Birla Institute of Technology &Science, Pilani

Computer Networks (CS F 303 / IS F 303)

Second Semester 2015-2016

Lab Session: 6

Source: NetSim

NetSim is a leading network simulation software for protocol modeling and simulation, network R & D and defence applications. It allows you to analyze computer networks with unmatched depth, power and flexibility.
More information available at: https://www.http://tetcos.com

Transmission Control Protocol (TCP)

New Experiments

In the **Simulation** menu select → **New** → **WAN** → **TCP**.

To perform experiments in **TCP**, the following steps should be followed,

- **Create Scenario**
- **Set CPE Properties**
- **Set Link Properties**
- **Set Router Properties**
- **Remove Devices (or) Links**
- **Simulate**

Create Scenario

Adding CPE (Customer Premise Equipment) - **Click** on the **TCP CPE** icon, **drag** and **drop** the **TCP CPE** on the environment builder.

Adding Router - **Click** on the **TCP Router** icon, **drag** and **drop** the **Router** on the environment builder. A **Router** here has eight **Ports** in which eight devices can be connected.

Establishing Connections between TCP CPE and Router - To establish a connection follow these steps,

- The connection between the two **TCP CPEs** cannot be made in the network.
- On **clicking** the two devices connection can be made.
- The connection possibilities are as follows,
    - **CPE** to **Router** and
    - **Router** to **Router**.

Set CPE (Customer Premises Equipment) Properties

Right Click on the appropriate node to select Properties. Then, **click** on **Application 1** to modify properties.

Transmission Type: This indicates the type of transmission made by this session. Only Point to Point Transmission is supported.

Destination: This property indicates the Destination CPE.

Traffic Type: This property indicates the type of traffic.

Data

Packet Size

Distribution: Only Constant distribution is available in this version**.**

Packet Size: Sets the size of the packets being generated by the Constant distribution.

Inter Arrival Time: This indicates the time gap between packets.

Traffic Pattern: Only Backlog is available in this version since the packets are transmitted only on receipt of acknowledgements.

Click OK to accept the user entered values. **Click** on the close button at the top right corner to exit the screen.

Transport Layer

Congestion Control: By default Old Tahoe is available. This can be modified to Tahoe.

Window size (Bytes): Either 11680 or 23360 can be selected as the Window size.

Network Layer

IP Address: Set the IP Address of the Nodes by selecting the appropriate values.

Subnet Mask: Enter a suitable subnet mask in this field.

Modifying/Viewing/Accepting Properties

On opening an already configured properties of an application the input fields will be frozen (i.e. the input cannot be changed).To modify these values click on the **Modify** button in the screen. Now the input value can be changed. Click on the **Accept** button, the modified values will be saved.

This **View** button is enabled once the **Accept** Button is clicked. To view the given values, click on the **View** button.

Set Link Properties

CPE to Router Link - To set the property values **right click** the **Link** between **CPE** to **Router** and select **Properties** option**.** There are 4 property options that are available. They are,

Error Rate (BER) - This property defines the rate at which the data is affected by error in the network. The values that can be selected are **10^-6**, **10^-7**, **10^-8**, **10^-9** and **No Error**. By **default** the **Error Rate** is **10^-6**.**10^-6** means one error in every 1000000 bits transmitted.

Physical Medium - This property defines the type of **Physical Medium** that is used in the network. The types of **Physical Medium** used in this simulation are **E0**, **T1**, **E1**, **T2** and **E2**. By **default E0** is entered.

Data Rate (Mbps) - This property defines the rate at which the link transmits data. Based on the type of **Physical Medium** the value of **Data Rate** is automatically **calculated** and **substituted**. By **default 0.064 Mbps** is entered. Changes cannot be made to this property.

Distance (Kms) - This property defines the **Distance** between two devices in **Kilometers**. By **default 1Km** is entered. A **4** digit value is the maximum **Distance** that can be entered.

Router to Router Link - To change the property values **right click** the **Link** between **Router** to **Router** and **click Properties.** There are 4 options for which changes can be made. They are,

Error Rate (BER) - This property defines the rate at which the data is affected by error in the network. The values that can be selected are **10^-6**, **10^-7**, **10^-8**, **10^-9** and **No Error**. By **default** the **Error Rate** is **10^-6**.**10^-6** means one error in every 1000000 bits transmitted.

Physical Medium - This property defines the type of **Physical Medium** used in the network. The **Physical Medium** that is used in connecting 2 **Routers** is a **CAT5**.

Data Rate (Mbps) - This property defines the rate at which the **Link** transmits data. The two types of **Data Rate** that can be selected are, **10** and **100 Mbps**. By **default 10Mbps** is entered.

Distance (km) - This property defines the **Distance** between two devices in **Kilometers**. By **default 1Km** is entered. A **4** digit value is the maximum Distance that can be entered.

Set Router Properties

Router Properties - To **change** any property, **right click** on the appropriate **Router** to get the option window and **click Properties**.

Ports Properties - The number of ports available in a **Router** are **8**. For each **Port** in a **Router** the following properties are available,

IP Address - The **IP Address** obtained automatically. If Port 1 is selected then the **IP Address** would be"**10.1.1.1**". Changes can be made by entering values less than 255.

Subnet Mask - By **default** the value that is found in the **Subnet Mask** field is "**255.255.255.0**".

Connected To - This property gives the **Router CPE** that is connected to that **Port** (i.e. If the **CPE1** is connected to **Port1**, then when **Port1** is selected **CPE1** would be displayed).

Router Properties

Buffer Size (KB) - This property defines the **Buffer size** that should be selected. **Click** on the drop down button to avail the values. The values that are available are, "**8**, **16**, **32**, **64**, **128**, **256**, **512**, **1024**, **2048** and **4096** (**KB**)". **8KB** is the **default** value.

Scheduling Type - Here the type of scheduler required can be selected. The **Scheduling Type** available is **FIFO**. Changes cannot be made.

Routing Properties - The options available under **Routing Properties** are,

Routing Method - By **default** Static Routing method is used.

Data Link Layer - The options available under this property is,

Protocol Type - By **default** the **Protocol Type** found here is **Ethernet**. Here changes cannot be made.

MAC Address - The Address of the particular router port.

Remove Devices (or) Links

Remove Link - Right click on the appropriate **Link / Connection** and **click Remove**.

Remove CPE - Right click on the appropriate **Router CPE** and **click Remove**.

Remove Router - Right click on the appropriate **Router** and **click Remove**.

Note -

- First remove the connecting Link.
- Next remove the Router / CPE. The removal of the Router / CPE can be done after the connecting link has been removed.

Simulate - After creating the **Scenario** the following steps need to be followed,

- **Click** on **Validate** button.
- **Click** on **Simulate** button.
- **Select** the **Simulation End Time** and then **click** on **"OK"** button to start the **Simulation**.

NetSim - TCP

Sample Experiments - User can understand the internal working of TCP through these sample experiments. Each sample experiment covers:

- Procedure
- Sample Inputs
- Output
- Comparison chart
- Inference

Index	Objective
Experiment 1	During client-server TCP downloads study the throughputs of Slow start + Congestion avoidance (also known as Old Tahoe) and Fast Retransmit (also known as Tahoe), Congestion Control Algorithms.

Sample Experiment 1

Objective:

During client-server TCP downloads study the throughputs of Slow start + Congestion avoidance (also known as Old Tahoe) and Fast Retransmit (also known as Tahoe), Congestion Control Algorithms.

Theory:

One of the important functions of a TCP Protocol is congestion control in the network. Given below is a description of how Old Tahoe and Tahoe variants (of TCP) control congestion.

Old Tahoe:

Congestion can occur when data arrives on a big pipe (i.e. a fast LAN) and gets sent out through a smaller pipe (i.e. a slower WAN). Congestion can also occur when multiple input streams arrive at a router whose output capacity is less than the sum of the inputs. Congestion avoidance is a way to deal with lost packets.

The assumption of the algorithm is that the packet loss caused by damaged is very small (much less than 1%), therefore the loss of a packet signals congestion somewhere in the network between the source and destination. There are two indications of packets loss: a timeout occurring and the receipt of duplicate ACKs

Congestion avoidance and slow start are independent algorithms with different objectives. But when congestion occurs TCP must slow down its transmission rate and then invoke slow start to get things going again. In practice they are implemented together.

Congestion avoidance and slow start requires two variables to be maintained for each connection: a Congestion Window (i.e. cwnd) and a Slow Start Threshold Size (i.e. ssthresh).

Old Tahoe algorithm is the combination of slow start and congestion avoidance. The combined algorithm operates as follows,

1. Initialization for a given connection sets cwnd to one segment and ssthresh to 65535 bytes.
2. When congestion occurs (indicated by a timeout or the reception of duplicate ACKs), one-half of the current window size (the minimum of cwnd and the reciever's advertised window, but at least two segments) is saved in ssthresh. Additionally, if the congestion is indicated by a timeout, cwnd is set to one segment (i.e. slow start).
3. When new data is acknowledged by the other end, increase cwnd, but the way it increases depends on whether TCP is performing slow start or congestion avoidance.

If cwnd is less than or equal to ssthresh, TCP is in slow start. Else TCP is performing congestion avoidance. Slow start continues until TCP is halfway to where it was when congestion occurred (since it recorded half of the window size that caused the problem in step 2). Then congestion avoidance takes over.

Slow start has cwnd begins at one segment and be incremented by one segment every time an ACK is received. As mentioned earlier, this opens the window exponentially: send one

segment, then two, then four, and so on. Congestion avoidance dictates that cwnd be incremented by 1/cwnd, compared to slow start's exponential growth. The increase in cwnd should be at most one segment in each round trip time (regardless of how many ACKs are received in that RTT), whereas slow start increments cwnd by the number of ACKs received in a round-trip time.

Tahoe (Fast Retransmit):

The Fast retransmit algorithms operating with Old Tahoe is known as the Tahoe variant.
TCP may generate an immediate acknowledgement (a duplicate ACK) when an out-of-order segment is received out-of-order, and to tell it what sequence number is expected.
Since TCP does not know whether a duplicate ACK is caused by a lost segment or just a re-ordering of segments, it waits for a small number of duplicate ACKs to be received. It is assumed that if there is just a reordering of the segments, there will be only one or two duplicate ACKs before the re-ordered segment is processed, which will then generate a new ACK. If three or more duplicate ACKs are received in a row, it is a strong indication that a segment has been lost. TCP then performs a retransmission of what appears to be the missing segment, without waiting for a re-transmission timer to expire.

Procedure:

How to Create Scenario

Create Scenario: "Help → NetSim Help F1→Simulation → New → WAN → TCP →Create Scenario".

Sample Inputs:

Follow the steps given in the different samples to arrive at the objective.

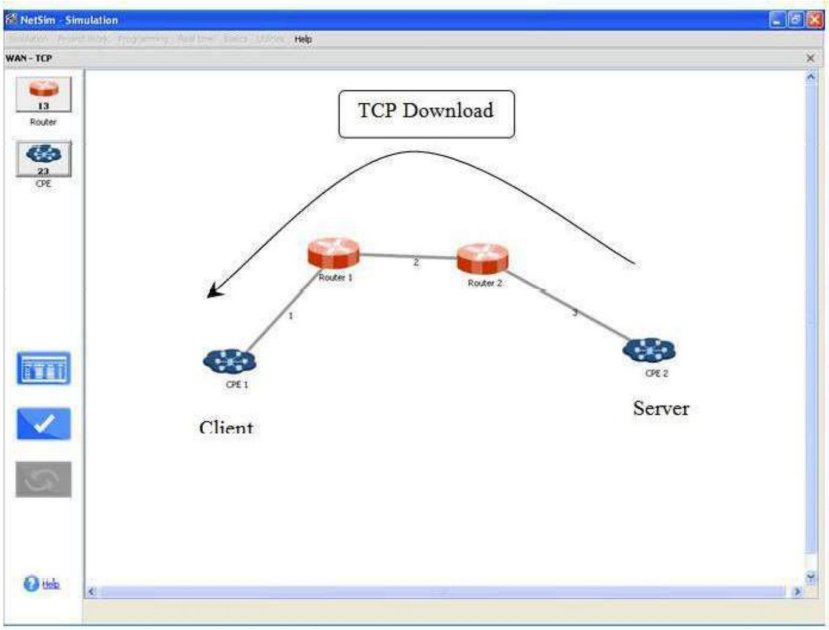
Sample 1.a: Old Tahoe (1 client and 1 server)

In this Sample,

- Total no of CPE's used: 2
- Total no of Routers used: 2

The devices are inter connected as given below,

- CPE 1 is connected with Router 1 by Link 1.
- CPE 2 is connected with Router 2 by Link 3.
- Router 1 and Router 2 are connected by Link 2.



Set the properties for each device by following the tables,

CPE Properties	CPE2
Destination	CPE 1
Traffic Type	Data
Application Data Size	
Distribution	Constant
Application Data Size (Bytes)	1460
Window size (Bytes)	11680
Congestion Control	**Old Tahoe**

Router Properties	Router1	Router2
Buffer Size (KB)	8	8
Scheduling Type	FIFO	FIFO

Link Properties	Link 1	Link 2	Link 3
Distance (kms)	1	1	1
Bit Error Rate (BER)	10^{-6}	10^{-6}	10^{-6}
Physical Medium	E2	CAT5(10 Mbps)	E2

Simulation Time - 10 Sec

(**Note:** The Simulation Time can be selected only after doing the following two tasks,

- Set the properties of CPE , Router, & Link
- Then click on the Validate & Simulate button)**.**

Sample 1.b: Tahoe (1 client and 1 server)

In this Sample,

- Total no of CPE's used: 2
- Total no of Routers used: 2

The devices are inter connected as given below,

- CPE 1 is connected with Router 1 by Link 1.
- Router 1 and Router 2 are connected by Link 2.
- CPE 2 is connected with Router 2 by Link 3.
- CPE 1 is not transmitting data in this sample.

Set the properties for each device by following the tables,

CPE Properties	**CPE2**
Destination	CPE 1
Traffic Type	Data
Application Data Size	
Distribution	Constant
Application Data Size (Bytes)	1460
Window size (Bytes)	11680
Congestion Control	**Tahoe**

Router Properties	**Router1**	**Router2**
Buffer Size (KB)	8	8
Scheduling Type	FIFO	FIFO

Link Properties	**Link 1**	**Link 2**	**Link 3**
Distance (kms)	1	1	1
Bit Error Rate (BER)	10^{-6}	10^{-6}	10^{-6}
Physical Medium	E2	CAT5 (10 Mbps)	E2

Sample 2.a: Old Tahoe (2 clients and 2 servers)

In this Sample,

- Total no of CPE's used: 4
- Total no of Routers used: 2

The devices are inter connected as given below,

- CPE 1 and CPE 2 are connected with Router 1 by Link 1 and Link 2.
- Router 1 and Router 2 are connected by Link 3.
- CPE 3 and CPE 4 are connected with Router 2 by Link 4 and Link 5.
- CPE 1 and CPE 2 are not transmitting data in this sample.

Set the properties for each device by following the tables,

CPE Properties	CPE3	CPE4
Destination	CPE 1	CPE 2
Traffic Type	Data	Data
Application Data Size		
Distribution	Constant	Constant
Application Data Size (Bytes)	1460	1460
Window size (Bytes)	11680	11680
Congestion Control	**Old Tahoe**	**Old Tahoe**

Router Properties	Router1	Router2
Buffer Size (KB)	8	8
Scheduling Type	FIFO	FIFO

Link Properties	Link 1	Link 2	Link 3	Link 4	Link 5
Distance (kms)	1	1	1	1	1
Bit Error Rate (BER)	10^{-6}	10^{-6}	10^{-6}	10^{-6}	10^{-6}
Physical Medium	E2	E2	(CAT5 10Mbps)	E2	E2

Simulation Time - 10 Sec