



Performance Evaluation

Round Robin Cellular Network

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Introduction

Objectives:

We analyze the performance of a Round-Robin cellular network using the following indices:

- **Antenna Performance:**

- Response time for any packet

- Throughput as number of users served per timeslot

- Throughput as number of bytes served per timeslot

- **Users' Performance:**

- Response time for the i -th user

- Throughput as number of bytes served for the i -th user per timeslot

Scenarios

Uniform Cqi:

- CQIs are integer RVs $U(1,15)$

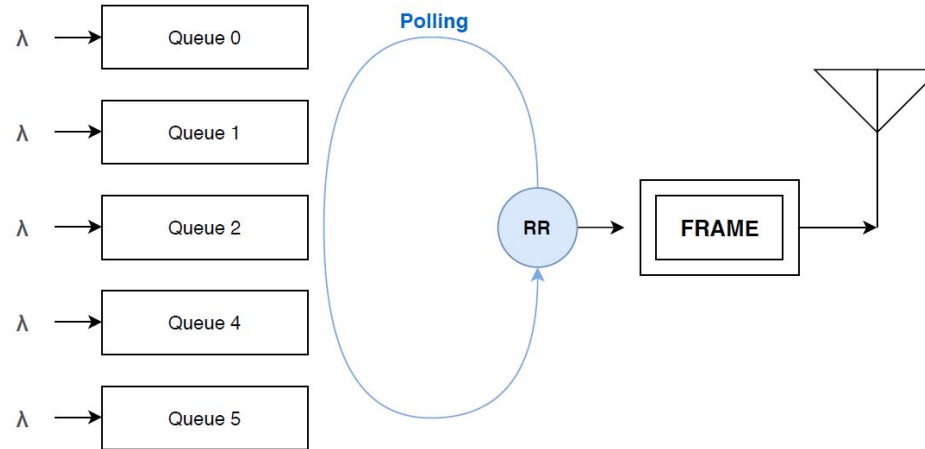
Binomial Cqi:

- Each user has its own success probability used to generate the CQI
- Users are splitted into two classes: **LOW** with mean **CQI = 3.09**, **HIGH** with mean **CQI = 12.89**

Each scenario considers always:

- Exponential interarrivals with mean $(1/\lambda)$
- Uniform service demand

Modeling



Entities:

- **1 Antenna**, which has infinite FIFO queues, one for each user, containing user packets
- **10 Mobile Stations**, which are the users connected to the Antenna
- **10 Packets Generators**, which are the packet sources, one for each user

Stability condition

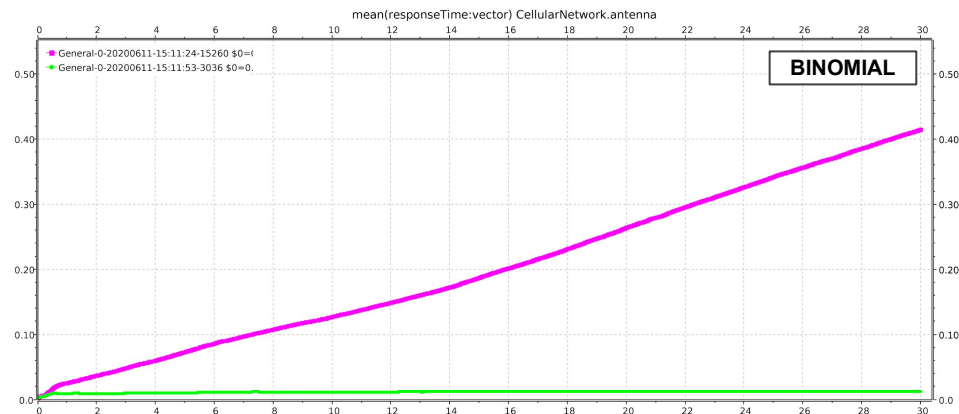
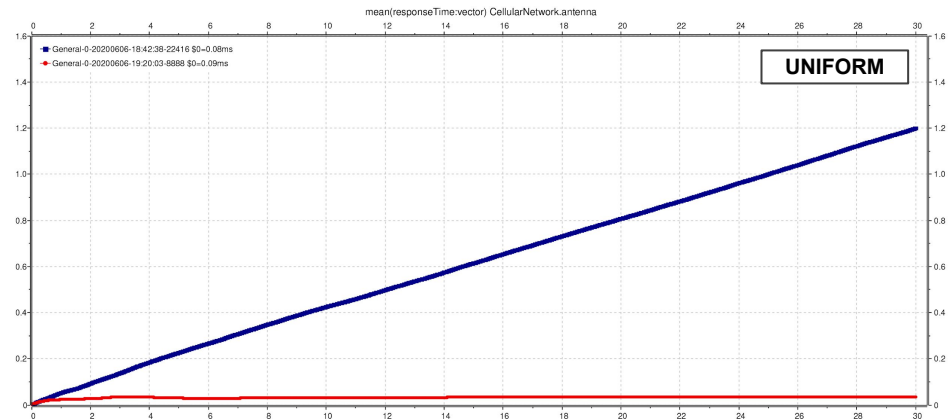
1. Find **maximum capacity** of the antenna in non-stable condition.
2. Set the mean-interarrival time such that the mean overall incoming packets doesn't exceeds the capacity.

Uniform:

- Stability for $\lambda > 0.09\text{ms}$

Binomial:

- Stability for $\lambda > 0.7\text{ms}$



Warmup Period

Basic Scenario:

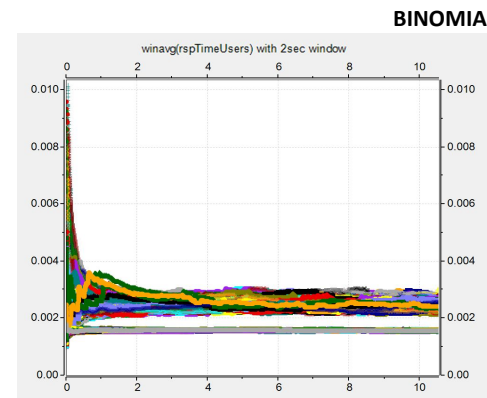
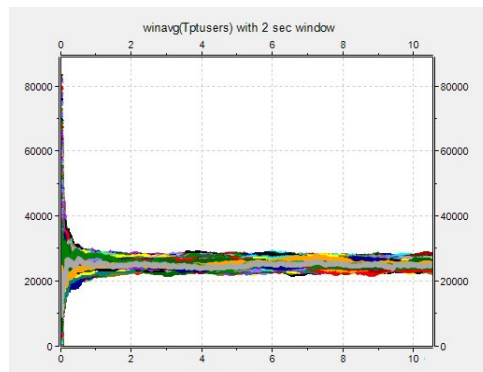
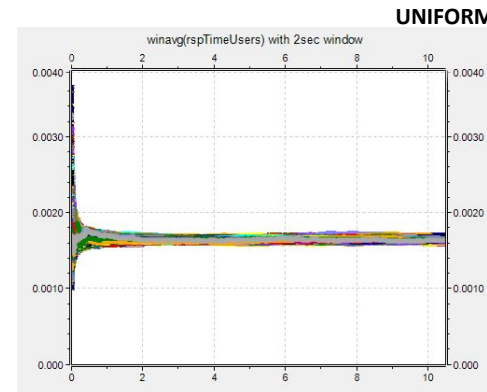
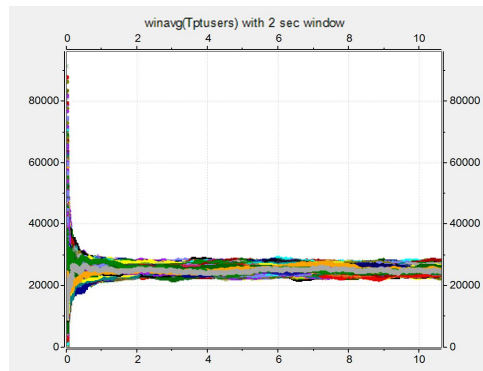
- 10 Users
- 60s Simulation time
- 100 Repetitions
- $1/\lambda = 1.5\text{ms}$

Uniform:

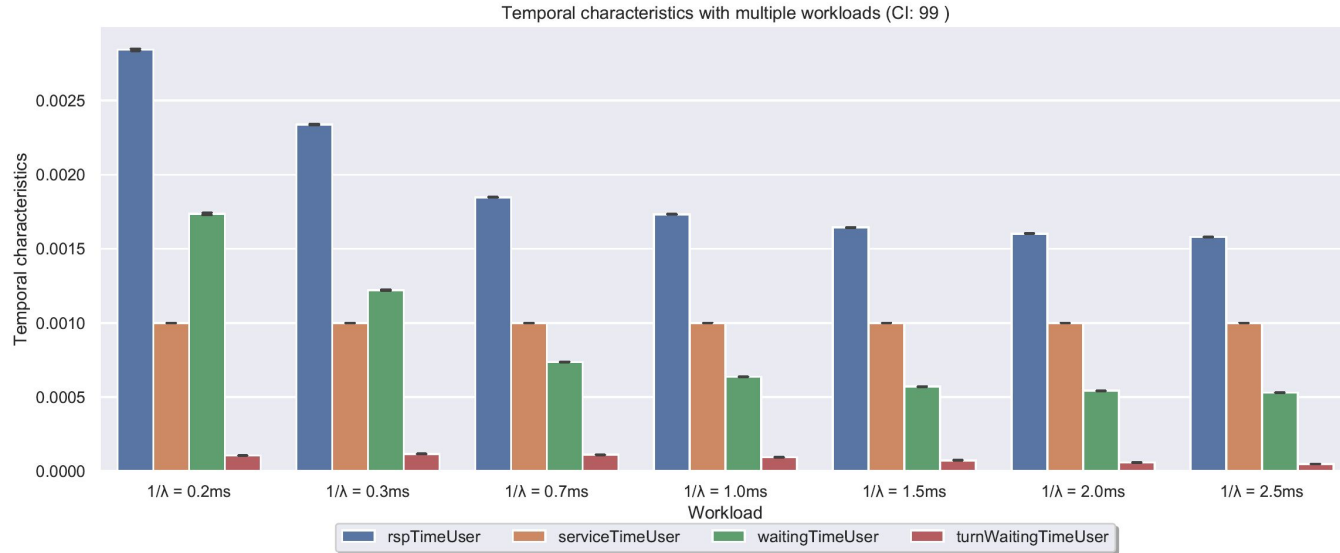
- Warmup Period = **3s**

Binomial:

- Warmup Period = **3s**

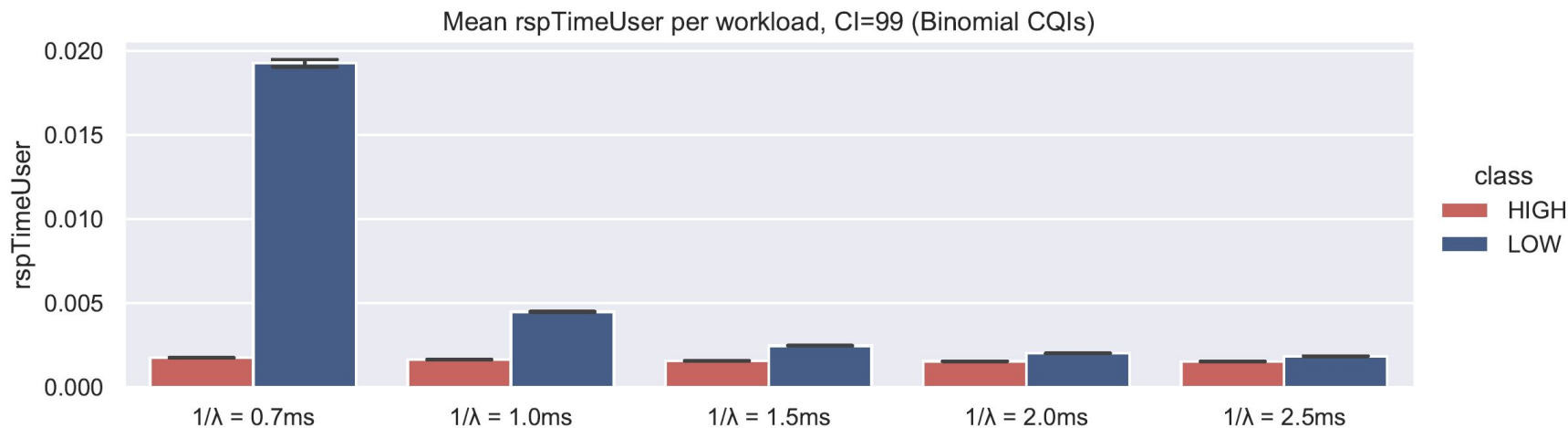


Response Time Analysis (Uniform)



- The average Response Time decreases when inter arrival time increases

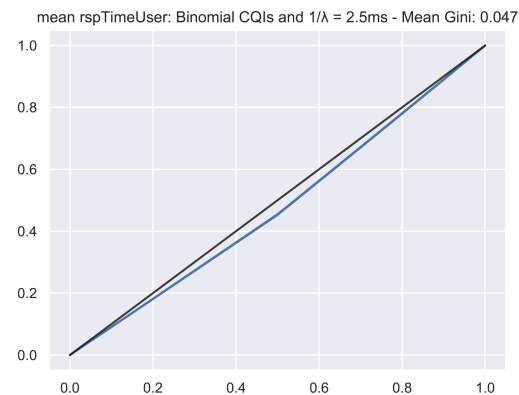
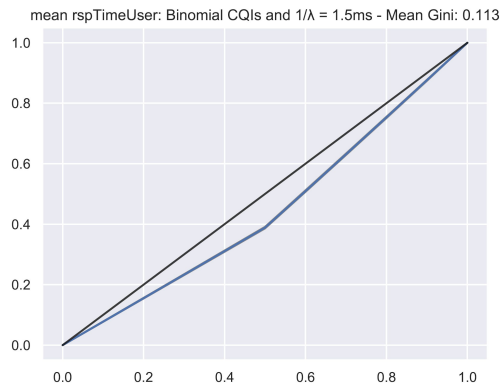
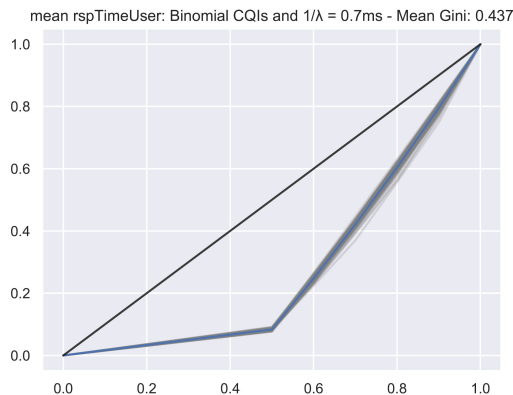
Response Time Analysis (Binomial)



- Exponential decrement for low class users
- Hardly noticeable decrement for high class users

Fairness of the system

- In the uniform scenario the system is obviously strongly fair
- In **binomial** scenario, w.r.t. response time, the system unfairness increase with the workload, as you can see from the **Lorenz Curves**:



HIGHER WORKLOAD

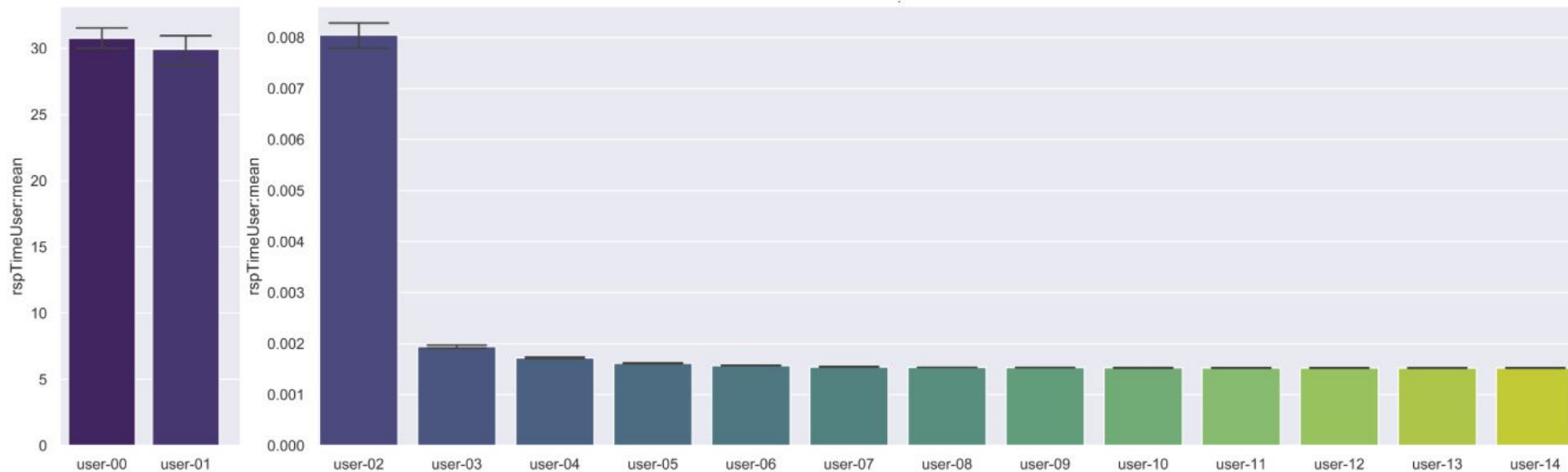


LOWER WORKLOAD

CQI's Impact 1

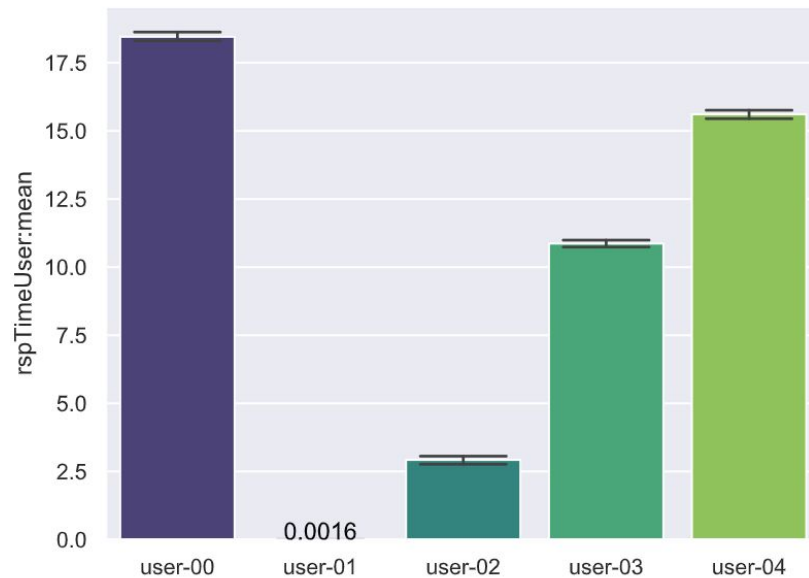
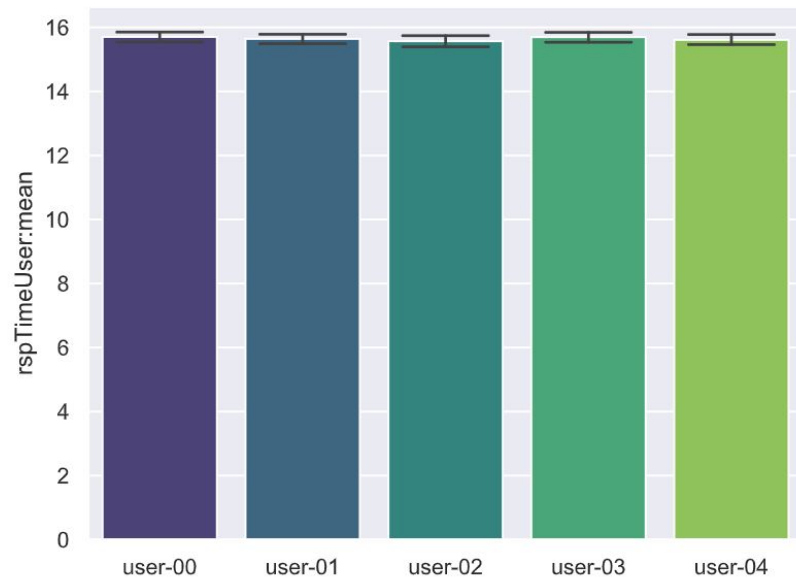


CQI from 1 to 15



- The performance of the system decays only with very bad CQIs

CQI's Impact 2

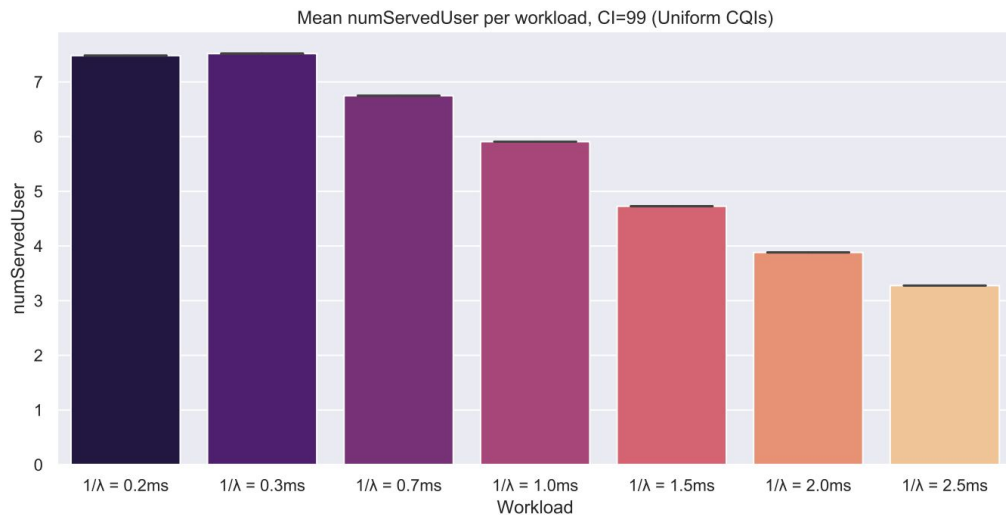


- One good user can influence the performance of its successors

Throughput Analysis

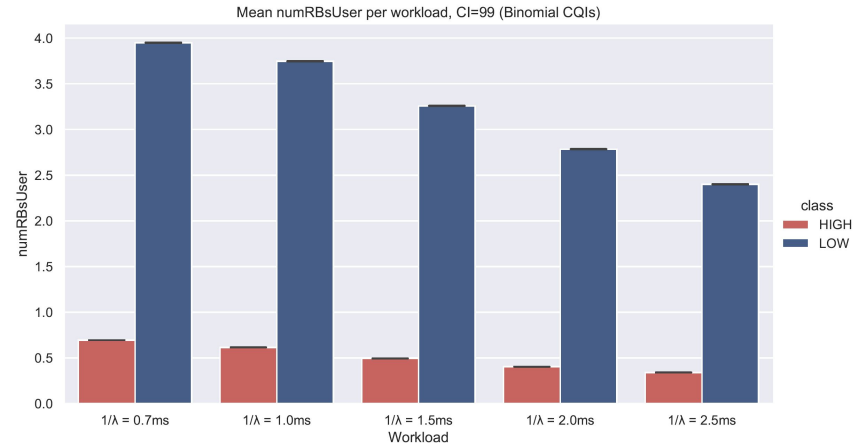
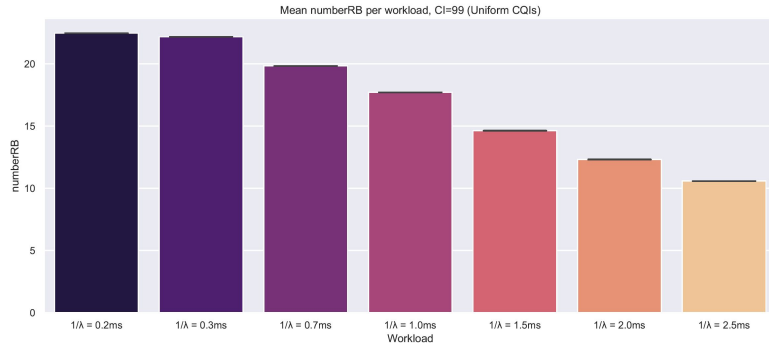


Since the number of packets transmitted is always equal to λ , we focused our attention on another aspect: the number of users served per timeslot



Both scenarios don't present relevant differences on equal terms

Frame Utilization Analysis



- Number of RB decreases exponentially in the same way
- In the binomial scenario most of the frame are occupied by low class users RBs

Conclusion

- As for the stability, the **binomial** case achieves this with a **lower workload** than the uniform case. The Uniform scenario can withstand an higher workload.
- The impact of the CQI on the response time is remarkable only **with very low CQIs**. Whereas having a good user will influence its successors.
- The **number of transmitted packets**, depends only on the **workload**. We can serve almost the 70% of the users at each iteration in uniform scenario, and a few less in the binomial scenario.



Questions?