Performance analysis of LTE by setting up a test bed using srsLTE

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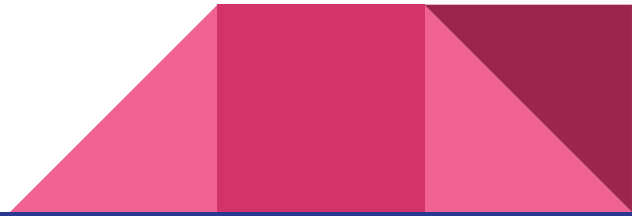
Outline

- Motivation
- References/Related Work
- LTE Architecture
- Testbed setup
- NUMA
- Test Scenarios
- Challenges faced
- Conclusion

Motivation

- We wanted to explore working of LTE.
- We are also interested in exploring VNF in 5g. So, to get an insight as to how services like EnodeB, EPC/Core are virtualized and how they are managed as VNFs’.

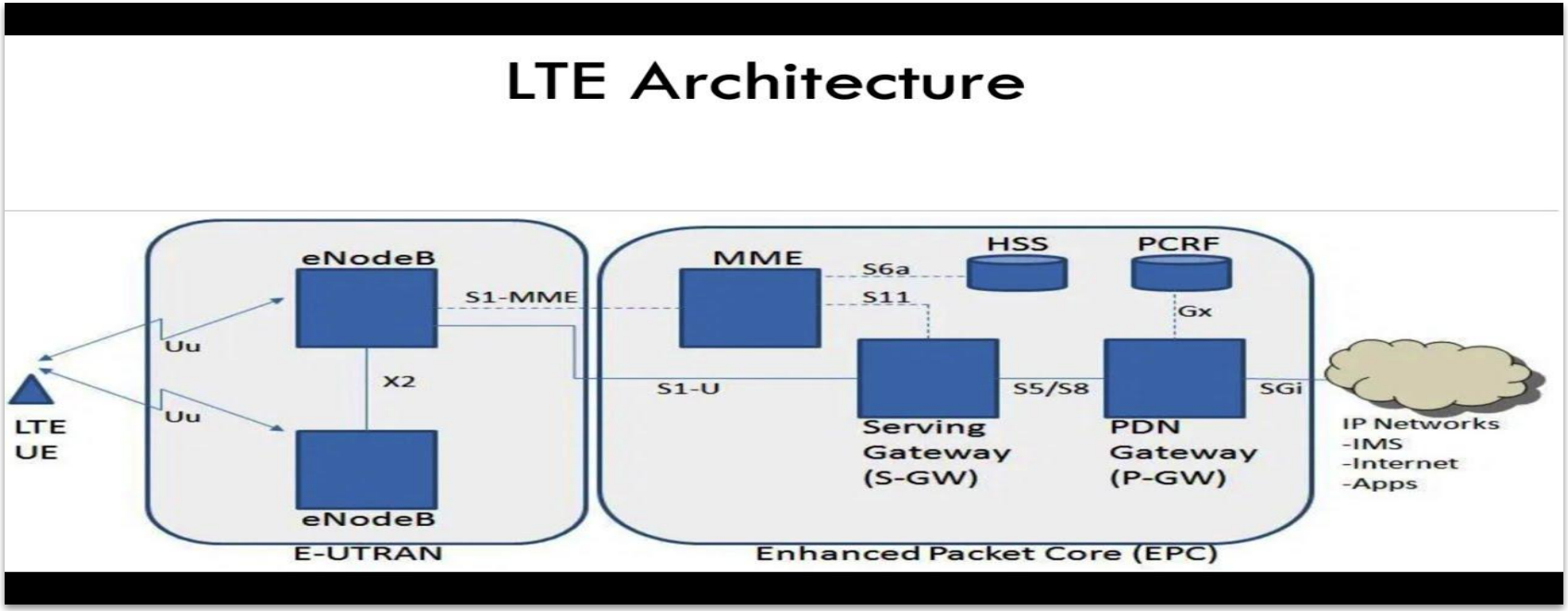


References/ Related Work

[1]NUMASFP: NUMA-Aware Dynamic Service Function Chain Placement in Multi-Core Servers
Venkatarami Reddy Chintapalli, Sai Balaram Korrapati, Bheemarjuna Reddy Tamma, Antony Franklin A
(2022 14th International Conference on COMmunication Systems & NETworkS (COMSNETS))

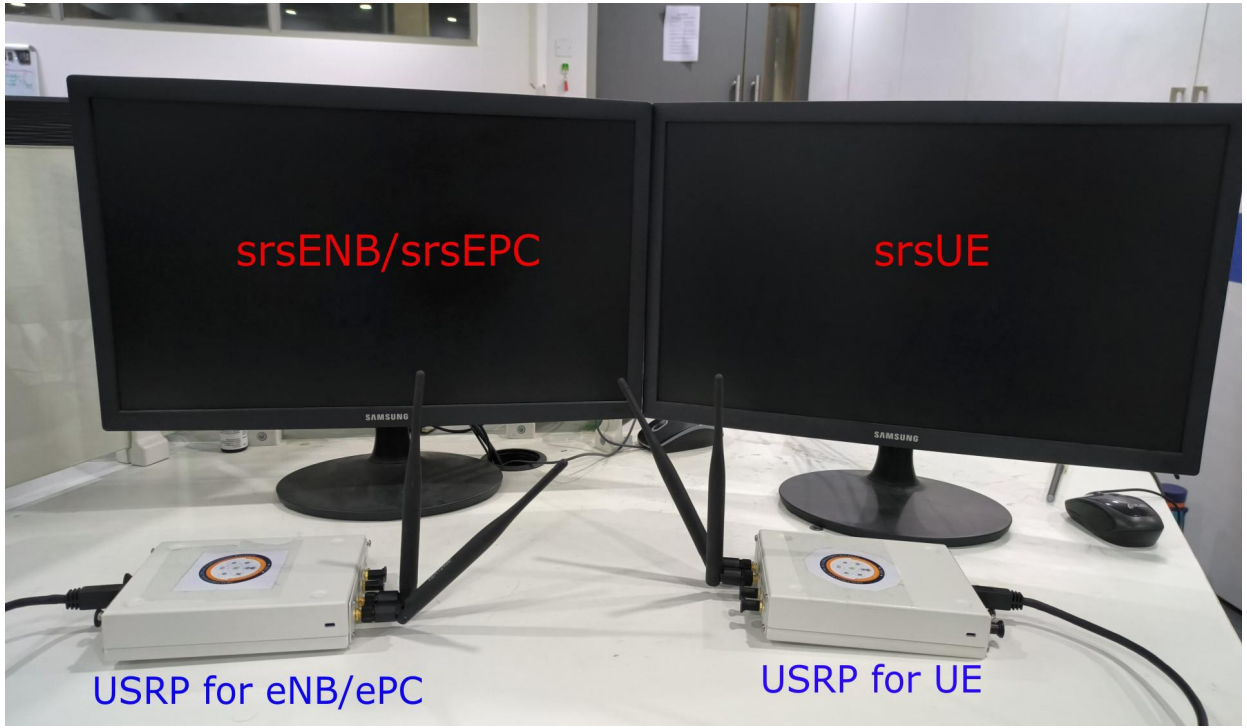
[2]Implementation and performance analysis of software defined radio (SDR) based LTE platform for truck connectivity application.(Degree project in Electrical Engineering**) by** BILAL MAQSOOD

LTE Architecture



Testbed Setup

- srsLTE
- USRP B210
- Tools used to gather metrics/data



srsLTE

- What is srsLTE(aka srsRAN) ?
  - The srsRAN suite includes:
    - srsUE - a full-stack SDR 4G/5G UE application
    - srsENB - a full-stack SDR 4G/5G e(g)NodeB application
    - srsEPC - a light-weight 4G core network implementation with MME, HSS and S/P-GW

- We used srsRAN to launch instances of srsUE/EPC/ENB and they communicated using **USRP boards** (more on this in the next slide!)

USRP B210

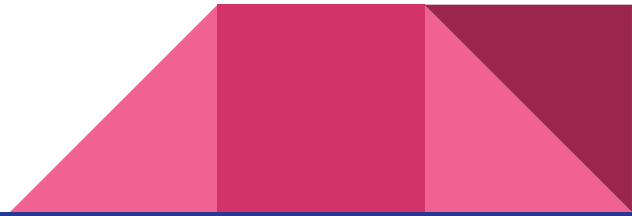
- Some features of the USRP B210
  - It’s an low cost **SDR**!
  - USB 3.0 connectivity
  - Two-channel USRP device with continuous

    RF coverage from 70 MHz – 6 GHz

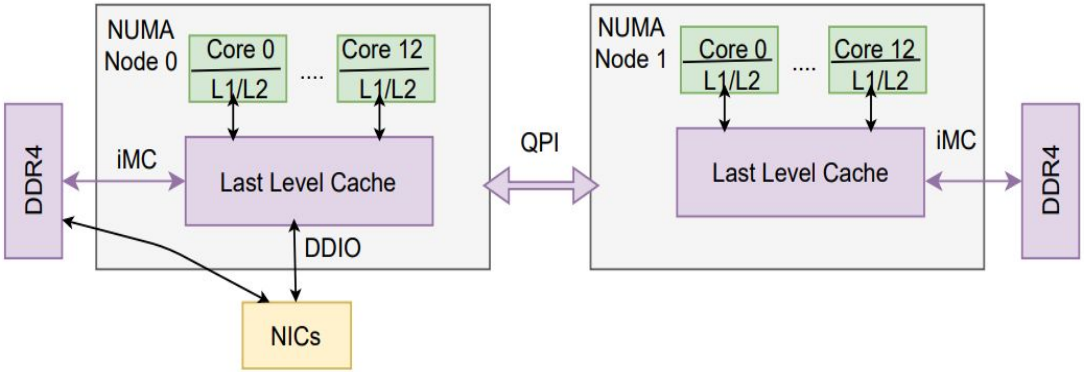
  - Full duplex, MIMO (2 Tx & 2 Rx)

Tools

- Iperf3
- ping
- taskset
- pqos
- stress-ng
- cset



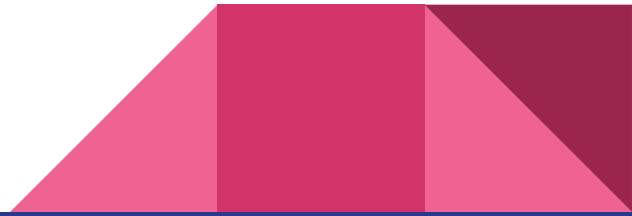
NUMA-Non Uniform Memory Access



- UMA vs NUMA
- Inter-node resource contention
- Intra node resource contention

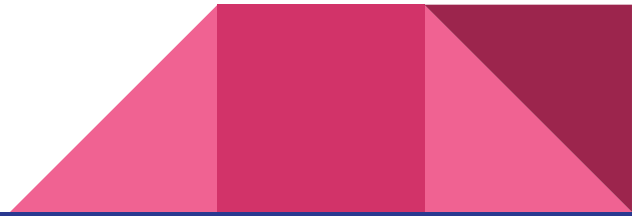
Scenarios

- Test Scenario 1
- Test Scenario 2
- Test Scenario 3
- Test Scenario 4
- Test Scenario 5

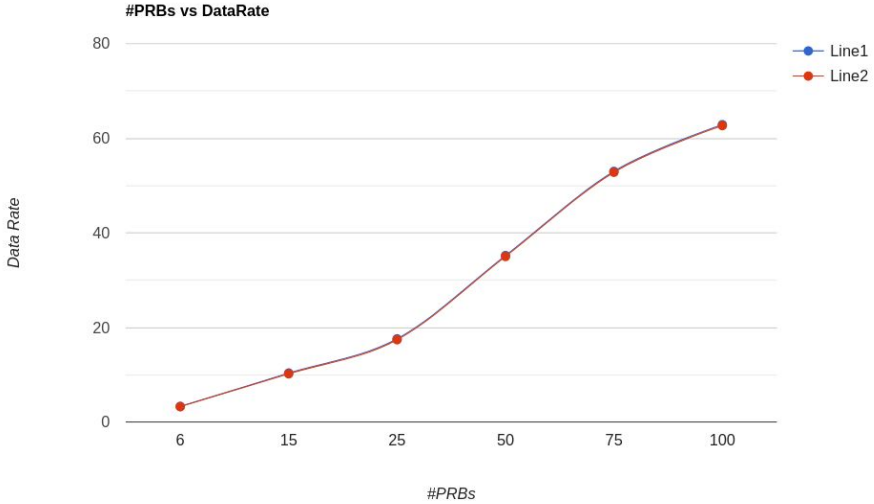


Test Scenario-1

- Run EPC in one terminal and eNB in another terminal on host1.
- Run UE in a terminal on host2.
- Using `iperf3 -s` to start a server on UE using port 5201.
- Using `iperf3 -c <ip-address>` to start a client on eNB using port 5201.(ip-address of UE)
- Running 3 iterations of iperf3 for 100 sec each



Test Scenario-1 Results



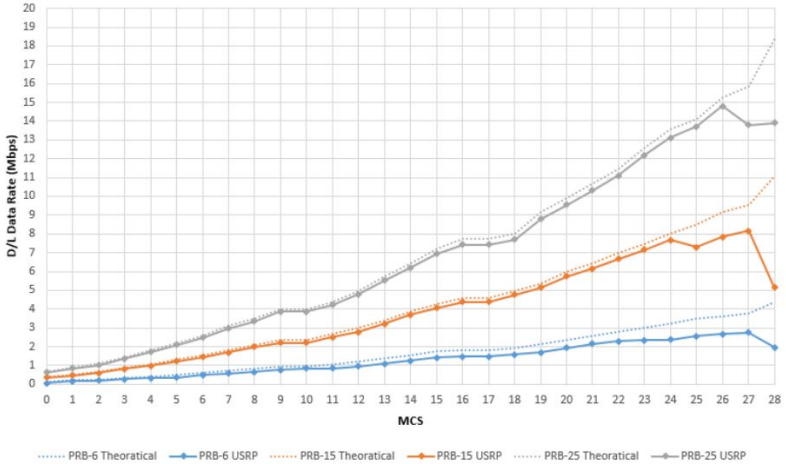
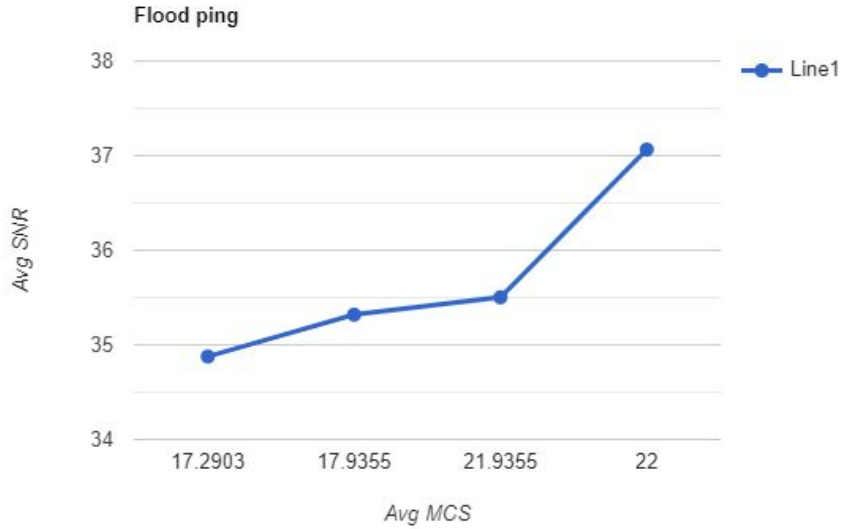


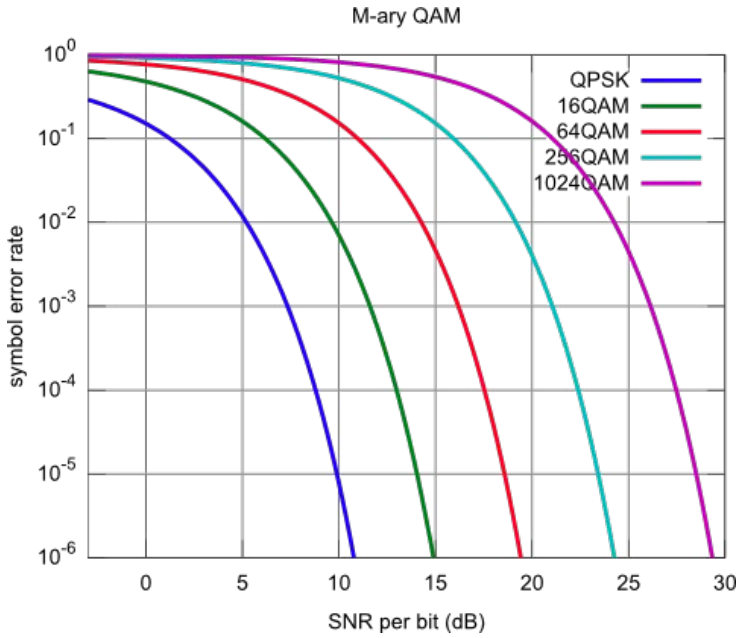
Figure 5.3: UE Downlink Data Rate (USRP) - 1/2

Test Scenario 2

- Perform flood ping on data sizes of 100, 500,1400,5000, 10000, 15000, 17000 bytes for 1000 packets(`.sudo ping -f -c 30000 -s 500 172.16.0.1` c is count of packets and 500 is the size of packet)
- In next experiment we didn't keep the number of packets sent fixed, wrote a script that will start and stop ping for x seconds

Test Scenario 2 Results



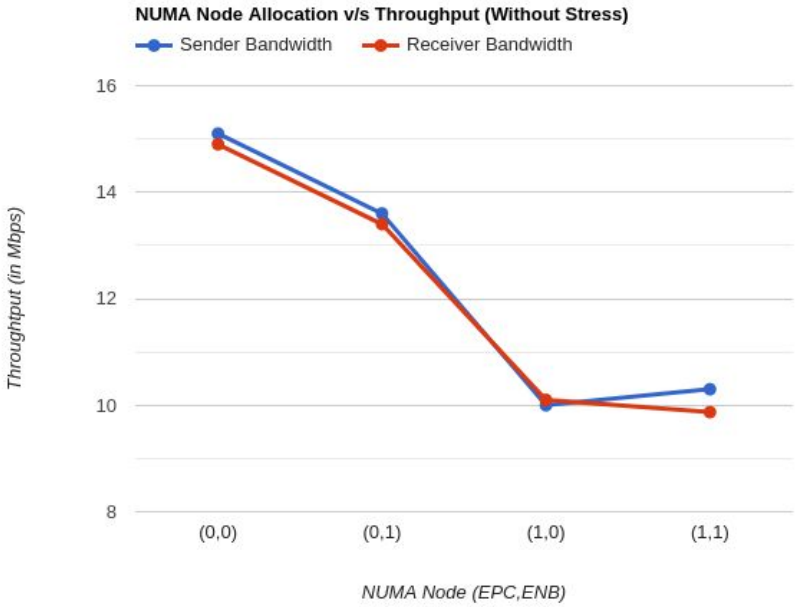


Test Scenario 3

Considering all 4 situations of allocating srsepc and srsenb to two nodes :

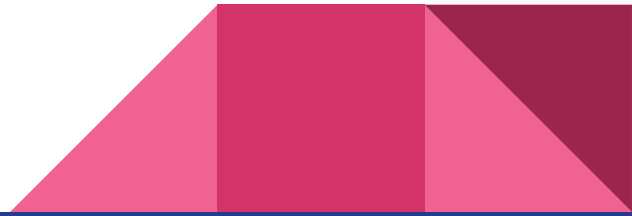
- srsepc on node 0 and srsenb on node 0
- srsepc on node 0 and srsenb on node 1
- srsepc on node 1 and srsenb on node 0
- srsepc on node 1 and srsenb on node 1

Test scenario 3 Results

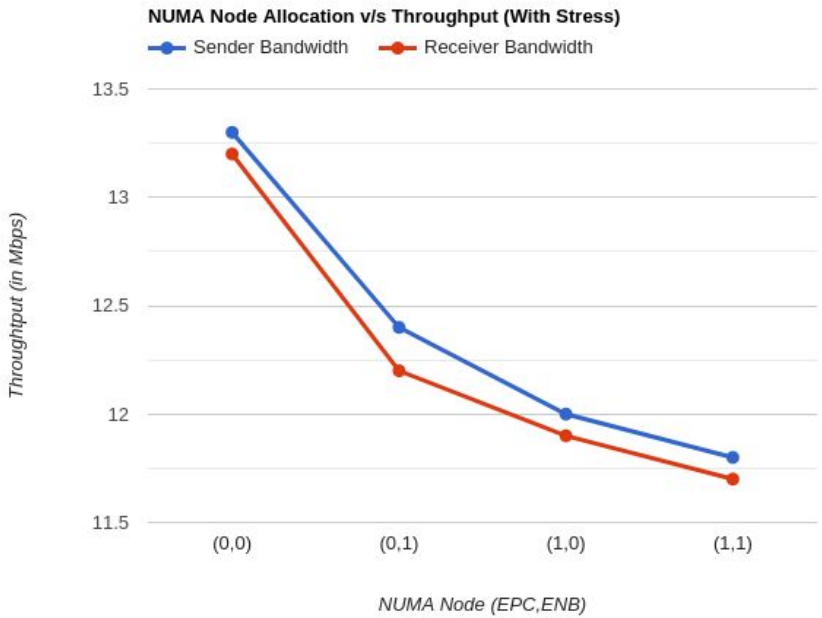


Test Scenario 4

Introducing stress-ng to increase the load on non-allocated cores and doing performance analysis



Test Scenario 4 Results

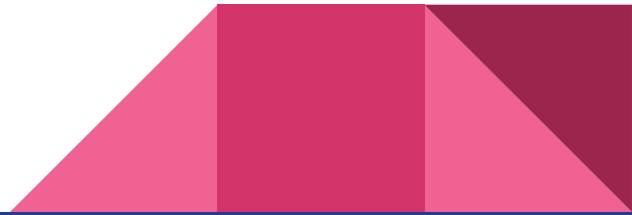


Test Scenario 5

Maximizing Total aggregate throughput

Assuming we don’t have sufficient resources to allocated (say cores are limited)

- Statically allocating cores to the functions
- Dynamically allocating cores to the functions based on traffic rate.

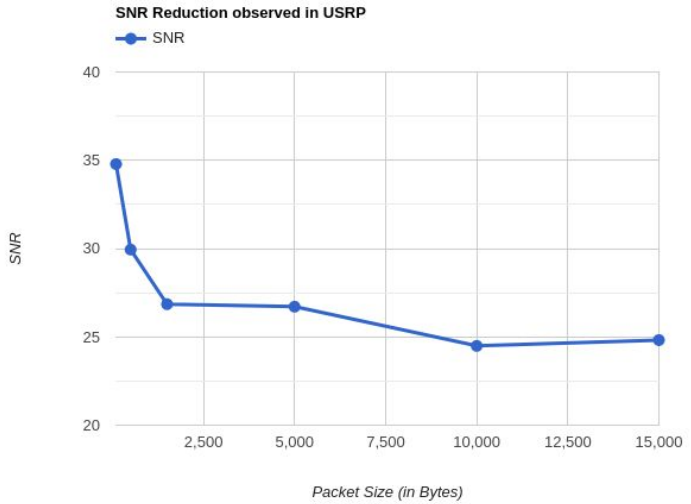


Test Scenario 5 - Expected Results

Expected Results are that when we allocate cores statically to the functions we don’t observe maximum aggregate throughput because consider a scenario where there two functions both are allocated say x and y cores , initially when there is moderate traffic rate on both functions this will not affect throughput much but when the traffic rate on one function is less and needs less than x cores , traffic rate on another function is high and requires more than y cores in this case throughput will be less and the throughput can be increased by dynamically allocating the cores for maximum utilization.

Challenges Faced

- Fluctuations in signal leading to not so accurate results
- Real time analysis of observations and comparison with theoretical observations.
- Drop in SNR while increasing the packet size during flood ping request



Conclusion

1. Experimental analysis of LTE testbed led to the understanding of how to work on srsLTE.
2. Data rate increases with increase in PRB
3. Higher SNR can have higher MCS values
4. Allocating EPC and eNB on same node gives better performance
5. We sometimes do not get the expected results in practice as visualized in theory. We should check and analyze for various factors which may be responsible for the same.

Thank You

Questions ??