DYNAMIC RESOURCE BLOCK ALLOCATION IN NETWORK SLICING

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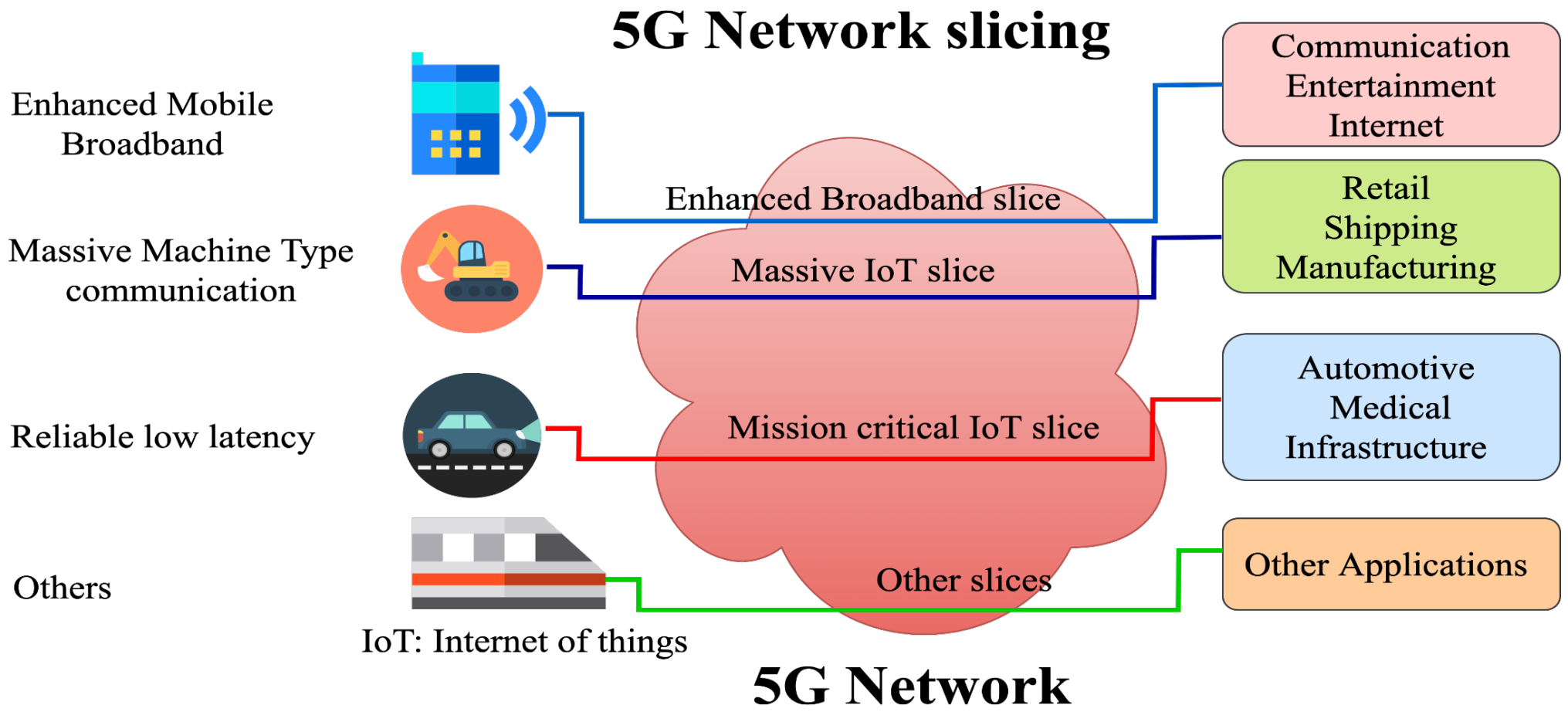
CONTENTS

NETWORK SLICING

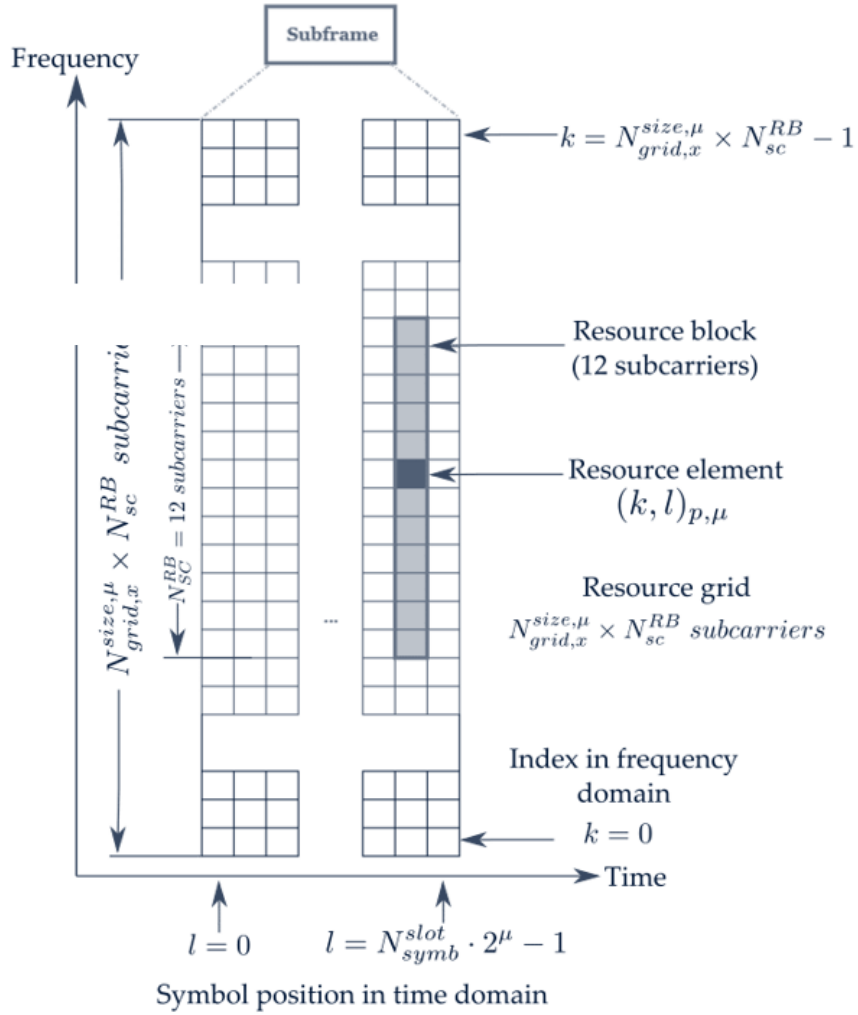


5G NR RESOURCE BLOCK

5G NR resource block : a block of 14 OFDM symbols (1 slot across time domain) with the corresponding 12 subcarriers for those symbols.

A resource element is the smallest time-frequency resource over one subcarrier of a single OFDM symbol.

A resource block is a block of 12 subcarriers over which the transmissions are scheduled.



RESOURCE BLOCK ALLOCATION

- gNodeB allocates UE, the bandwidth resources to transmit/receive data in downlink and uplink.
- The RBs are the smallest resource entity assigned to a single user.
- The time-domain resource allocation in 5G NR defines the allocated symbols (OFDM symbols).
- In frequency domain allocation, the RB as sub-carriers and comprehends 12 subcarriers in the frequency domain with a flexible RB-bandwidth, unlike LTE-A.
- RB bandwidth depends on sub-carrier spacing.
- NR provides a higher bandwidth efficiency (up to 99%) than the LTE (90%) and operates at a channel bandwidth of 100 MHz in < 6 GHz and 400 MHz in mmWave

SIMULATION

- We simulated in MATLAB the two-level scheduler for eMBB and URLLC slices for a varying number of users in each slice, keeping the other constant to observe CQI variations.
- A two-level scheduler to share the Physical Radio Blocks (pRB) among slices by abstracting pRBs to schedule each UE with Virtual Resource Blocks (vRB).
- The goal is to improve network performance and introduce flexibility and optimization of the network resources by accurately and dynamically provisioning the activated network slices with the appropriate resources to meet their diverse requirements. The aim is to have a flexibility in RAN resource allocation concerning slicing.

SIMULATION SETUP

- eMBB Slice Requirements: High data rate

$$N_{pRBmax}(i) * d_{pRB} = N_{users}(i) * d_{App/user}.$$

- URLLC Slice Requirements: Ultra-Low Latency

$$\mu = \frac{N_{pRB} * d_{pRB}}{avd\ packet\ size}$$

- The aim is to keep latency below a maximum threshold (Latmax) while calculating *NpRBmax(i)*

NpRBmax(i): required pRBs for each eNB i

dApp/user: the data rate per user required by the application running on top of the slice

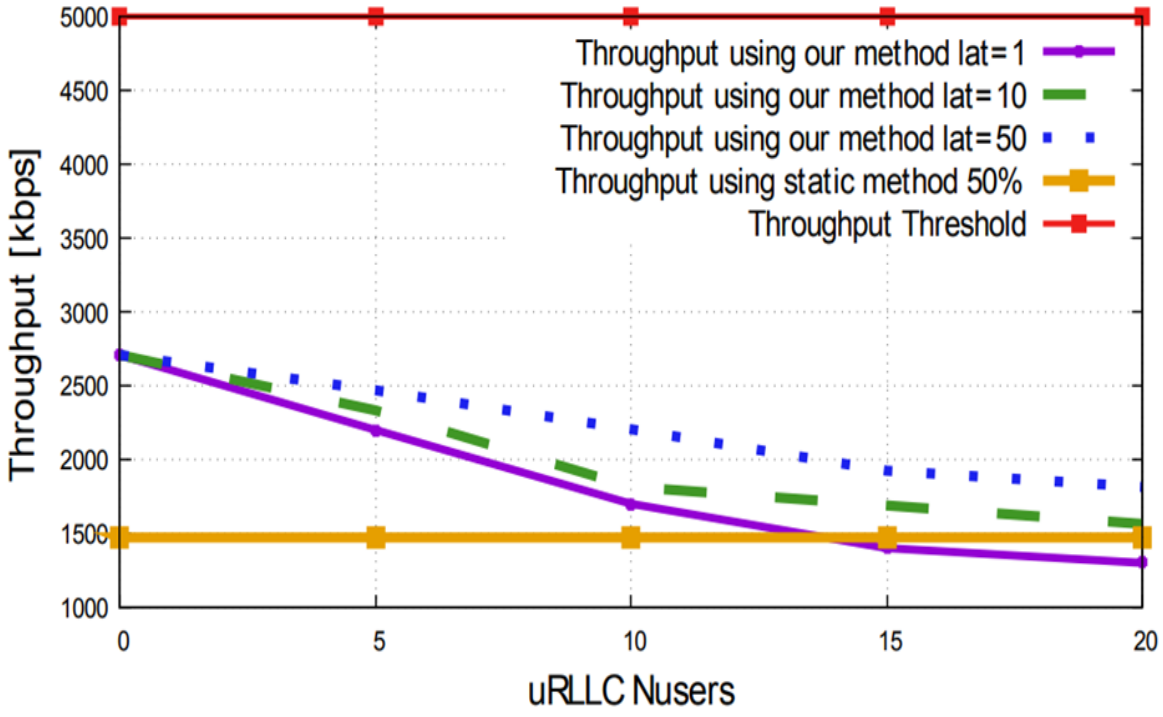
Nusers: the number of active users

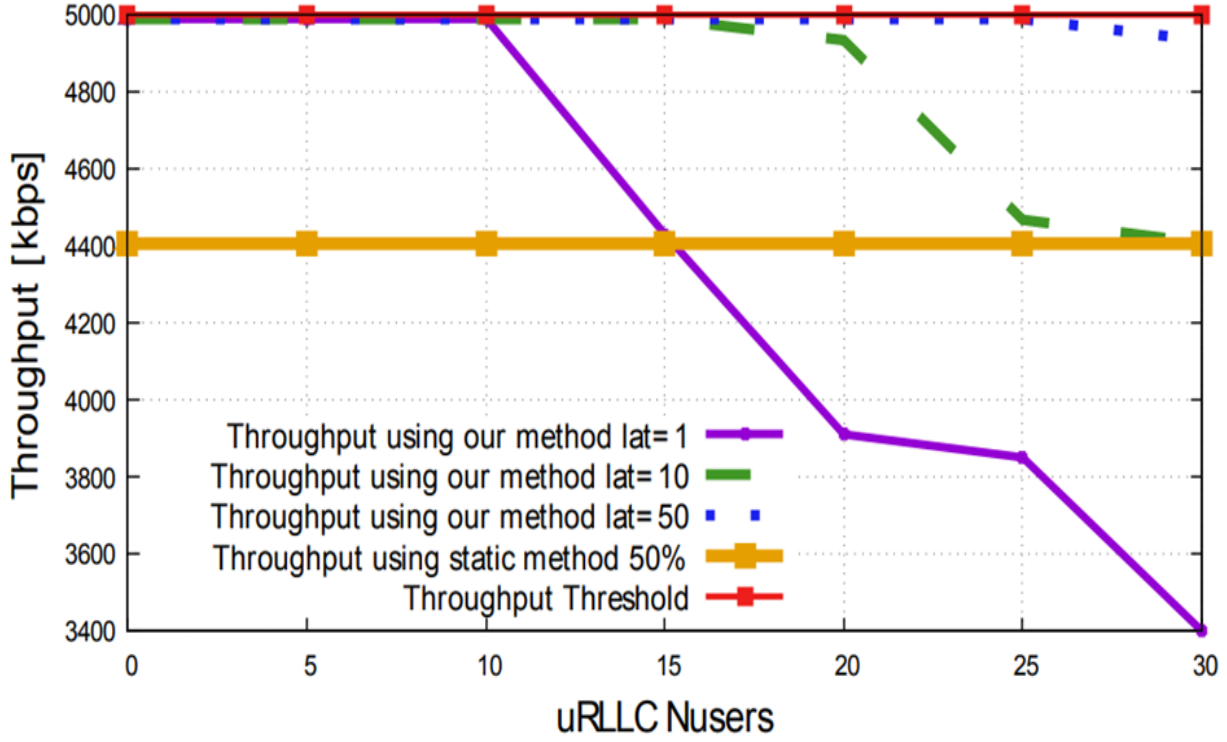
dpRB: maximum data rate provided by one pRB (same for all users)

Ideal channel conditions, i.e., the maximum possible CQI value of 15

pRB: Physical Radio Blocks

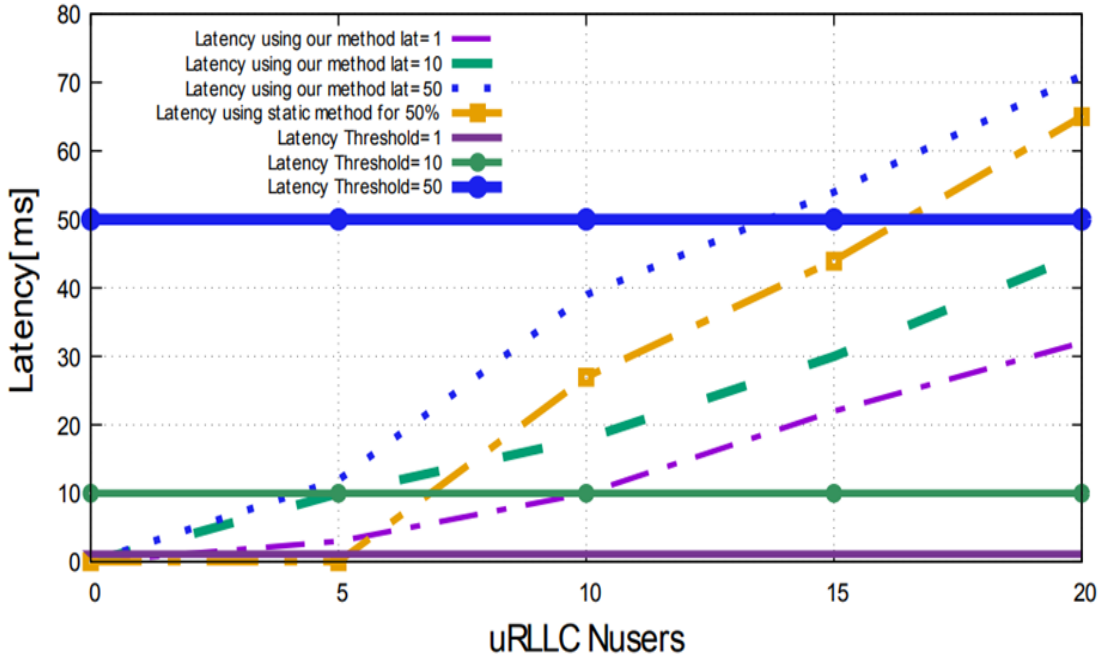
RESULT: THROUGHPUT

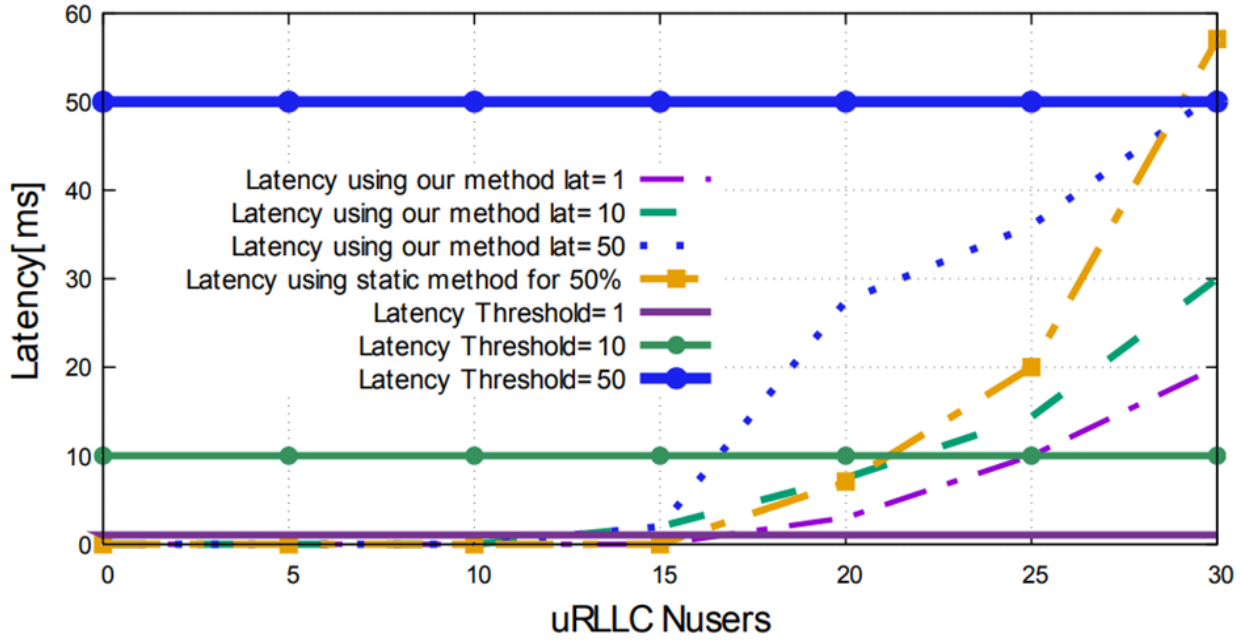




For URLLC slice, Throughput variations against the no. of users. Above: medium CQI values, below: high CQI values

RESULT: LATENCY





For URLLC slice, Latency variations against the no. of users.
Above: medium CQI values, below: high CQI values

DISCUSSION AND CONCLUSION

- We Proposed a slice creation and allocation of resource blocks while isolating the slices for eMBB and URLLC by using the two-level scheduling with varying CQI values.

- The obtained results illustrate our proposed algorithm for estimating the number of physical resource blocks by the eMBB and URLLC slices.

- Demonstrated the slice creation and resource allocation.

FUTURE WORK

- The main foreseen challenge in 5G New Radio dynamic resource allocation is the associated overhead when we extract the information from the base station (UE provides CQI to the base stations) to the SO.
- Thus, to eliminate/minimize the communication overhead, we need
  - ML approach to infer the stability of UE channel conditions;
  - A predictive scheme to efficiently reduce the dependency on the network's configuration to address the various service and demands;
  - Admission Control Policy/ Decision based on Q-Learning and Regret Matching for the SP to manage the slice requests.

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