Lab Experiment 2

Build and configure a simple wired network

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Course – Wireless Network

Aim : To build and configure a simple wired network of four nodes connected with point to point links and observe the statistics by creating a bottleneck in link.

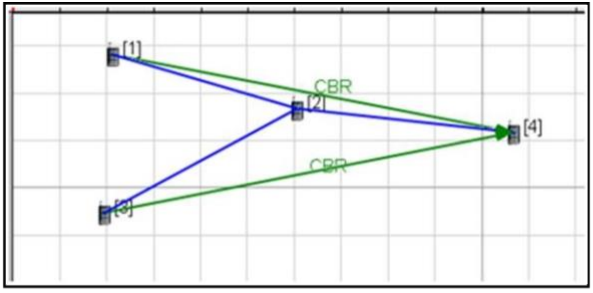
Theory :

Bottleneck

1. A network bottleneck refers to a discrete condition in which data flow is limited by computer or network resources.
2. The flow of data is controlled according to the bandwidth of various system resources.
3. If the system working on a network is delivering a higher volume of data than what is supported by the existing capacity of the network, then a network bottleneck will occur.
4. A network bottleneck results in slow communication speeds and limits user efficiency and productivity on a network.
5. To avoid all these problems, systems are built to support a particular data flow capacity so that work can continue without any issues.
6. On a network, each system is able to work according to its processor speed, its memory size, its cache speed and its network interface card speed. These discrete systems do not rely on other network resources to accept their incoming data at the rate they are sending because these objects only receive data according to their own capacity.

Cause of Bottlenecks

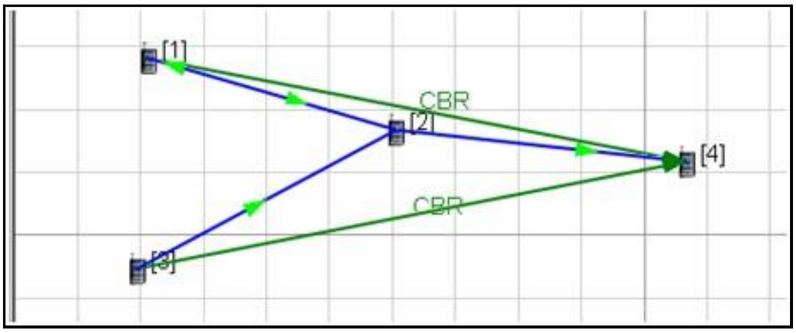
a. Hardware components, like CPUs
b. Graphical processing units
c. RAM memory



Procedure:

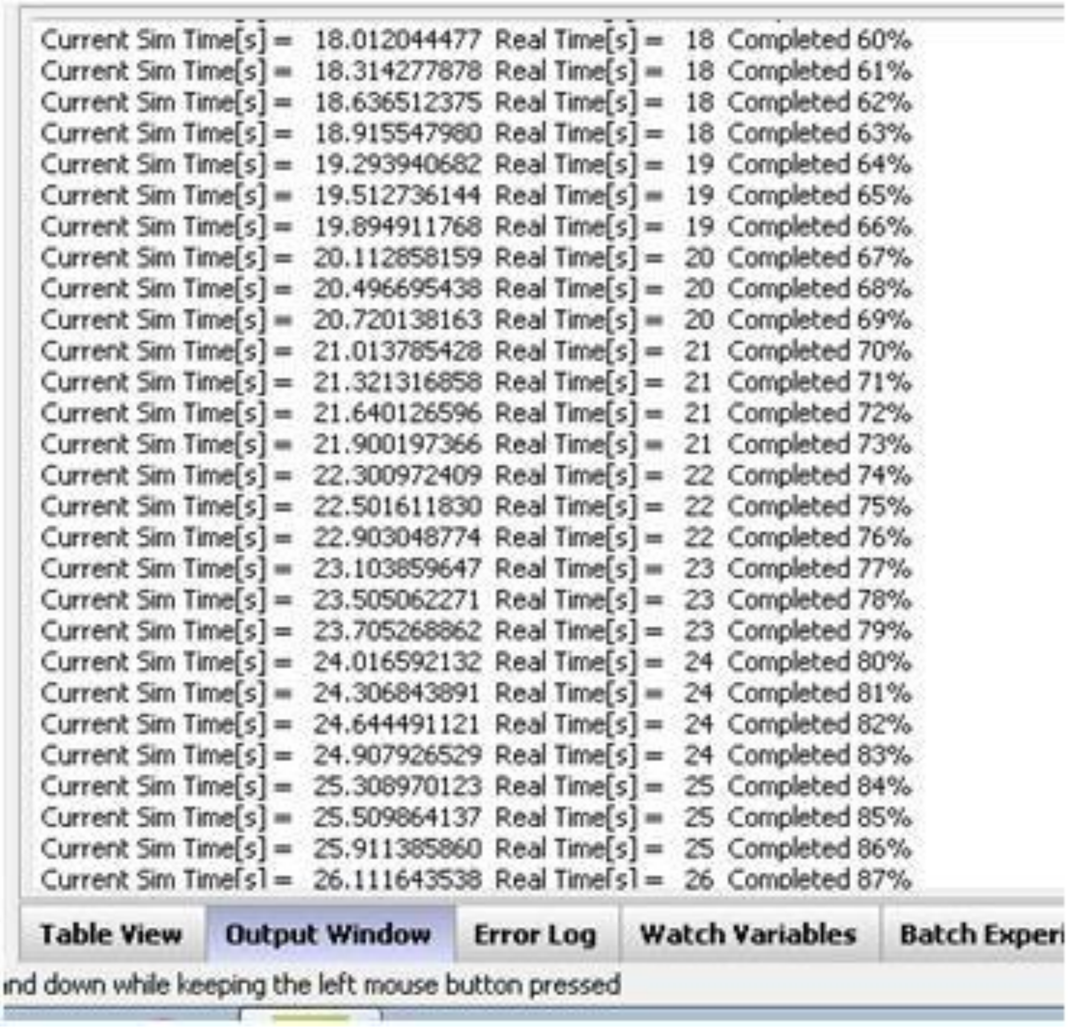
For non-bottleneck scenario:

1. Create a new scenario in the Scenario Designer and save it.
2. Place four default nodes (mobile devices) manually in the same order as in the topology using a CBR link.
3. Connect 1-2, 2-4, 3-2 using wires.
4. Connect nodes with point-to-point links. Use bandwidth of 10Mbps and propagation delay of 1MS by default.
5. Add CBR (Constant Bit Rate) as application layer traffic from nodes 1, 2 to node 4. (Modify Items to Send as '100', Interval as 'lMS', Start Time as '0S', and End Time as '30S', which means node 1 sends totally 75 application layer packets-(512B each) to node 4 at a rate of 1 packet every 1 millisecond starting from OS to 30S.)
6. Run the simulation to get the results.
7. Switch to the analyzer to view the graphs.



Running the simulation:

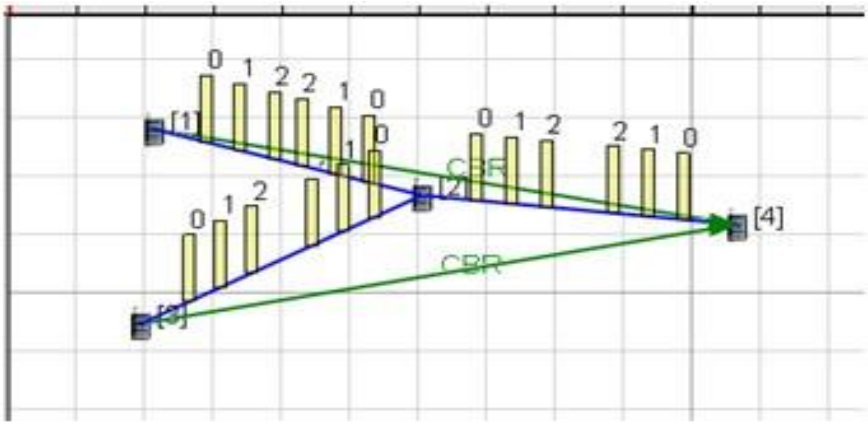
Output window:



```
Current Sim Time[s] =  18.012044477 Real Time[s] =  18 Completed 60%
Current Sim Time[s] =  18.314277878 Real Time[s] =  18 Completed 61%
Current Sim Time[s] =  18.636512375 Real Time[s] =  18 Completed 62%
Current Sim Time[s] =  18.915547980 Real Time[s] =  18 Completed 63%
Current Sim Time[s] =  19.293940682 Real Time[s] =  19 Completed 64%
Current Sim Time[s] =  19.512736144 Real Time[s] =  19 Completed 65%
Current Sim Time[s] =  19.894911768 Real Time[s] =  19 Completed 66%
Current Sim Time[s] =  20.112858159 Real Time[s] =  20 Completed 67%
Current Sim Time[s] =  20.496695438 Real Time[s] =  20 Completed 68%
Current Sim Time[s] =  20.720138163 Real Time[s] =  20 Completed 69%
Current Sim Time[s] =  21.013785428 Real Time[s] =  21 Completed 70%
Current Sim Time[s] =  21.321316858 Real Time[s] =  21 Completed 71%
Current Sim Time[s] =  21.640126596 Real Time[s] =  21 Completed 72%
Current Sim Time[s] =  21.900197366 Real Time[s] =  21 Completed 73%
Current Sim Time[s] =  22.300972409 Real Time[s] =  22 Completed 74%
Current Sim Time[s] =  22.501611830 Real Time[s] =  22 Completed 75%
Current Sim Time[s] =  22.903048774 Real Time[s] =  22 Completed 76%
Current Sim Time[s] =  23.103859647 Real Time[s] =  23 Completed 77%
Current Sim Time[s] =  23.505062271 Real Time[s] =  23 Completed 78%
Current Sim Time[s] =  23.705268862 Real Time[s] =  23 Completed 79%
Current Sim Time[s] =  24.016592132 Real Time[s] =  24 Completed 80%
Current Sim Time[s] =  24.306843891 Real Time[s] =  24 Completed 81%
Current Sim Time[s] =  24.644491121 Real Time[s] =  24 Completed 82%
Current Sim Time[s] =  24.907926529 Real Time[s] =  24 Completed 83%
Current Sim Time[s] =  25.308970123 Real Time[s] =  25 Completed 84%
Current Sim Time[s] =  25.509864137 Real Time[s] =  25 Completed 85%
Current Sim Time[s] =  25.911385860 Real Time[s] =  25 Completed 86%
Current Sim Time[s] =  26.111643538 Real Time[s] =  26 Completed 87%
```

ınd down while keeping the left mouse button pressed

Transmission in non bottlenecked network

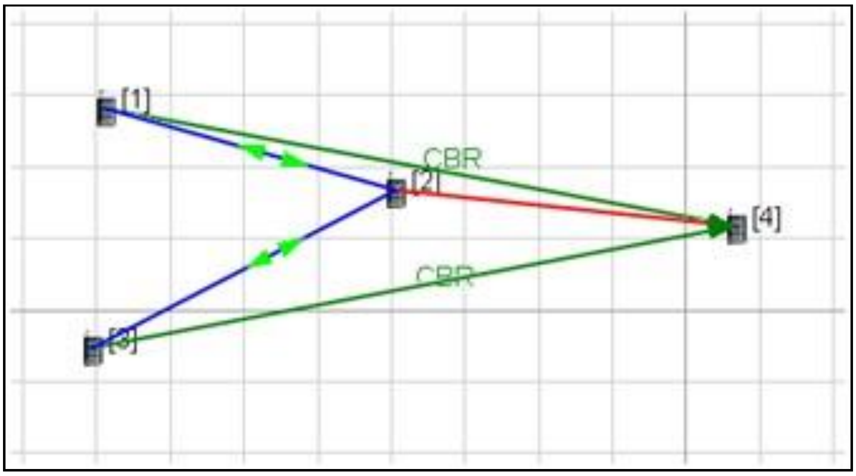


For bottleneck scenario:

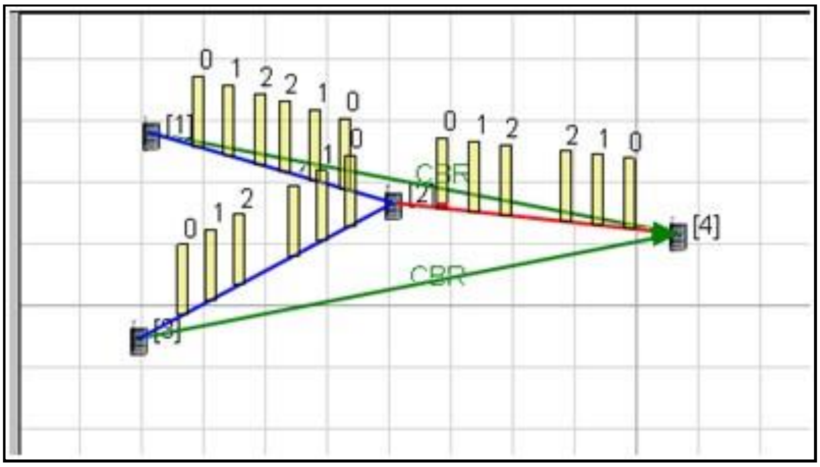
1. In bottleneck the bandwidth of the 4th mobile device is reduced to 1bps.

2. Now run the simulation again keeping all other configurations the same.

- ***Running the simulation for bottlenecked network:***



Transmission in bottlenecked network:

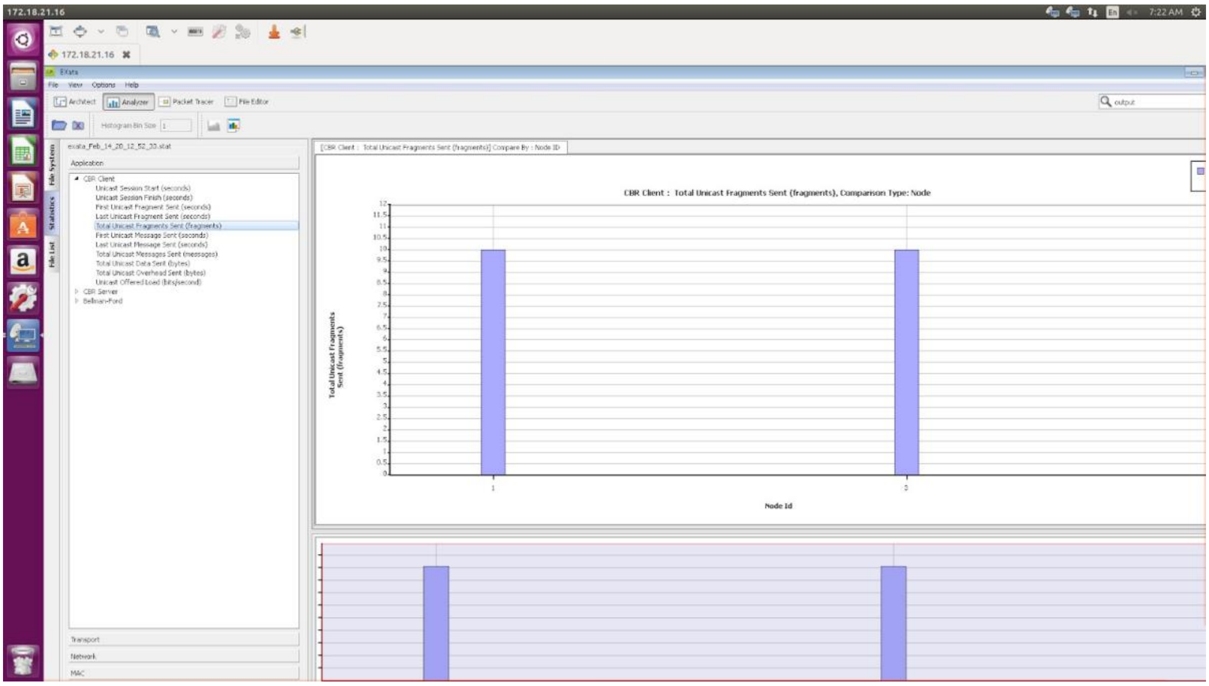


Here in the above image, the red part in the bar indicates that a bottleneck was created.

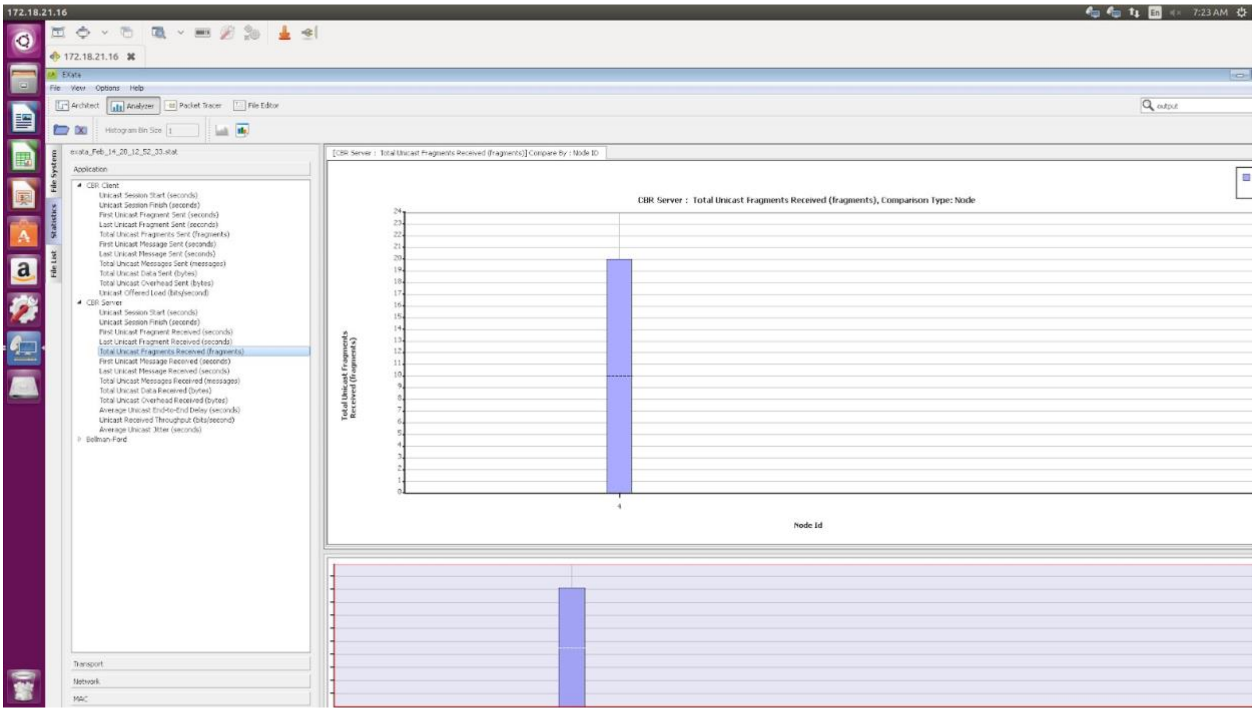
RESULTS:

- ***For non-bottlenecked network***

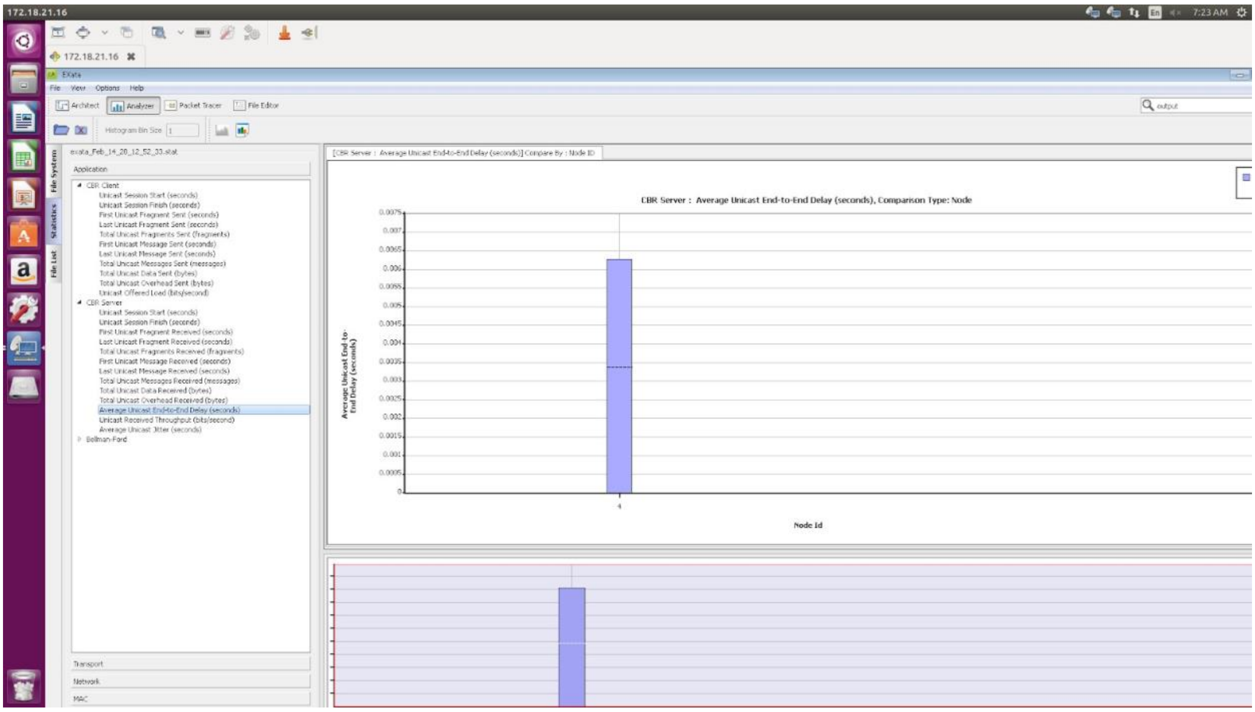
➢ ***Number of packets sent***


172.18.21.16
7:22 AM
172.18.21.16
EXata
File View Options Help
Architect
Analyzer
Packet Tracer
File Editor
output
Histogram Bin Size 1
File System
Statistics
File List
exata_Feb_14_20_12_52_33.stat
Application
CBR Client
Unicast Session Start (seconds)
Unicast Session Finish (seconds)
First Unicast Fragment Sent (seconds)
Last Unicast Fragment Sent (seconds)
Total Unicast Fragments Sent (fragments)
First Unicast Message Sent (seconds)
Last Unicast Message Sent (seconds)
Total Unicast Messages Sent (messages)
Total Unicast Data Sent (bytes)
Total Unicast Overhead Sent (bytes)
Unicast Offered Load (bits/second)
CBR Server
Bellman-Ford
Transport
Network
MAC
[CBR Client : Total Unicast Fragments Sent (fragments)] Compare By : Node ID
CBR Client : Total Unicast Fragments Sent (fragments), Comparison Type: Node
Total Unicast Fragments Sent (fragments)
12
11.5
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1
2
Node Id

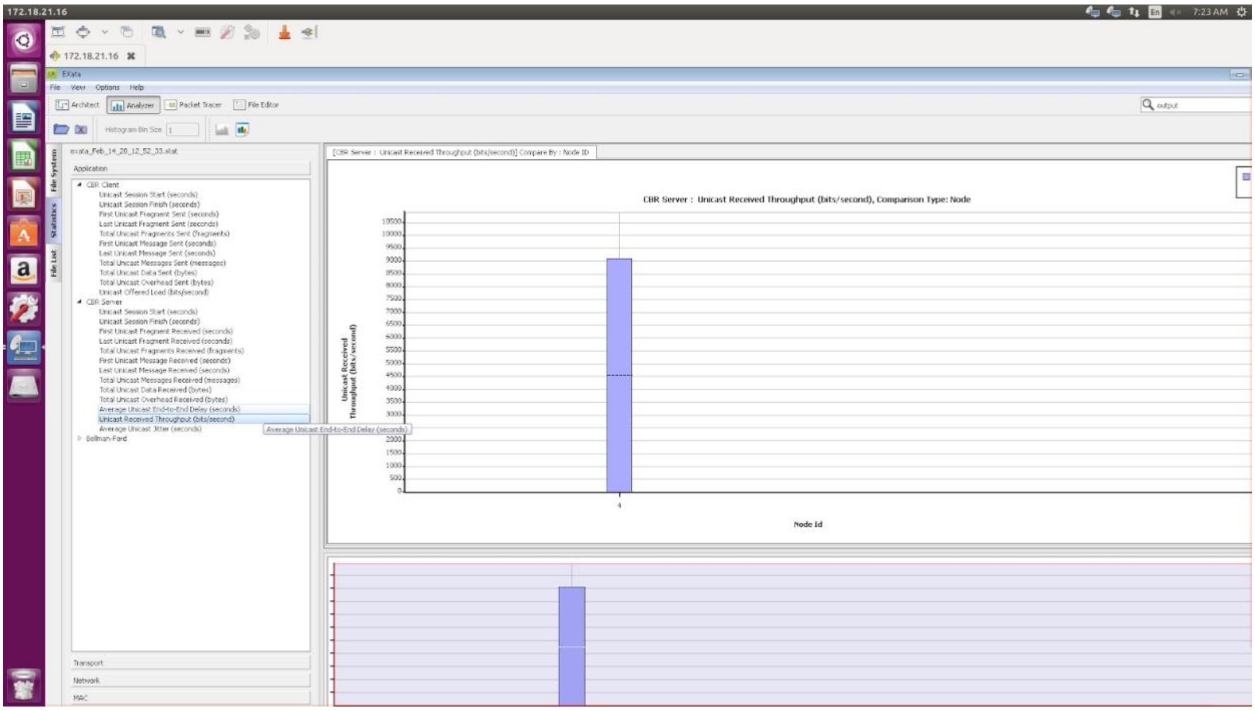
- ***Number of packets received***


172.18.21.16
7:23 AM
172.18.21.16
EXata
File View Options Help
Architect
Analyzer
Packet Tracer
File Editor
output
Histogram Bin Size 1
File System
Statistics
File List
exata_Feb_14_20_12_52_33.stat
Application
CBR Client
Unicast Session Start (seconds)
Unicast Session Finish (seconds)
First Unicast Fragment Sent (seconds)
Last Unicast Fragment Sent (seconds)
Total Unicast Fragments Sent (fragments)
First Unicast Message Sent (seconds)
Last Unicast Message Sent (seconds)
Total Unicast Messages Sent (messages)
Total Unicast Data Sent (bytes)
Total Unicast Overhead Sent (bytes)
Unicast Offered Load (bits/second)
CBR Server
Unicast Session Start (seconds)
Unicast Session Finish (seconds)
First Unicast Fragment Received (seconds)
Last Unicast Fragment Received (seconds)
Total Unicast Fragments Received (fragments)
First Unicast Message Received (seconds)
Last Unicast Message Received (seconds)
Total Unicast Messages Received (messages)
Total Unicast Data Received (bytes)
Total Unicast Overhead Received (bytes)
Average Unicast End-to-End Delay (seconds)
Unicast Received Throughput (bits/second)
Average Unicast Jitter (seconds)
Bellman-Ford
Transport
Network
MAC
[CBR Server : Total Unicast Fragments Received (fragments)] Compare By : Node ID
CBR Server : Total Unicast Fragments Received (fragments), Comparison Type: Node
Total Unicast Fragments Received (fragments)
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
4
Node Id

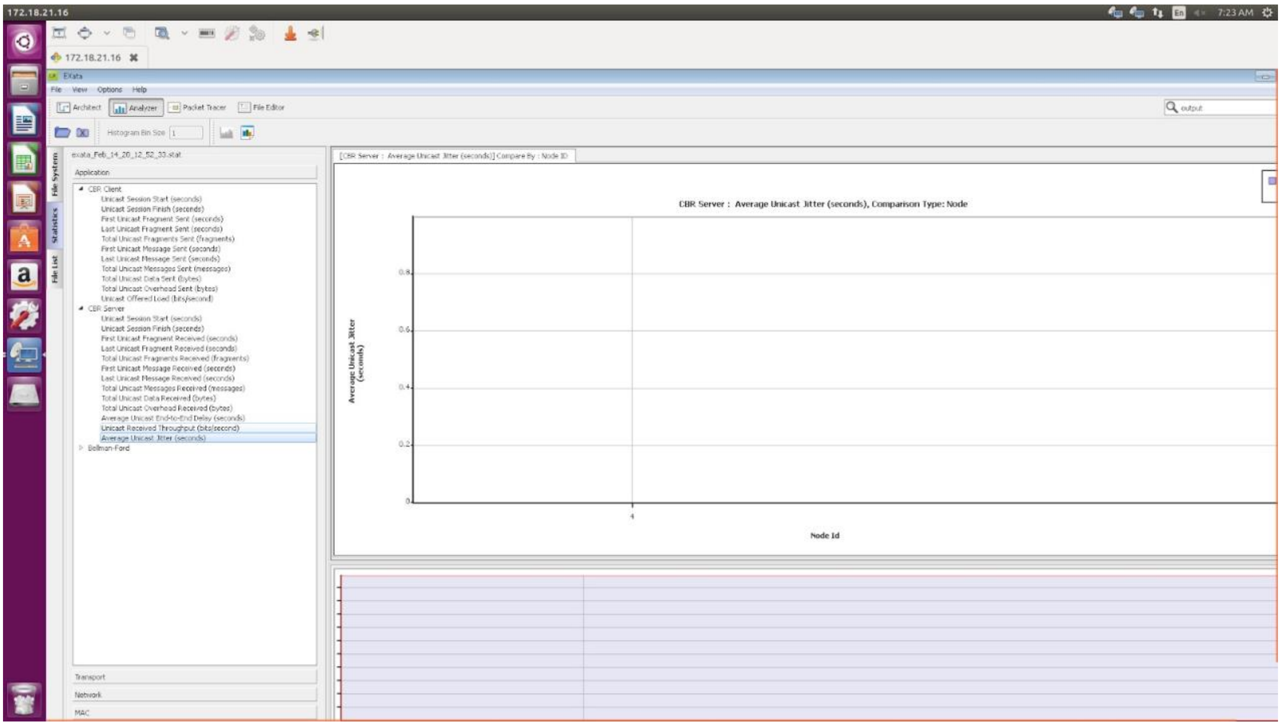
- ***End to end delay***


172.18.21.16
EXata
File View Options Help
Architect Analyzer Packet Tracer File Editor
Histogram Bin Size 1
exata_Feb_14_20_12_52_33.stat
Application
CBR Client
Unicast Session Start (seconds)
Unicast Session Finish (seconds)
First Unicast Fragment Sent (seconds)
Last Unicast Fragment Sent (seconds)
Total Unicast Fragments Sent (fragments)
First Unicast Message Sent (seconds)
Last Unicast Message Sent (seconds)
Total Unicast Messages Sent (messages)
Total Unicast Data Sent (bytes)
Total Unicast Overhead Sent (bytes)
Unicast Offered Load (bits/second)
CBR Server
Unicast Session Start (seconds)
Unicast Session Finish (seconds)
First Unicast Fragment Received (seconds)
Last Unicast Fragment Received (seconds)
Total Unicast Fragments Received (fragments)
First Unicast Message Received (seconds)
Last Unicast Message Received (seconds)
Total Unicast Messages Received (messages)
Total Unicast Data Received (bytes)
Total Unicast Overhead Received (bytes)
Average Unicast End-to-End Delay (seconds)
Unicast Received Throughput (bits/second)
Average Unicast Jitter (seconds)
Bellman-Ford
Transport
Network
MAC
[CBR Server : Average Unicast End-to-End Delay (seconds)] Compare By : Node ID
CBR Server : Average Unicast End-to-End Delay (seconds), Comparison Type: Node
Average Unicast End-to-End Delay (seconds)
0.0075
0.007
0.0065
0.006
0.0055
0.005
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
4
Node Id
7:23 AM

- ***Throughput***

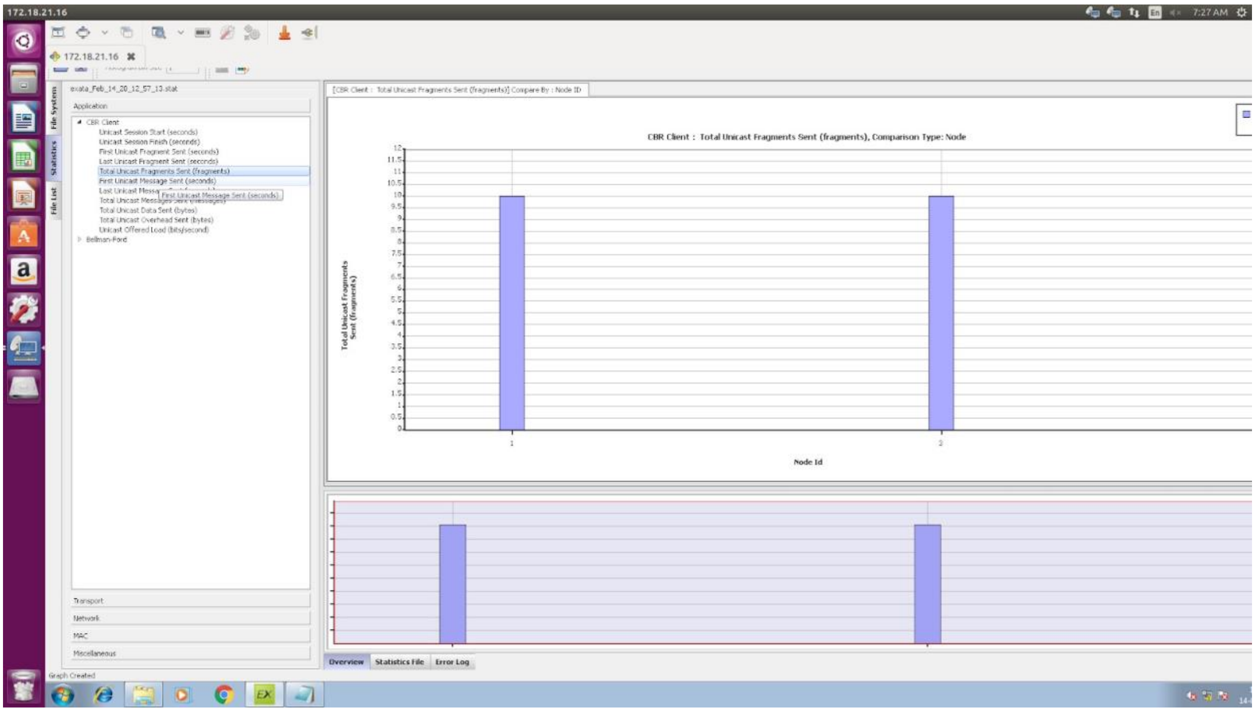

172.18.21.16
EXata
File View Options Help
Architect Analyzer Packet Tracer File Editor
Histogram Bin Size 1
exata_Feb_14_20_12_52_33.stat
Application
CBR Client
CBR Server
Average Unicast End-to-End Delay (seconds)
Unicast Received Throughput (bits/second)
Average Unicast Jitter (seconds)
Bellman-Ford
Transport
Network
MAC
[CBR Server : Unicast Received Throughput (bits/second)] Compare By : Node ID
CBR Server : Unicast Received Throughput (bits/second), Comparison Type: Node
Unicast Received Throughput (bits/second)
10500
10000
9500
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2000
1500
1000
500
0
4
Node Id
7:23 AM

- ***Average jitter***


172.18.21.16
7:23 AM
EXata
File View Options Help
Architect
Analyzer
Packet Tracer
File Editor
Histogram Bin Size 1
exata_Feb_14_20_12_52_33.stat
Application
CBR Client
Unicast Session Start (seconds)
Unicast Session Finish (seconds)
First Unicast Fragment Sent (seconds)
Last Unicast Fragment Sent (seconds)
Total Unicast Fragments Sent (fragments)
First Unicast Message Sent (seconds)
Last Unicast Message Sent (seconds)
Total Unicast Messages Sent (messages)
Total Unicast Data Sent (bytes)
Total Unicast Overhead Sent (bytes)
Unicast Offered Load (bits/second)
CBR Server
Unicast Session Start (seconds)
Unicast Session Finish (seconds)
First Unicast Fragment Received (seconds)
Last Unicast Fragment Received (seconds)
Total Unicast Fragments Received (fragments)
First Unicast Message Received (seconds)
Last Unicast Message Received (seconds)
Total Unicast Messages Received (messages)
Total Unicast Data Received (bytes)
Total Unicast Overhead Received (bytes)
Average Unicast End-to-End Delay (seconds)
Unicast Received Throughput (bits/second)
Average Unicast Jitter (seconds)
Bellman-Ford
Transport
Network
MAC
[CBR Server : Average Unicast Jitter (seconds)] Compare By : Node ID
CBR Server : Average Unicast Jitter (seconds), Comparison Type: Node
Average Unicast Jitter (seconds)
0.8
0.6
0.4
0.2
0
4
Node Id

- ***For network with bottleneck***

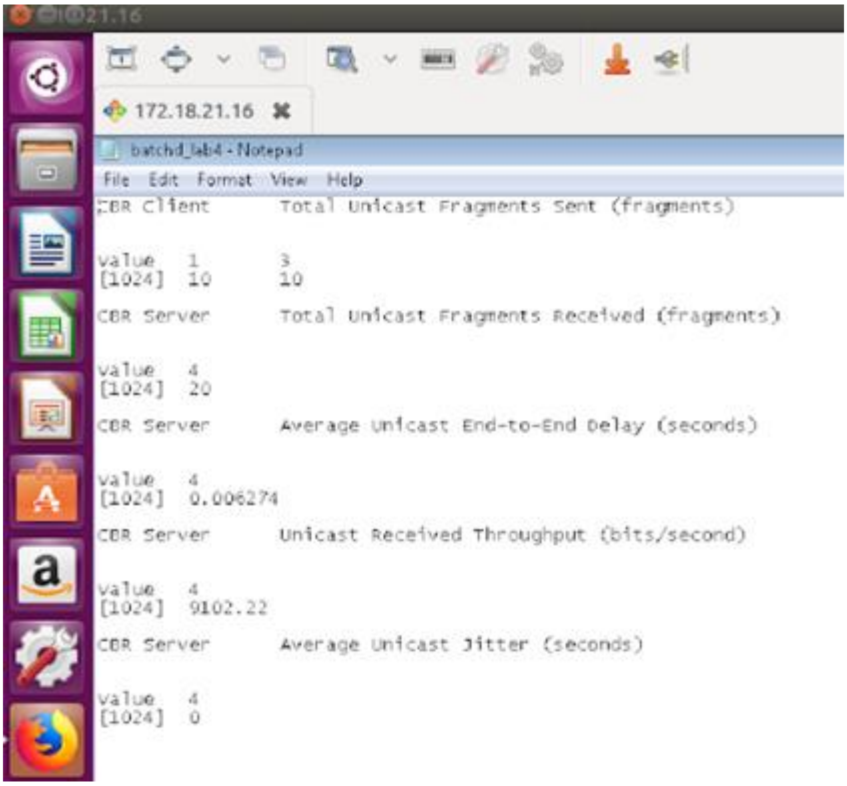
□ ***Number of packets sent***


172.18.21.16
7:27 AM
172.18.21.16
exata_Feb_14_20_12_57_13.stat
Application
CBR Client
Unicast Session Start (seconds)
Unicast Session Finish (seconds)
First Unicast Fragment Sent (seconds)
Last Unicast Fragment Sent (seconds)
Total Unicast Fragments Sent (fragments)
First Unicast Message Sent (seconds)
Last Unicast Message Sent (seconds)
Total Unicast Messages Sent (messages)
Total Unicast Data Sent (bytes)
Total Unicast Overhead Sent (bytes)
Unicast Offered Load (bits/second)
Bellman-Ford
Transport
Network
MAC
Miscellaneous
[CBR Client : Total Unicast Fragments Sent (fragments)] Compare By : Node ID
CBR Client : Total Unicast Fragments Sent (fragments), Comparison Type: Node
Total Unicast Fragments Sent (fragments)
12
11.5
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1
3
Node Id
Overview
Statistics File
Error Log
Graph Created

ANALYSIS:

For non bottlenecked network

Results



```
CBR Client          Total Unicast Fragments Sent (fragments)

Value    1          3
[1024]   10         10
CBR Server          Total Unicast Fragments Received (fragments)

Value    4
[1024]   20
CBR Server          Average Unicast End-to-End Delay (seconds)

Value    4
[1024]   0.006274
CBR Server          Unicast Received Throughput (bits/second)

Value    4
[1024]   9102.22
CBR Server          Average Unicast Jitter (seconds)

Value    4
[1024]   0
```

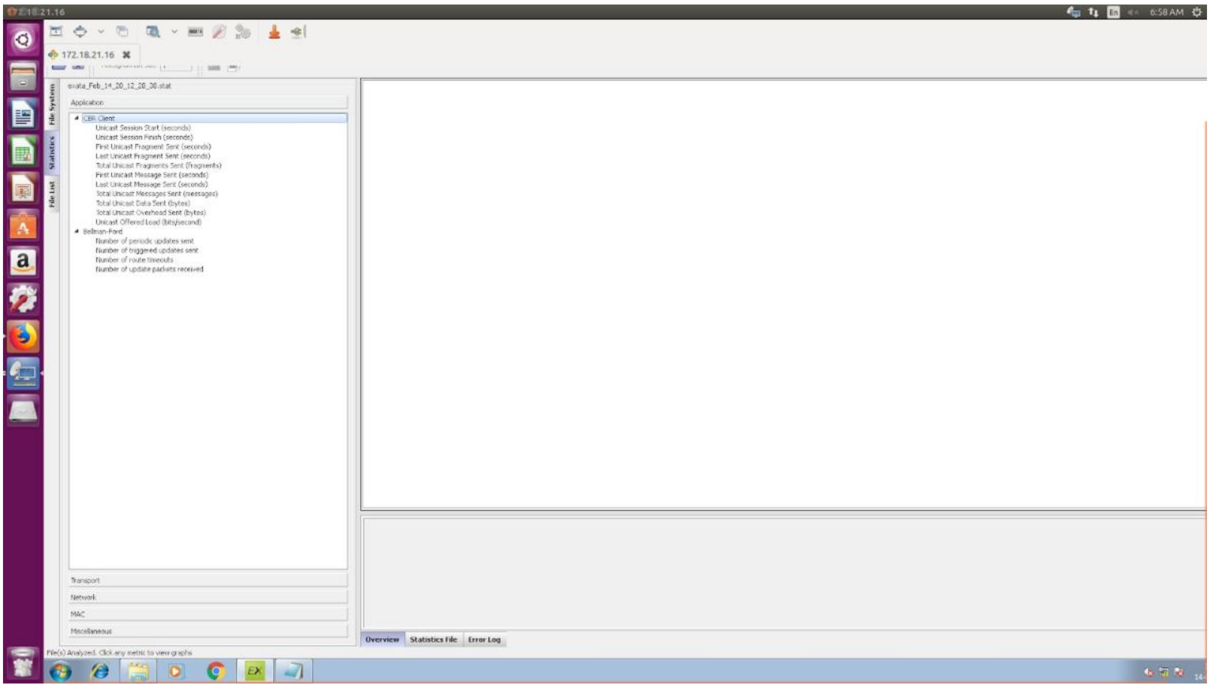
Packet delivery ratio (pdr) = **(**Number of packets received) / (Number of packets sent)

= 20 / 20

= 1

- *For network with bottleneck*

No packets received on the server side



```
exata_Feb_14_20_12_28_38.stat
CBR Client
    Unicast Session Start (seconds)
    Unicast Session Finish (seconds)
    First Unicast Fragment Sent (seconds)
    Last Unicast Fragment Sent (seconds)
    Total Unicast Fragments Sent (fragments)
    First Unicast Message Sent (seconds)
    Last Unicast Message Sent (seconds)
    Total Unicast Messages Sent (messages)
    Total Unicast Data Sent (bytes)
    Total Unicast Overhead Sent (bytes)
    Unicast Offered Load (bits/second)
Bellman-Ford
    Number of periodic updates sent
    Number of triggered updates sent
    Number of route timeouts
    Number of update packets received
```

Since, we decrease the bandwidth of the node the signal is not transmitted to the server from the client. Thus all packets are dropped due to the bottleneck created. As a result, we don‘t get graphs for the number of fragments received, throughput, delay or jitter.

Conclusion :

Thus we have studied about a simple wired network of four nodes connected with point to point links is studied and the results of a bottlenecked and non-bottlenecked network are analysed successfully.