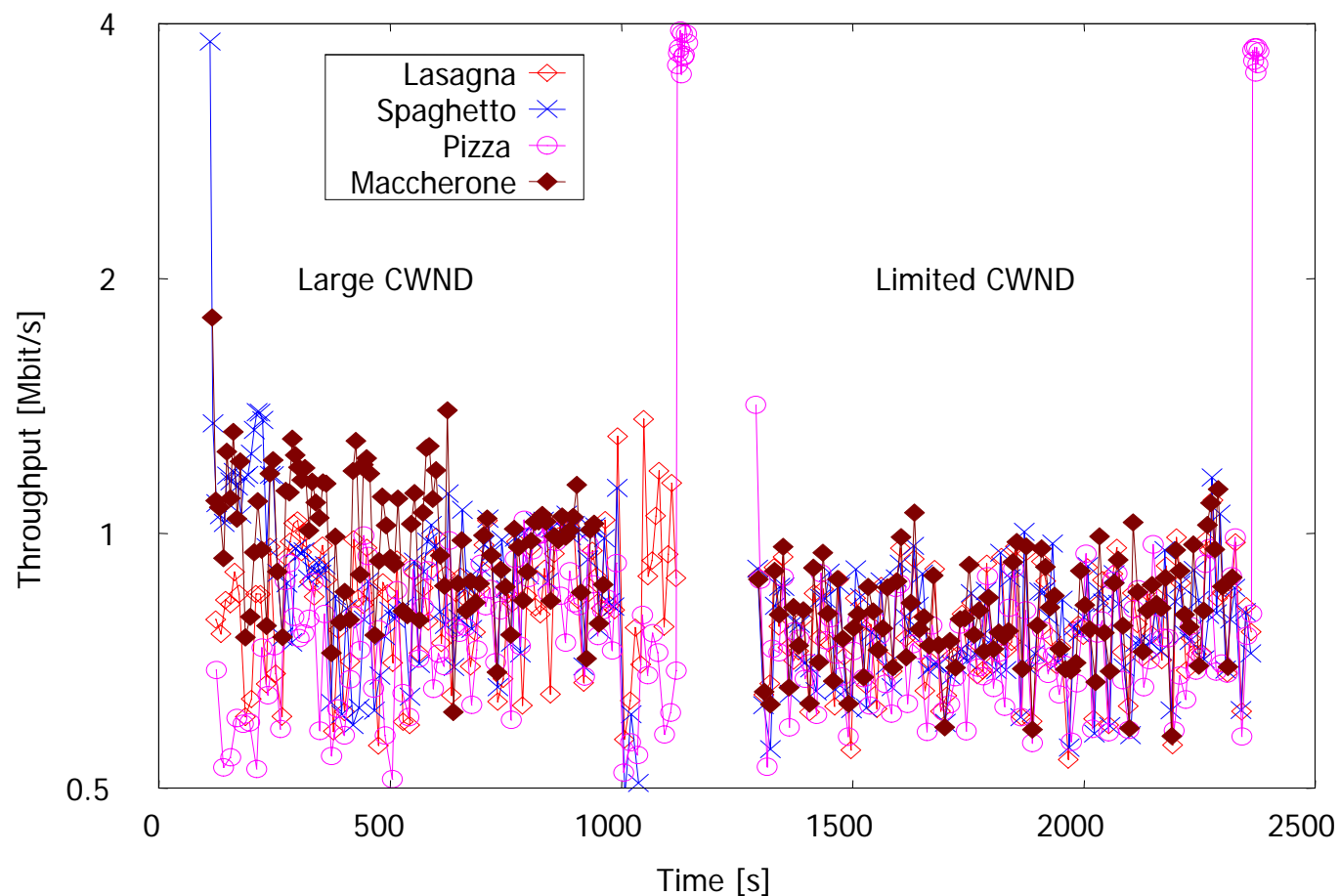


Results

- 100 consecutive transfers of 1Mbyte files
- **Downlink** scenario
 - Clients running on the laptops
 - Server on the NAT/Router
- **Uplink** scenario
- Uplink with RTS/CTS enabled
- Uplink with locked transmission rate

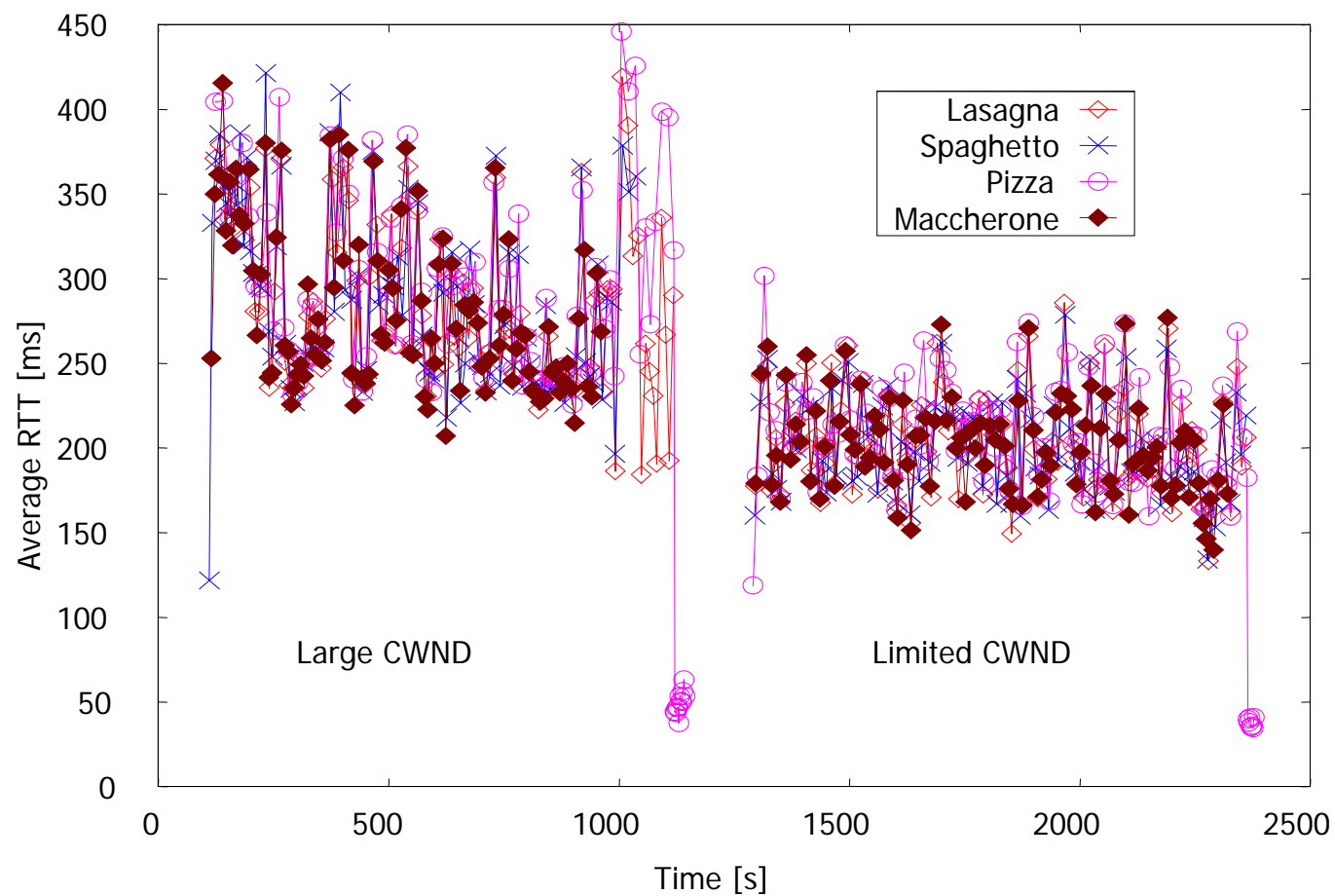


Downlink: TCP variance

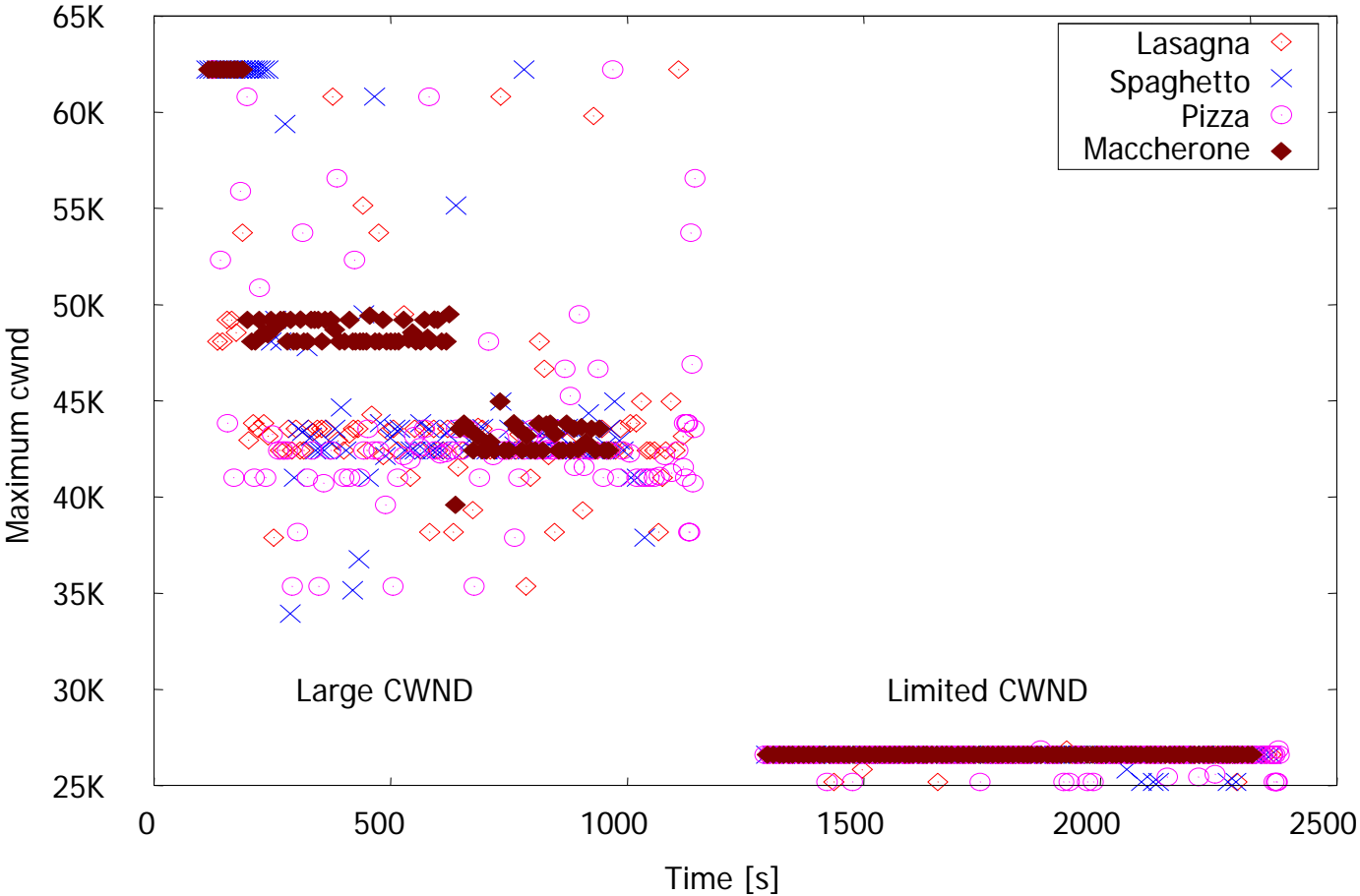




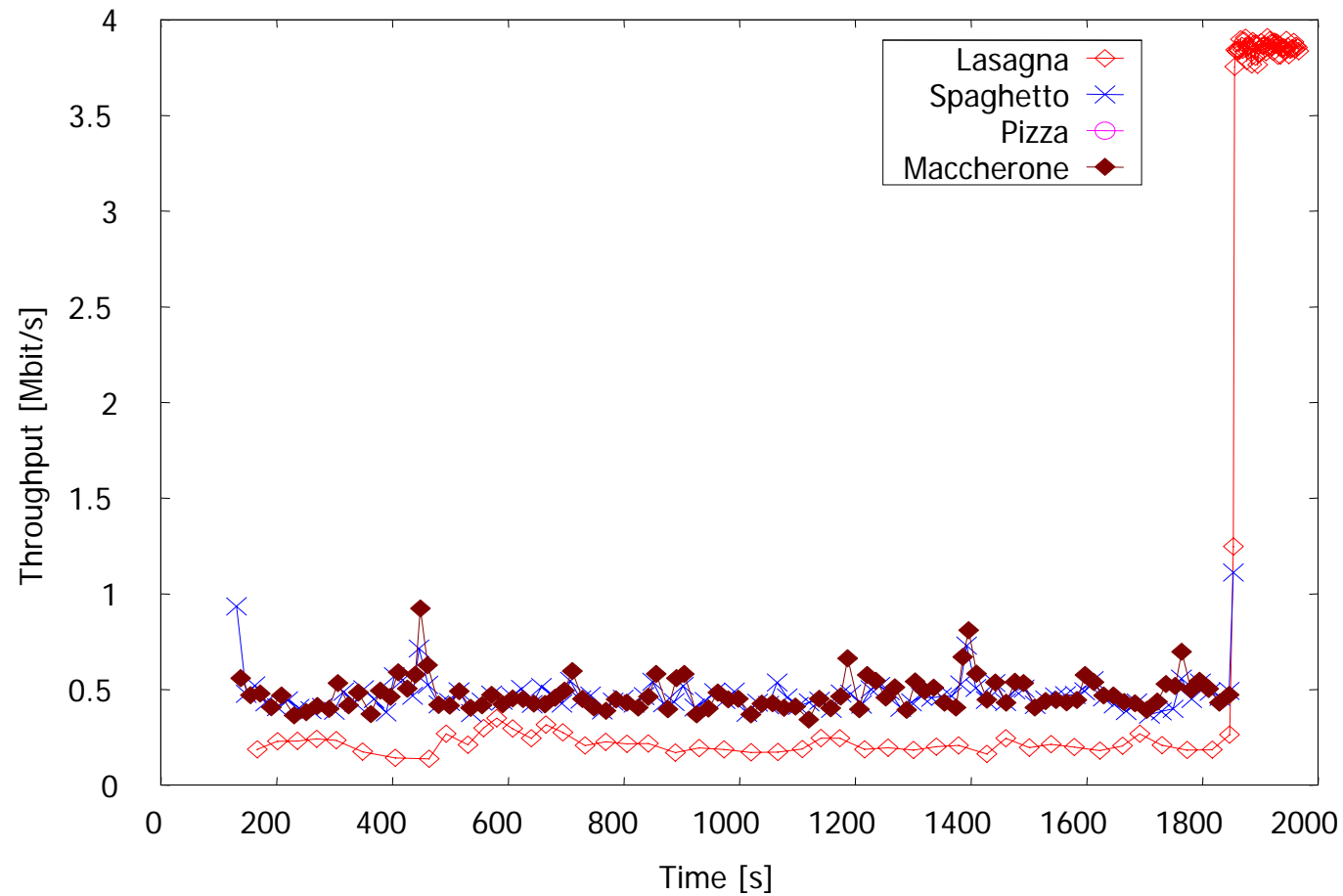
Downlink: TCP variance



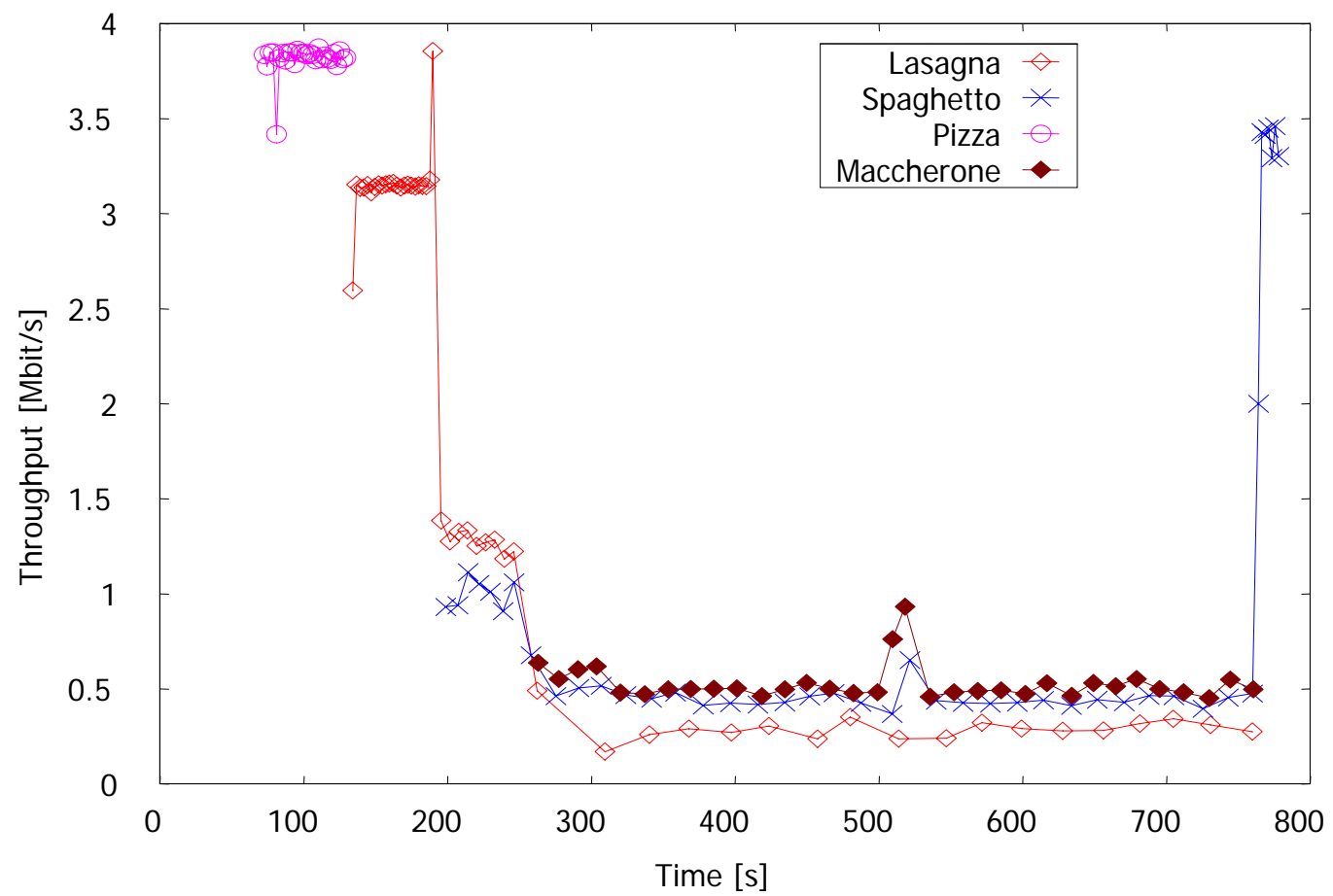
Downlink: TCP variance



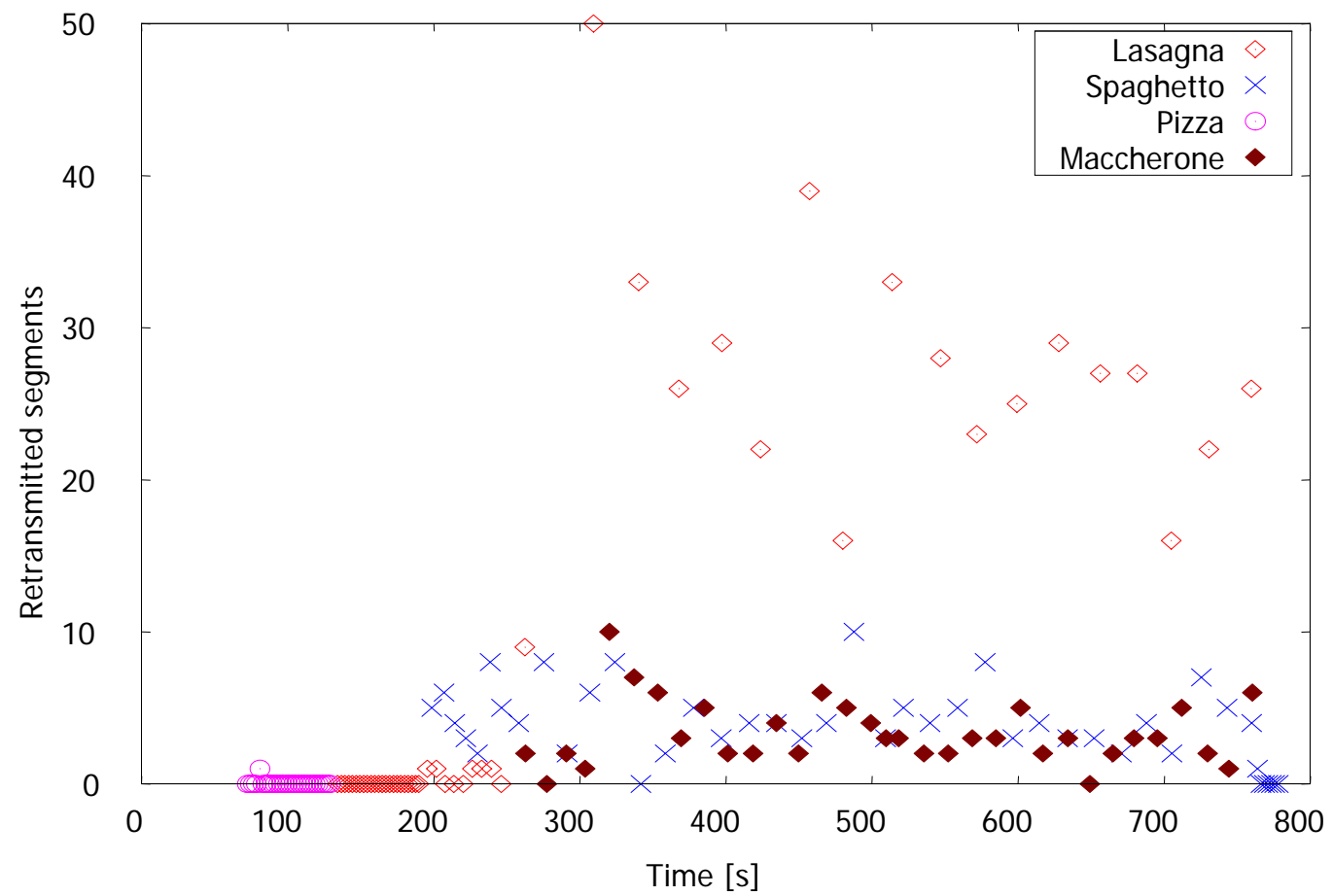
Uplink: Unfairness



Uplink: Unfairness



Uplink: Unfairness





Conclusions

- Downlink: TCP max congestion window can be properly set to reduce variance and unfairness
- Uplink: Joint effect of MAC and radio channel conditions induces serious unfairness
- Despite higher overhead, RTS/CTS improves throughput by reducing TCP losses
- Future work: UDP traffic, correlation between TCP and Link Layer performance