

18th November, 2016

COMPUTER NETWORKS

IT302

EXPERIMENT NUMBER-05

**“UNDERSTANDING PHYSICAL
CARRIER SENSING AND VIRTUAL
CARRIER SENSING IN IEEE 802.11”**

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Objective:

The purpose of this lab is to understand the virtues of physical and virtual carrier sensing mechanisms used in IEEE 802.11 (WiFi) networks.

Theoretical concepts:

- **Physical Carrier Sensing-**
- **Virtual Carrier Sensing-**
- **CSMA-** “*Carrier Sensing Multiple Access*”. It is of two types: CSMA/CD and CSMA/CA.
- **CSMA/CA-** “*Carrier Sensing Multiple Access with Collision Avoidance*” is a network multiple access method in which each station senses the channel before transmitting, and refrains from transmitting when the channel is sensed busy.
- In this experiment, we use collision avoidance (CSMA/CA) as collision detection is not possible in wireless networks.
- CSMA/CA, the moment a node receives a packet intended for sending, the first thing it does is to listen to the broadcast channel for a pre-specified time frame to determine if another node is broadcasting on the channel inside the wireless range. If the broadcast channel is detected as "idle", the node can then start transmitting the data packet.
- **Exponential backoff-** If the broadcast channel is detected as "busy", the node holds the transmission, waits for a random time frame and then checks all over again to find out whether the channel is free. This time frame is referred to as the *backoff factor*. The backoff factor is counted down using a backoff counter.
- If the channel is free when the backoff counter gets to zero, the node sends the data packet. If the channel is not clear even when the backoff counter reaches zero, the backoff factor is scheduled yet again, and the entire scenario is repeated. This is repeated until the channel becomes available. As soon as the channel becomes available, the data packet is transmitted. Once the data is received by the receiving node, it sends back an *acknowledgment packet (ACK)* after a short while. If the ACK is not received, it is assumed that the packet is lost and then a retransmission is set up.

- **CBR**- “*Constant Bit Rate*”. It is a term used in telecommunications, relating to the quality of service. CBR is useful for streaming multimedia content on limited capacity channels. CBR would not be the optimal choice for storage as it would not allocate enough data for complex sections while wasting data on simple sections.
- **RTS Threshold**- “*Request To Send Threshold*”. The 802.11 standard includes the RTS threshold function to control station access to the medium.
- **Virtual Carrier Sensing**-The mechanism is provided by the MAC layer and this is also called NAV. It maintains the duration of traffic on channels.
- **Physical Carrier Sensing**- It is provided by Physical layer (PHY). The function of PHY layer responsible for this is called Clear Channel Assessment (CCA).

Exercises:

| <u>RTS Threshold</u> | <u>Physical Carrier Sensing</u> | <u>Virtual Carrier Sensing</u> |
|----------------------|---------------------------------|--------------------------------|
| ≥ 2312 | on | off |
| < 2312 | off | on |

Physical Carrier Sensing: $RXThreshold > CSThreshold$

Virtual Carrier Sensing: $CSThreshold = 3.652e-10$ (default value)

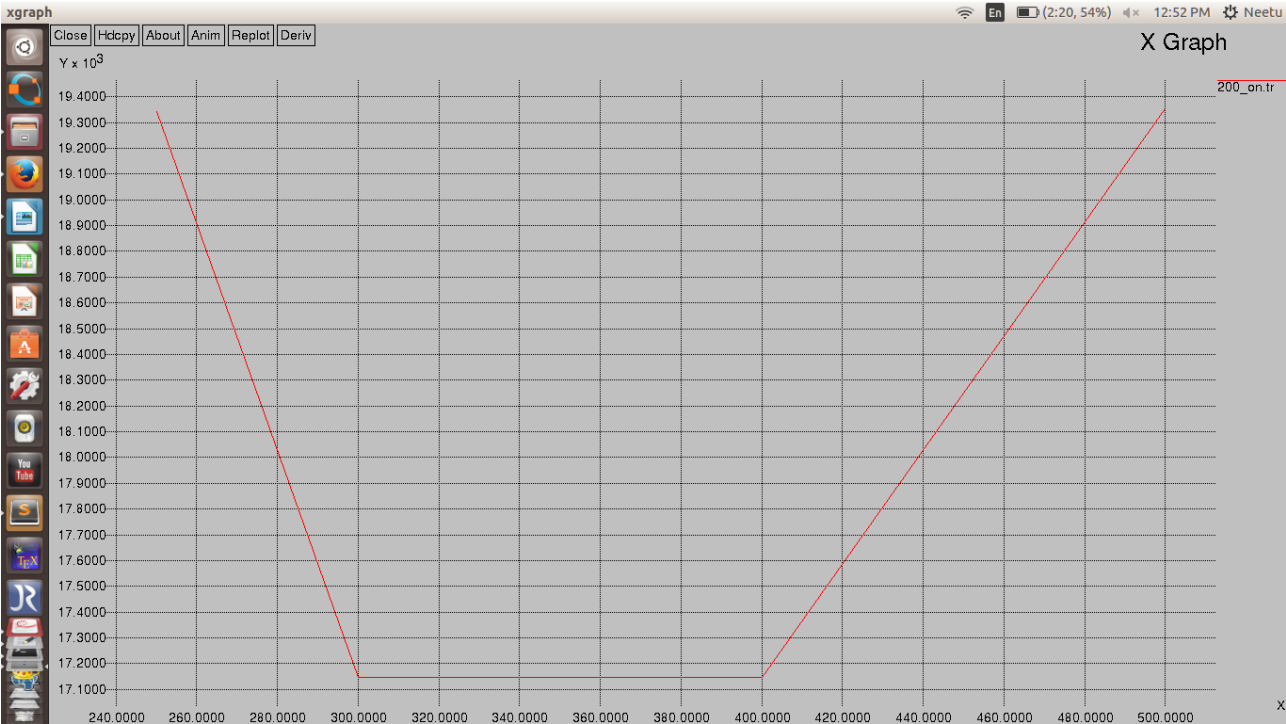
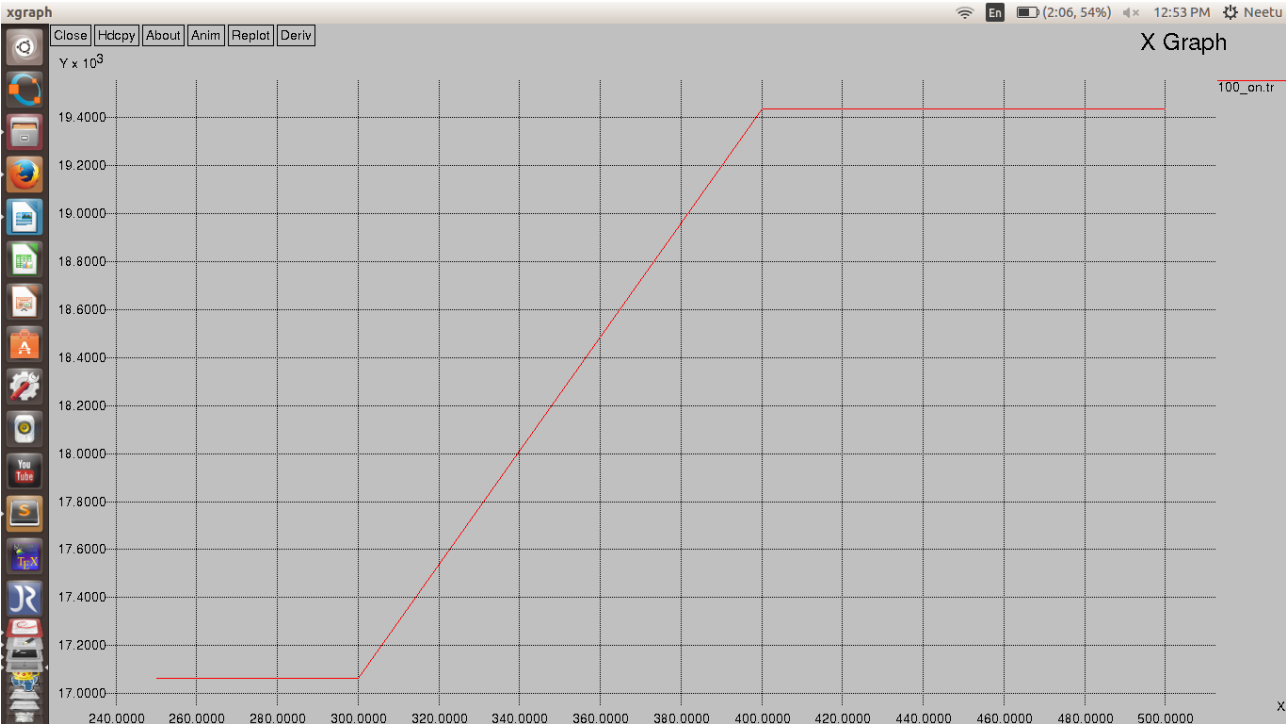
- **RXThresh_** is the reception threshold. If the received signal strength is greater than this threshold, the packet can be successfully received.
- **CSThresh_** is a carrier sensing threshold. If received signal strength is greater than this threshold, the packet transmission can be sensed. However, the packet cannot be decoded unless signal strength is greater than **RXThresh_**.

- | <u>Carrier Sensing Range</u> | <u>CSThresh</u> |
|------------------------------|-----------------|
| 250 | 3e-10 |
| 300 | 1.2e-10 |
| 400 | 4.7e-11 |
| 500 | 1.5e-11 |

- Physical Carrier Sensing:

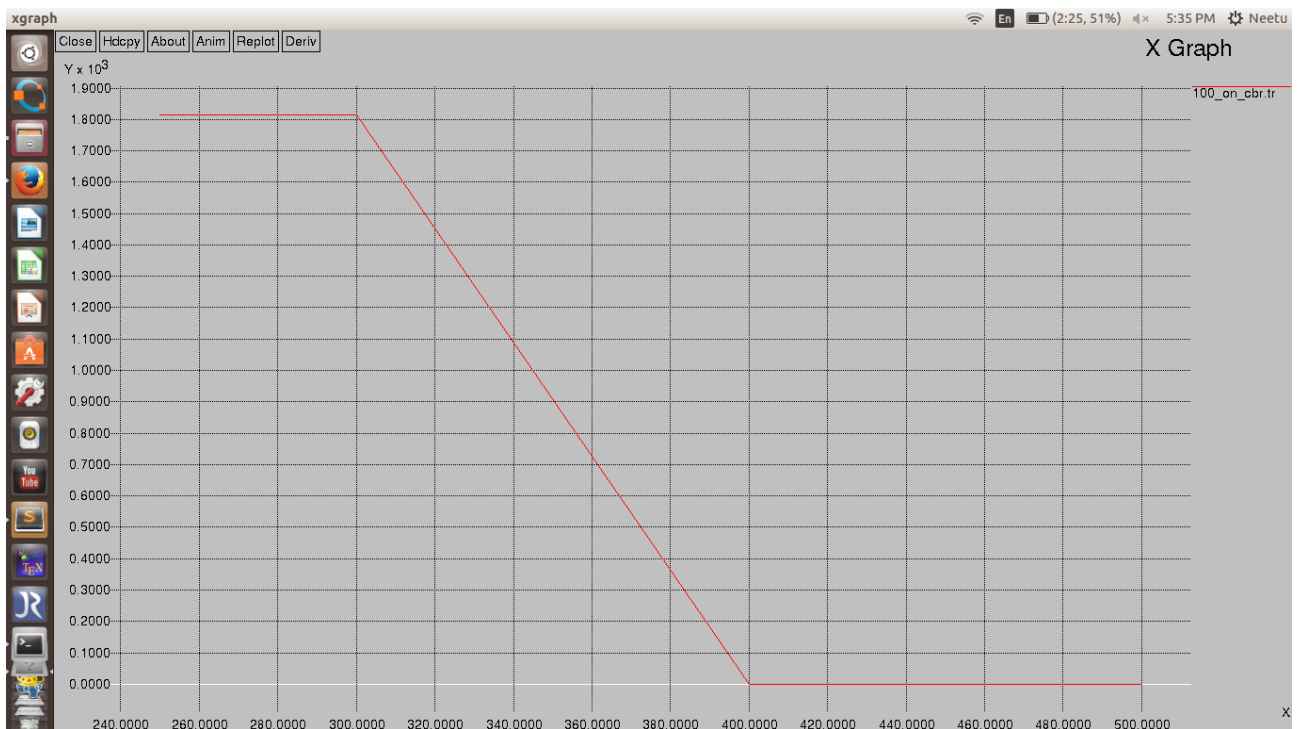
| <u>RTSThresh</u> | CSThresh | Distance | Throughput | CBR packets | Non-CBR packets |
|------------------|----------|----------|--------------|-------------|-----------------|
| | | | | | |
| 5000 | 3e-10 | 100 | 17064.300089 | 1814 | 31 |
| 5000 | 1.2e-10 | 100 | 17064.300089 | 1814 | 31 |
| 5000 | 4.7e-11 | 100 | 19435.246933 | 0 | 0 |
| 5000 | 1.5e-11 | 100 | 19435.246933 | 0 | 0 |
| | | | | | |
| 5000 | 3e-10 | 200 | 19341.585067 | 990 | 1 |
| 5000 | 1.2e-10 | 200 | 17147.403378 | 1795 | 14 |
| 5000 | 4.7e-11 | 200 | 17147.403378 | 1795 | 14 |
| 5000 | 1.5e-11 | 200 | 19352.416711 | 0 | 0 |
| | | | | | |
| 5000 | 3e-10 | 300 | 22318.557867 | 0 | 0 |
| 5000 | 1.2e-10 | 300 | 19341.585067 | 990 | 0 |
| 5000 | 4.7e-11 | 300 | 19332.664889 | 892 | 0 |
| 5000 | 1.5e-11 | 300 | 19333.120000 | 0 | 0 |

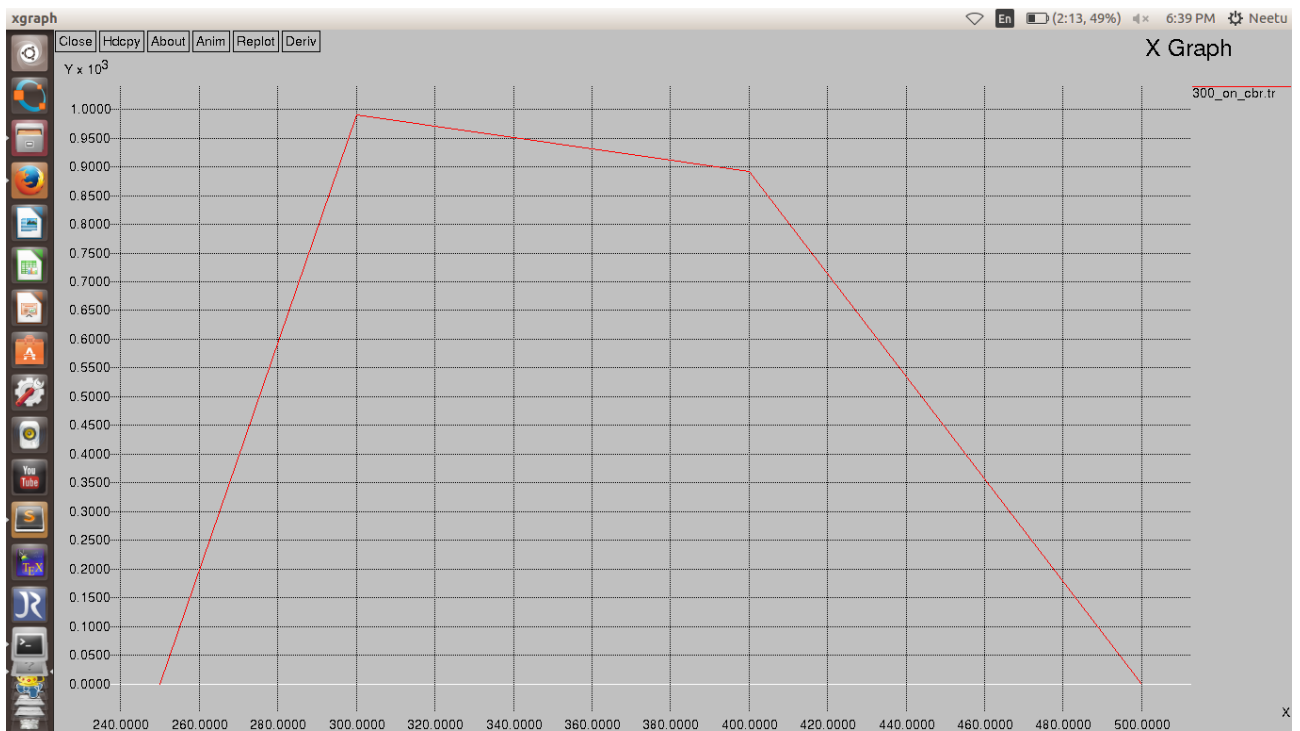
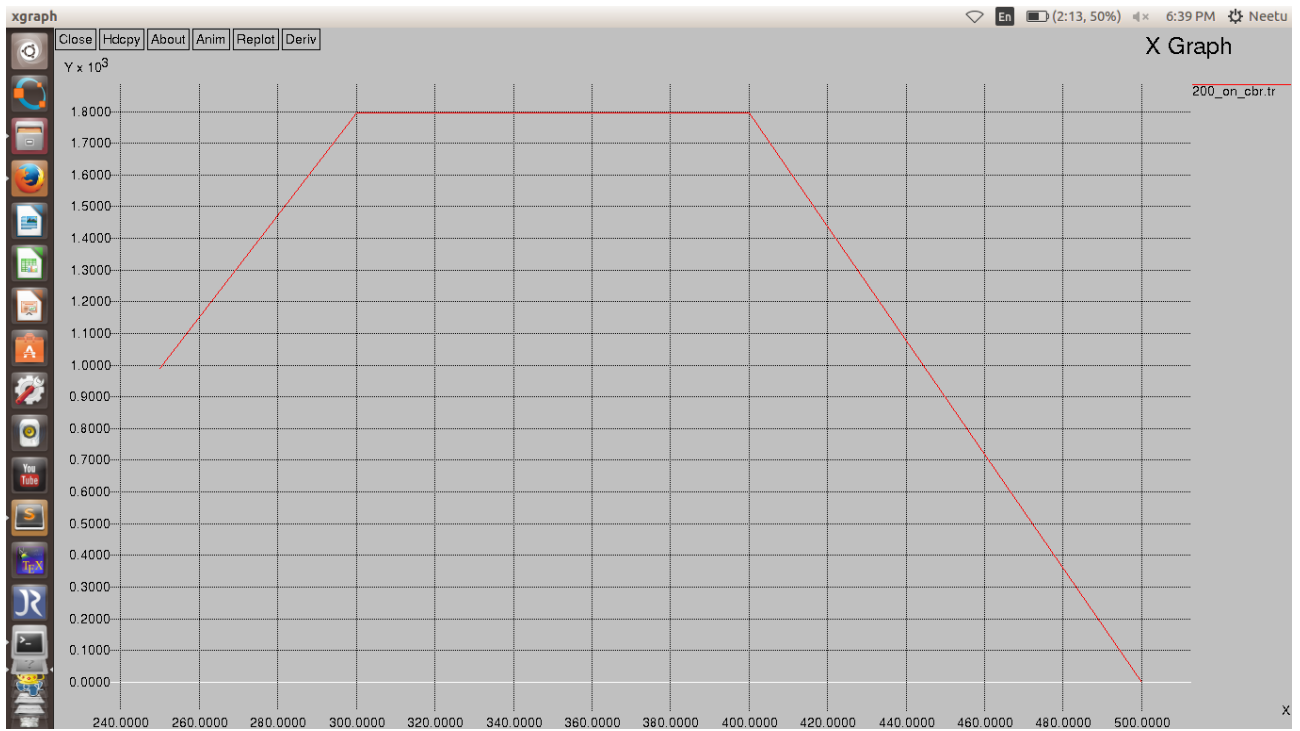
Throughput-graphs:



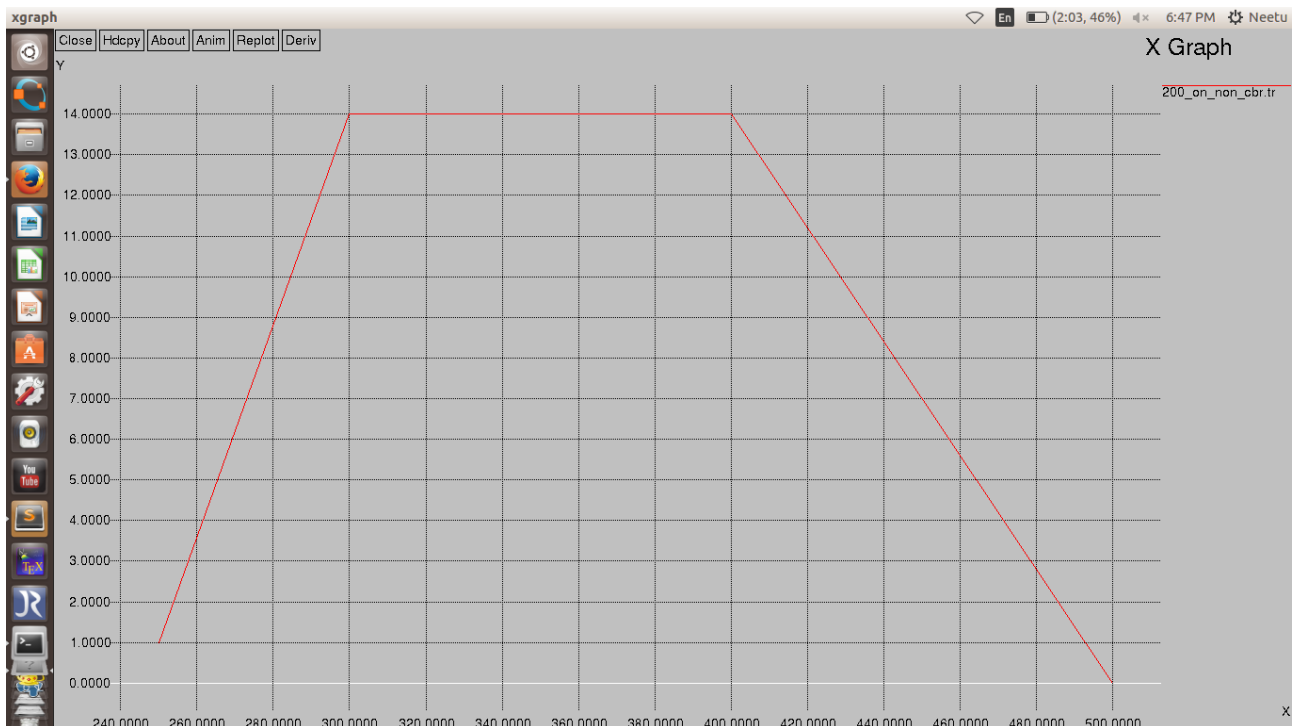


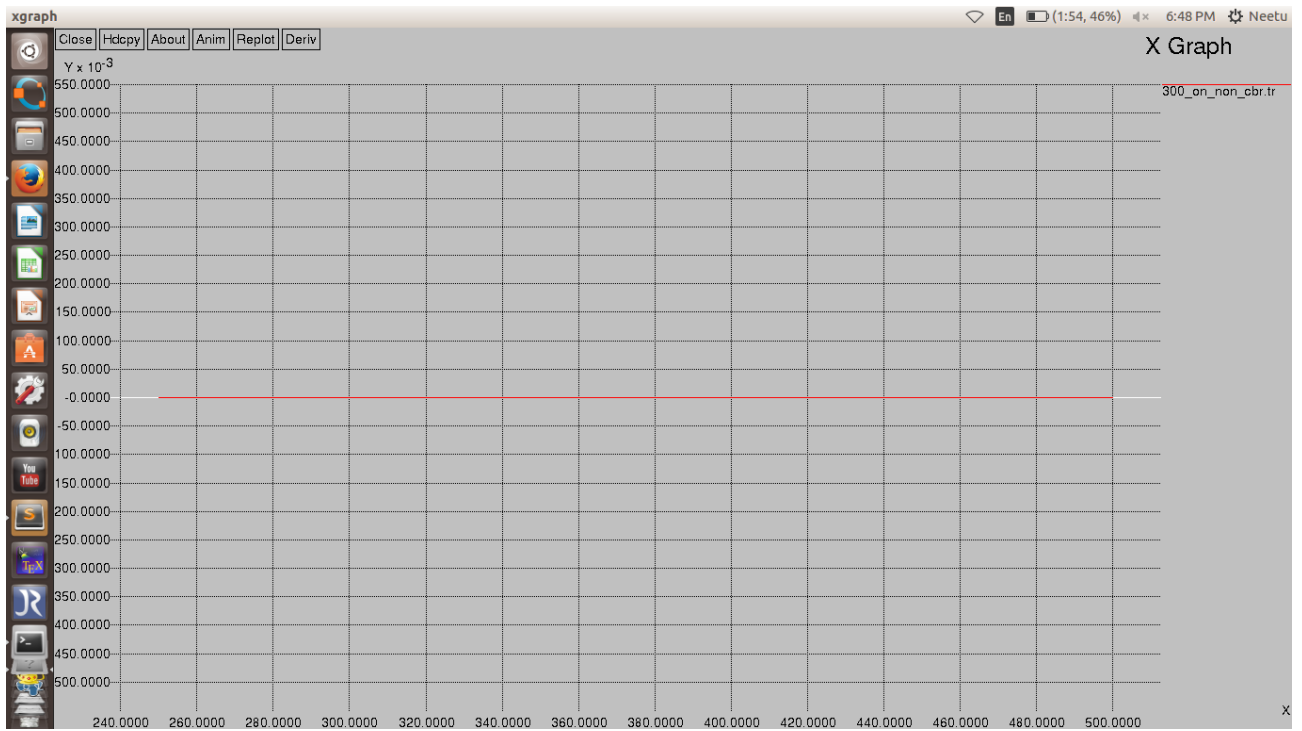
CBR packet-graphs:





Non CBR packet-graphs:

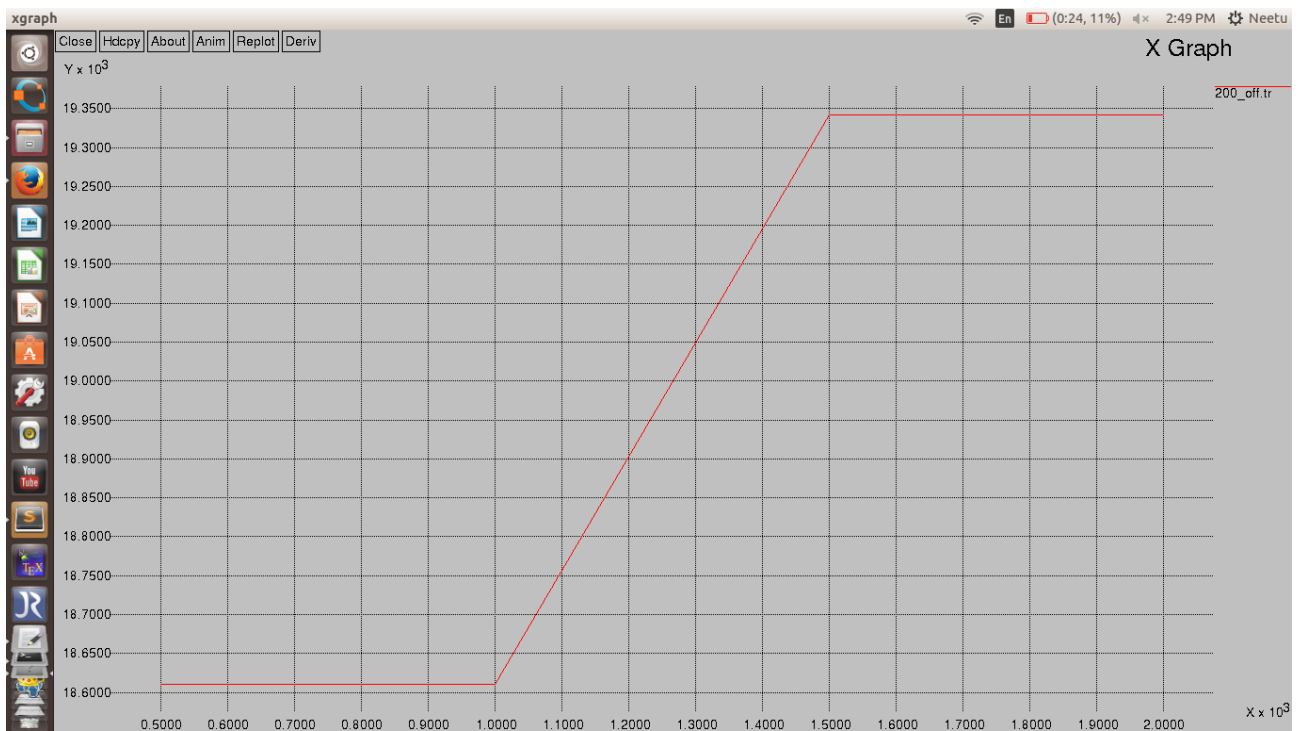


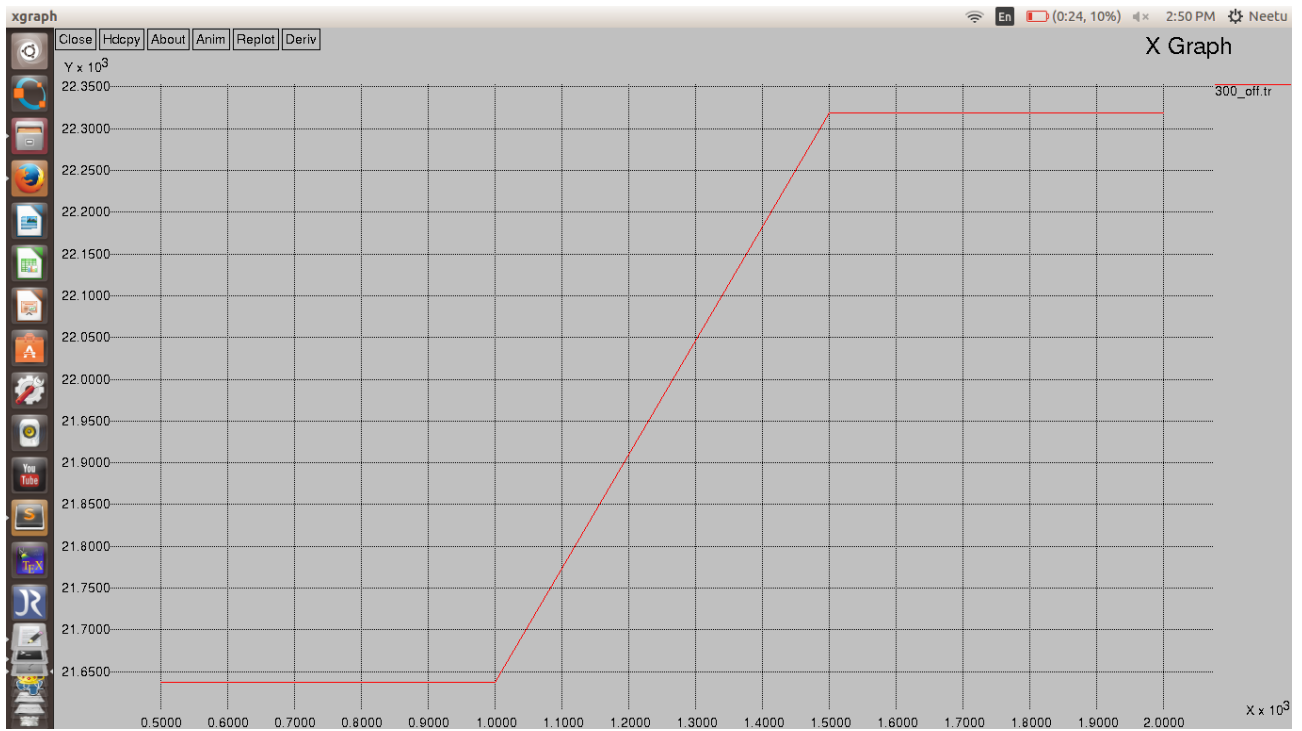


- Virtual Carrier Sensing:

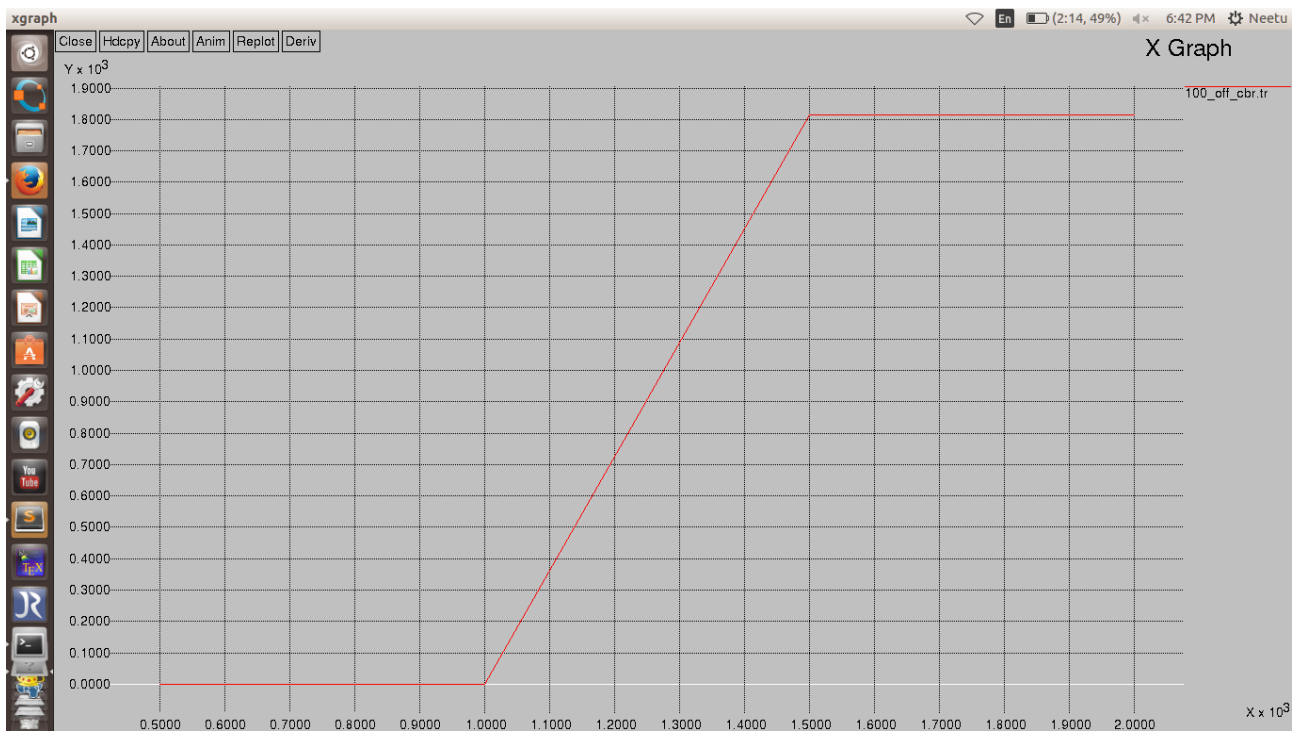
| RTSThresh | CSThresh_ | Distance | Throughput | CBR packets | Non-CBR packets |
|-----------|-----------|----------|--------------|-------------|-----------------|
| 500 | 3.652e-10 | 100 | 18906.043733 | 0 | 490 |
| 1000 | 3.652e-10 | 100 | 18906.043733 | 0 | 490 |
| 1500 | 3.652e-10 | 100 | 17064.300089 | 1814 | 31 |
| 2000 | 3.652e-10 | 100 | 17064.300089 | 1814 | 31 |
| | | | | | |
| 500 | 3.652e-10 | 200 | 18610.676622 | 456 | 385 |
| 1000 | 3.652e-10 | 200 | 18610.676622 | 456 | 385 |
| 1500 | 3.652e-10 | 200 | 19341.585067 | 990 | 1 |
| 2000 | 3.652e-10 | 200 | 19341.585067 | 990 | 1 |
| | | | | | |
| 500 | 3.652e-10 | 300 | 21637.529600 | 0 | 0 |
| 1000 | 3.652e-10 | 300 | 21637.529600 | 0 | 0 |
| 1500 | 3.652e-10 | 300 | 22318.557867 | 0 | 0 |
| 2000 | 3.652e-10 | 300 | 22318.557867 | 0 | 0 |

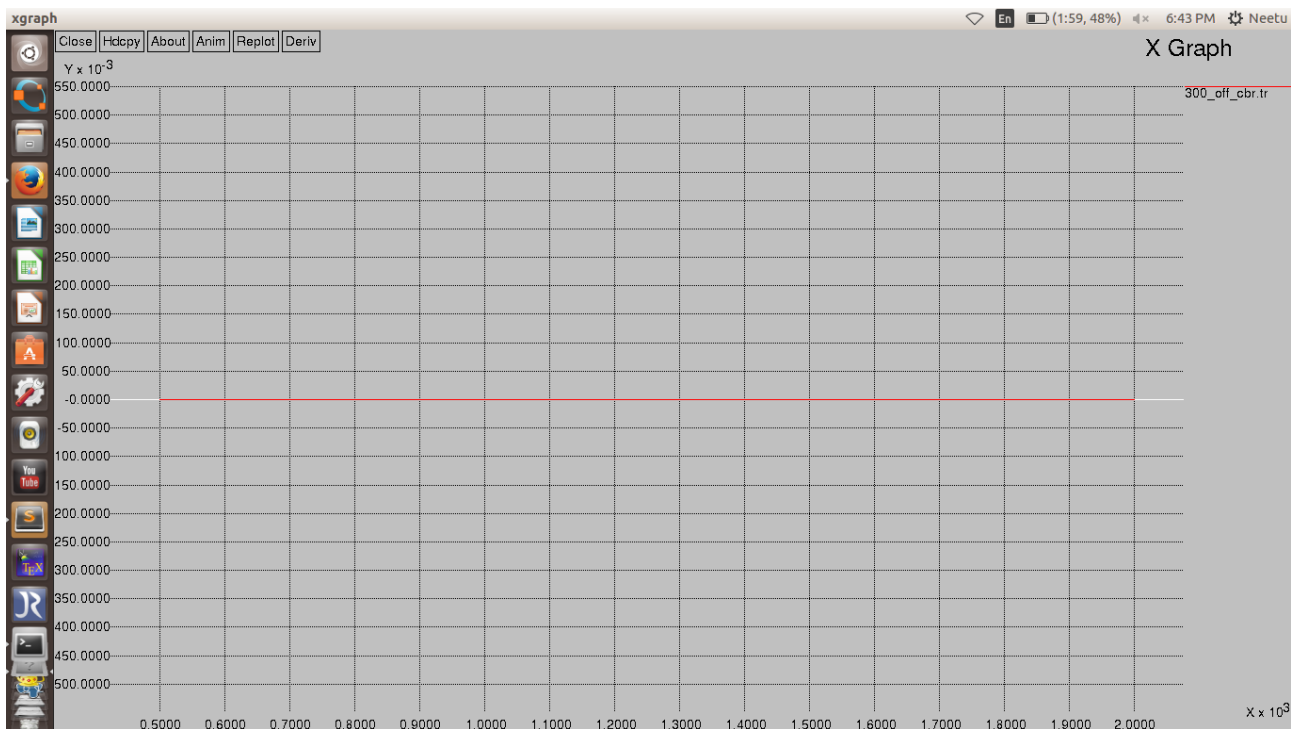
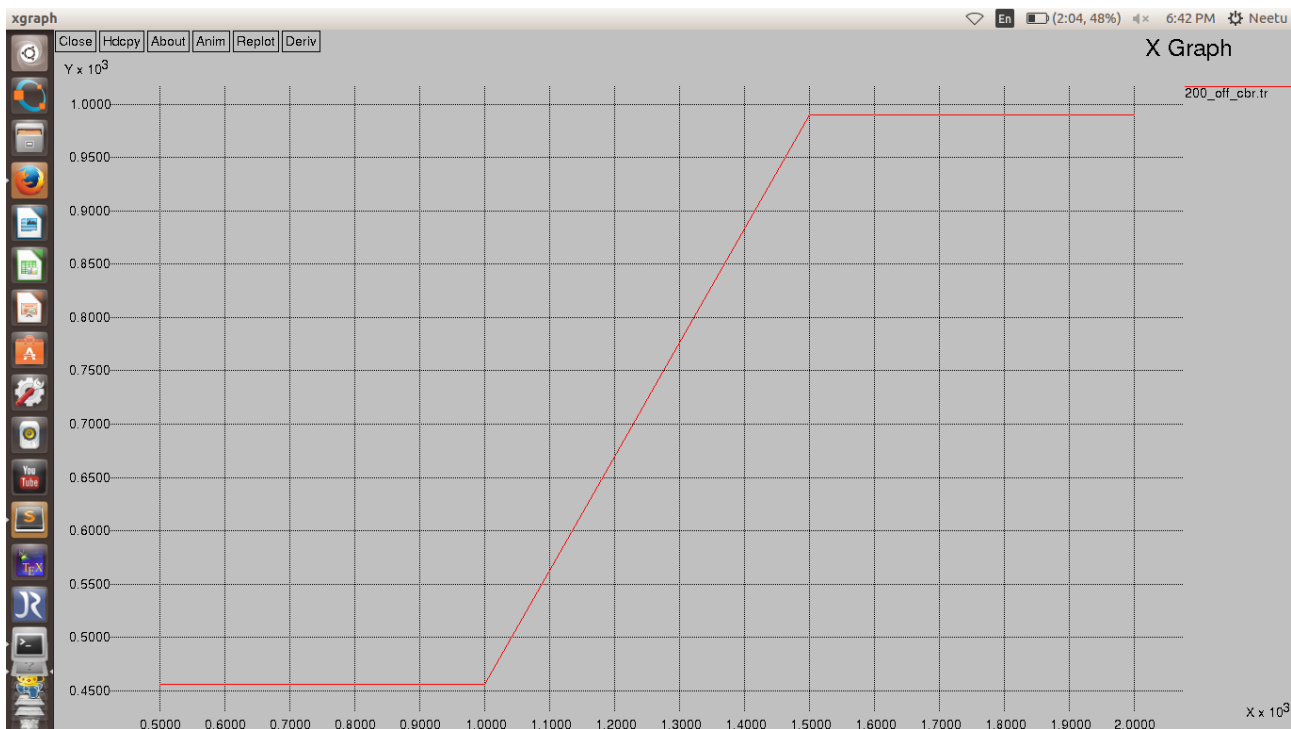
Throughput-graphs:



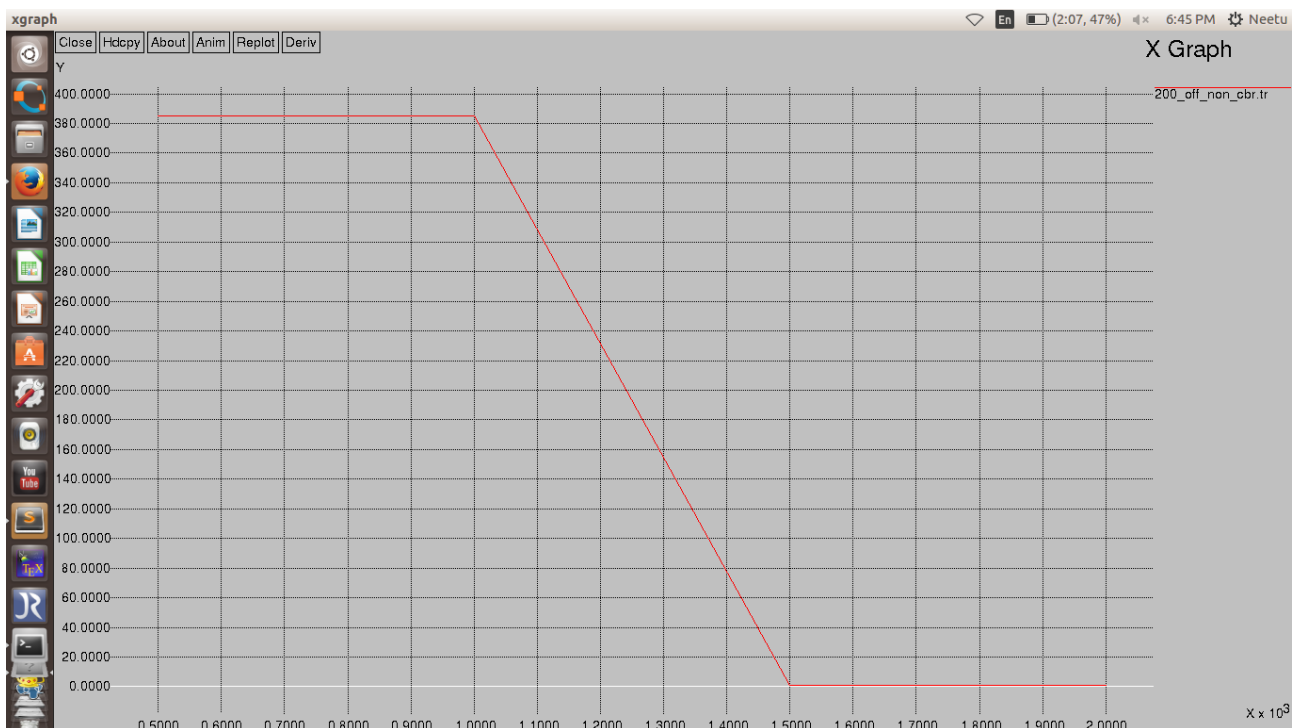
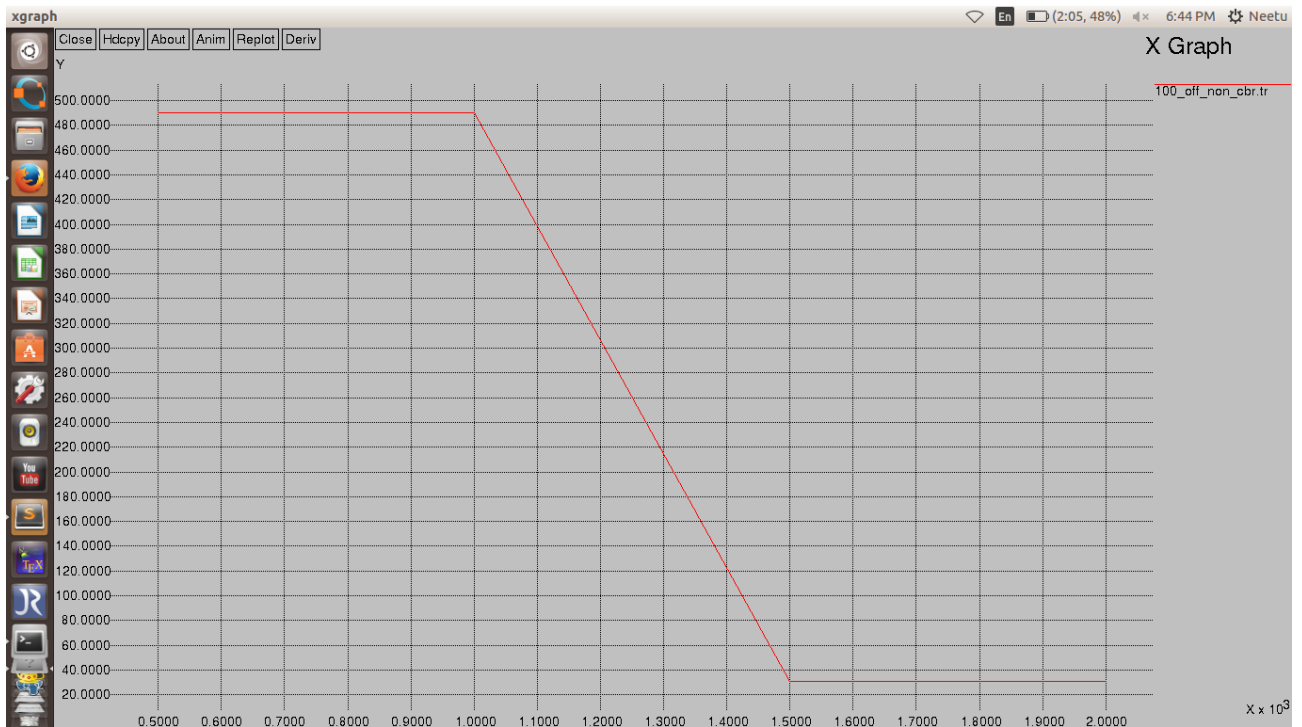


CBR packet-graphs:





Non CBR packet-graphs:



- Inference from graphs

- Physical Carrier Sensing:

When the distance was small, the throughput was increasing. At medium distance, the throughput increased at the beginning and then decreased. At high distance, the throughput decreased.

- Virtual Carrier Sensing:

When the distance was small, the throughput was decreasing. At medium and high distance, the throughput was increasing.