# Measurement and Analysis of Modern Web Traffic and Network Protocols

## HTTP/2 traffic characterization and classification

### Motivation

- Understanding modern web traffic
- Building traffic models for benchmarking and simulations
- Network management and provisioning
- Track the adoption of HTTP/2

### Challenges

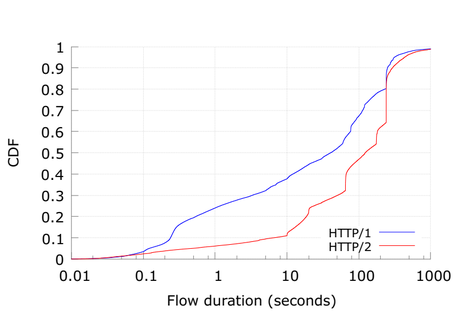
- DPI methods are expensive
- Prevalence of encryption

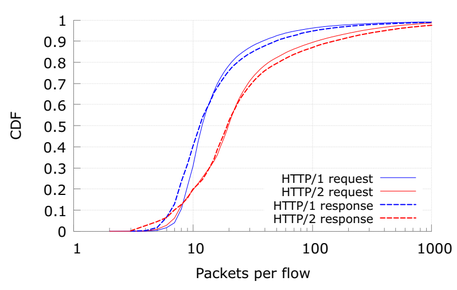
### State-of-the-art

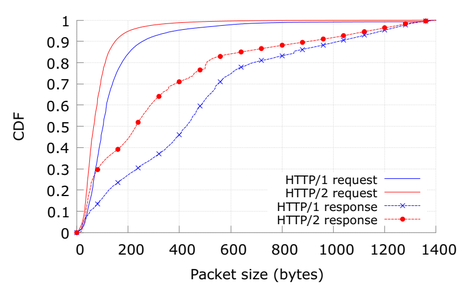
- Active probing

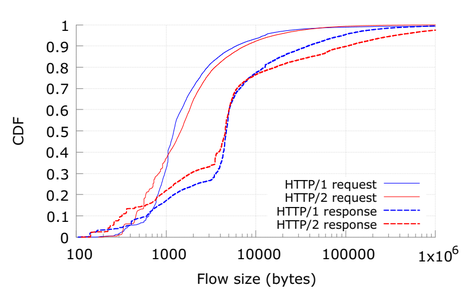
### Proposed Solution

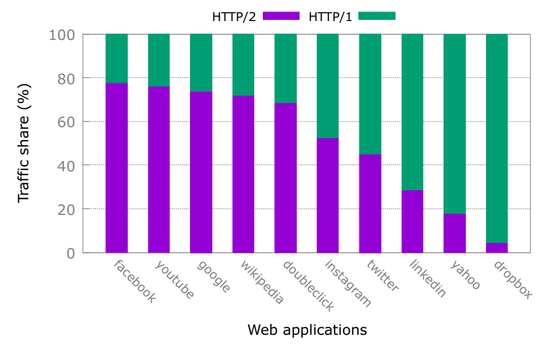
- Flow-based classification method
- Machine learning using passive measurements



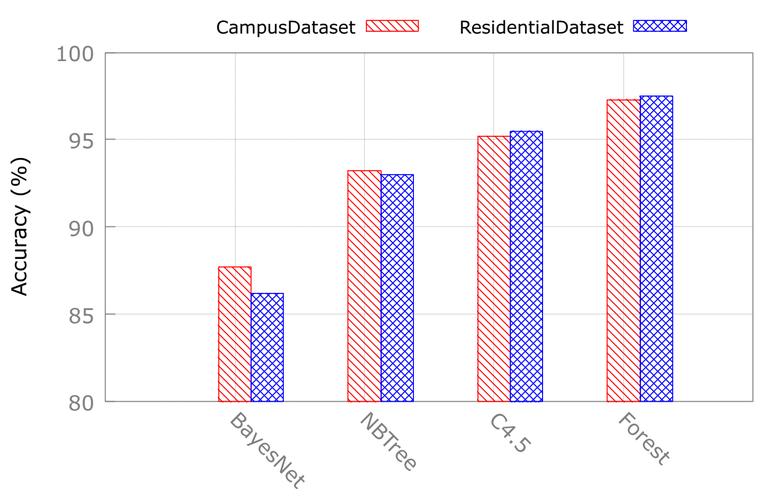



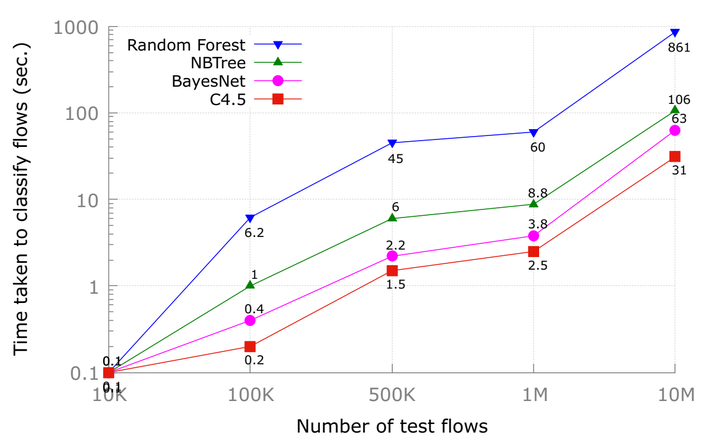




**Findings** On average, HTTP/2 flows are more than 30% longer, carry more packets and have smaller packet size than HTTP/1. HTTP/2 is dominant in popular web applications

## Flow-based classification

- Features: Number of client bytes, server bytes, client packets, server packets, average client bytes per packet, average server bytes per packet, flow duration.




| Period(2016) | Test Instances | Accuracy(%) |
|---|---|---|
| Jun | 800K | 95.8 |
| Jul | 700K | 94.8 |
| Aug | 400K | 95.9 |
| Sep | 1.5M | 95.5 |
| Oct | 2.1M | 91 |
| Nov | 2.2M | 90.4 |
| Dec | 1.4M | 90.8 |

**Findings** Decision trees are suited for classification of HTTP protocol. C4.5 has the fastest classification speed

C4.5 and Random Forest exhibit good temporal stability

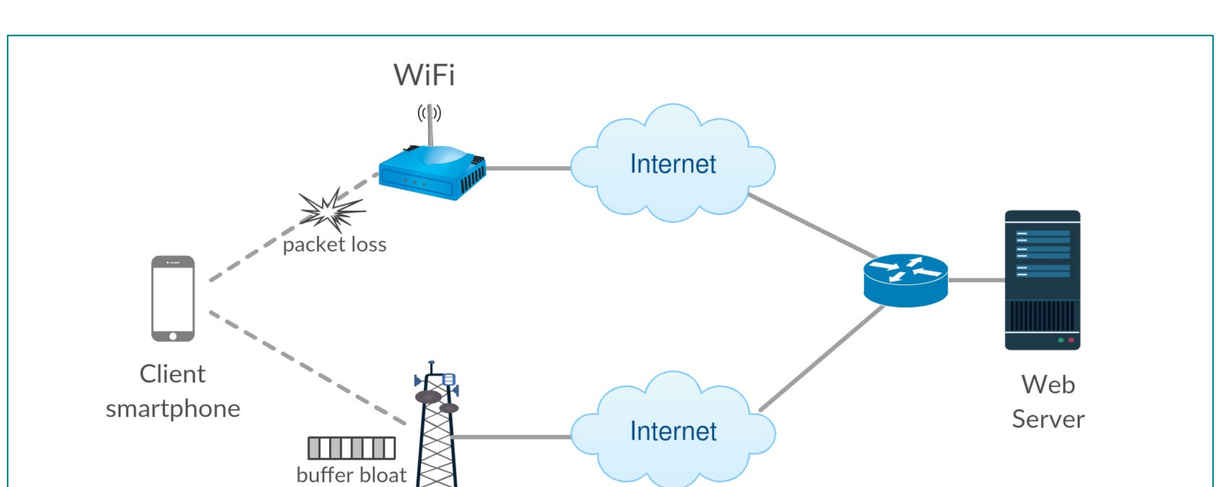
## HTTP/2 performance improvement using Multipath TCP

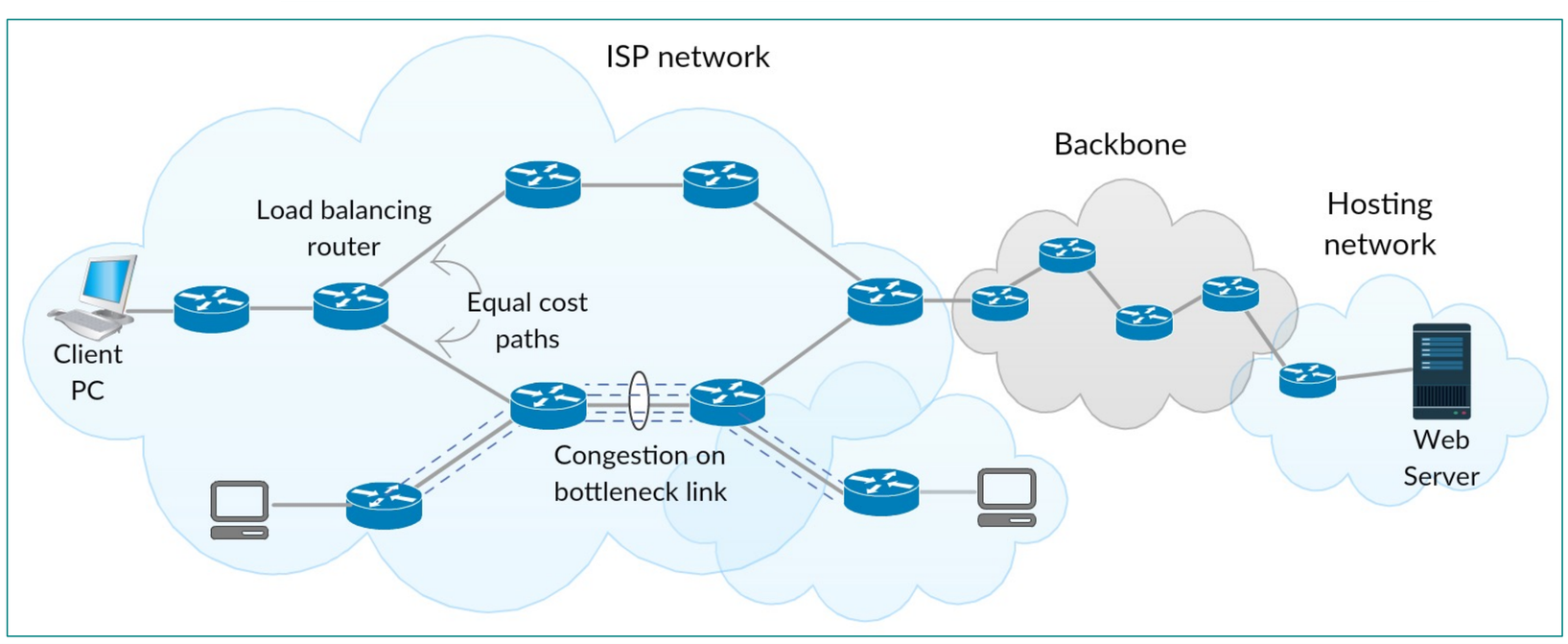
### Problem

The design of a single HTTP/2 connection can lead to poor performance in certain network conditions

### Objectives

- Experiment with parallel HTTP/2 connections natively in web browser.
- Explore MPTCP for parallel HTTP/2 subflows.
- Measure the effect of congestion control algorithms on performance.
- Test diverse real-world network conditions:
  - Congestion in ISP network
  - Random packet loss in WiFi
  - Bufferbloat in LTE network
- Devise application and network-aware path selection in MPTCP




Jawad Manzoor | Ramin Sadre
Idilio Drago | Olivier Bonaventure

jawad.manzoor@uclouvain.be
Erasmus Mundus Joint Doctorate in Distributed Computing