بخش اول: نصب نرم‌افزار OPNET

برای نصب نرم‌افزار شبیه‌ساز OPNET به آدرس زیر رجوع نمایید و طبق دستورالعمل مطرح‌شده اقدام به نصب این شبیه‌ساز نمایید.

https://p30download.ir/fa/entry/65152

لازم به ذکر است که فایل دانلودی، سیستم‌عامل ویندوز XP است که شبیه‌ساز را نیز به همراه دارد و باید این سیستم عامل را بر روی ماشین مجازی نصب نمایید. توجه داشته باشد که پس از نصب ویندوز XP، حتما تاریخ ویندوز XP را به قبل از اکتبر ۲۰۱۳ تغییر دهید و برای جلوگیری از به‌روز شدن این تاریخ، اینترنت ویندوز XP نصب شده در ماشین مجازی را قطع نمایید (بهتر است در هنگام نصب، برای ویندوز XP کارت شبکه را غیرفعال کنید).

بخش دوم – تمرین سری اول

متن زیر را به‌دقت بخوانید و مراحل را در آپنت پیاده‌سازی نمایید. توجه داشته باشید که با توجه به نسخه‌های مختلف شبیه‌ساز، ممکن است در برخی پارامترها تغییراتی در نرم‌افزار ایجاده شده باشد که لازم است با توجه به مفاهیم تمرین، پارامتر درست را انتخاب نمایید.

پس از طی مراحل شبیه‌سازی، صحت نتایج به‌دست‌آمده را بررسی نمایید. برای این کار لازم است خودتان همه‌ی مراحل را طی نمایید و نتایج را در گزارش خود ثبت نمایید.

در ادامه تمرینات مطرح‌شده را انجام دهید و جواب‌ها را نیز به‌طور کامل در گزارش ثبت نمایید.

در پایان لازم است پس از پیاده‌سازی یک یا چند سناریو، به چند سوال تکمیلی پاسخ دهید و در گزارش خود ثبت نمایید.

Switched LANs

A Set of Local Area Networks Interconnected by Switches

Objective

This lab is designed to demonstrate the implementation of switched local area networks. The simulation in this lab will help you examine the performance of different implementations of local area networks connected by switches and hubs.

Overview

There is a limit to how many hosts can be attached to a single network and to the size of a geographic area that a single network can serve. Computer networks use switches to enable the communication between one host and another, even when no direct connection exists between those hosts. A switch is a device with several inputs and outputs leading to and from the hosts that the switch interconnects. The core job of a switch is to take packets that arrive on an input and forward (or switch) them to the right output so that they will reach their appropriate destination.

A key problem that a switch must deal with is the finite bandwidth of its outputs. If packets destined for a certain output arrive at a switch and their arrival rate exceeds the capacity of that output, then we have a problem of contention. In this case, the switch will queue, or buffer, packets until the contention subsides. If the contention lasts too long, however, the switch will run out of buffer space and be forced to discard packets. When packets are discarded too frequently, the switch is said to be congested.

In this lab you will set up switched LANs using two different switching devices: hubs and switches. A hub forwards the packet that arrives on any of its inputs on all the outputs regardless of the destination of the packet. On the other hand, a switch forwards incoming packets to one or more outputs depending on the destination(s) of the packets. You will study how the throughput and collision of packets in a switched network are affected by the configuration of the network and the types of switching devices that are used.

Create a New Project

1. Start the **OPNET IT Guru Academic Edition** ⇒ Choose **New** from the **File** menu.

2. Select **Project** and click **OK** ⇒ Name the project **<your initials>_SwitchedLAN**, and the scenario **OnlyHub** ⇒ Click **OK**.

3. In the *Startup Wizard: Initial Topology* dialog box, make sure that **Create Empty Scenario** is selected ⇒ Click **Next** ⇒ Choose **Office** from the *Network Scale* list ⇒ Click **Next** three times ⇒ Click **OK**.

4. **Close** the *Object Palette* dialog box.

Create the Network

To create our switched LAN:

1. Select **Topology** ⇒ **Rapid Configuration**. From the drop-down menu choose **Star** and click **OK**.

2. Click the **Select Models** button in the *Rapid Configuration* dialog box. From the *Model List* drop-down menu choose **ethernet** and click **OK**.

The prefix **ethernet16_** indicates that the device supports up to 16 Ethernet connections.

3. In the *Rapid Configuration* dialog box, set the following five values: **Center Node Model = ethernet16_hub, Periphery Node Model = ethernet_station, Link Model = 10BaseT, Number=16, Y=50,** and **Radius = 42** ⇒ Click **OK**.

The **10BaseT** link represents an Ethernet connection operating at 10 Mbps.

4. Right-click on **node_16**, which is the hub ⇒ **Edit Attributes** ⇒ Change the **name** attribute to **Hub1** and click **OK**.

5. Now that you have created the network, it should look like the following one.
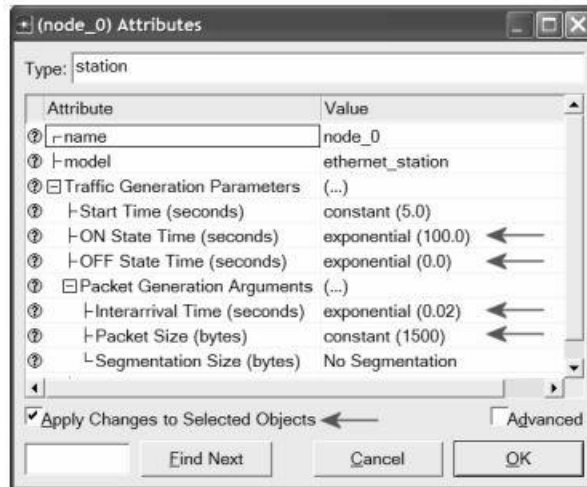
6. Make sure to save your project.
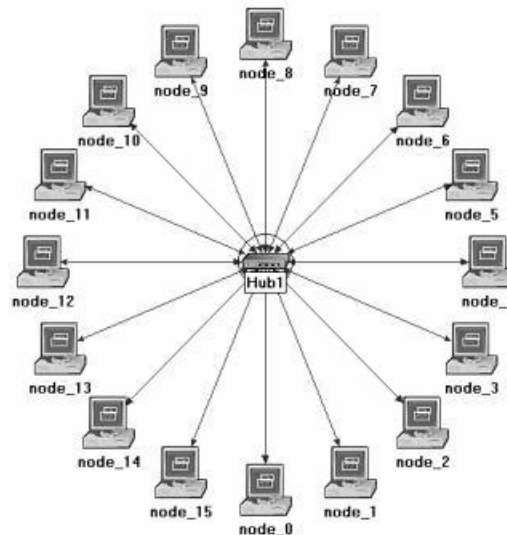
Configure the Network Nodes

Here you will configure the traffic generated by the stations.

1. Right-click on any of the 16 stations (node_0 to node_15) ⇒ **Select Similar Nodes**. Now all stations in the network are selected.

2. Right-click on any of the 16 stations ⇒ **Edit Attributes.**

   a. Check the **Apply Changes to Selected Objects** check box. This is important to avoid reconfiguring each node individually.

3. Expand the hierarchies of the **Traffic Generation Parameters** attribute and the **Packet Generation Arguments** attribute ⇒ Set the following four values:

4. Click **OK** to close the attribute editing window(s).

5. Save your project.

Attribute	Value
⑦ ┌name	node_0
⑦ ├model	ethernet_station
⑦ ⊟Traffic Generation Parameters	(...)
⑦ ├Start Time (seconds)	constant (5.0)
⑦ ├ON State Time (seconds)	exponential (100.0) ⬅
⑦ ├OFF State Time (seconds)	exponential (0.0) ⬅
⑦ ⊟Packet Generation Arguments	(...)
⑦ ├Interarrival Time (seconds)	exponential (0.02) ⬅
⑦ ├Packet Size (bytes)	constant (1500) ⬅
⑦ └Segmentation Size (bytes)	No Segmentation

Type: station

☑ Apply Changes to Selected Objects ⬅   ☐ Advanced

Find Next   Cancel   OK

Choose Statistics

To choose the statistics to be collected during the simulation:

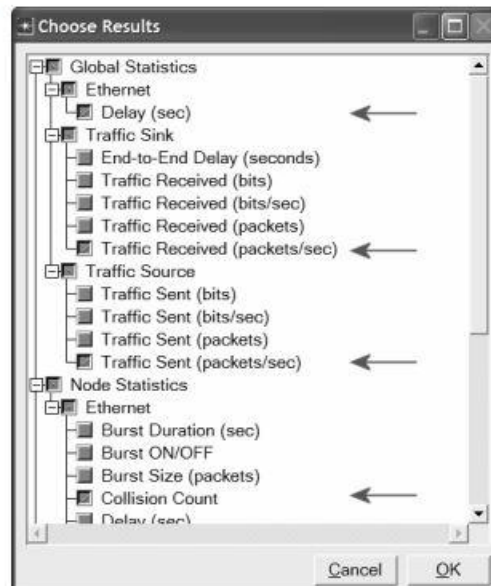The **Ethernet Delay** represents the end to end delay of all packets received by all the stations.

1. Right-click anywhere in the project workspace and select **Choose Individual Statistics** from the pop-up menu.

Traffic Received (in packets/sec) by the traffic sinks across all nodes.

2. In the *Choose Results* dialog box, choose the following four statistics:

Traffic Sent (in packets/sec) by the traffic sources across all nodes.

3. Click **OK**.

Collision Count is the total number of collisions encountered by the hub during packet transmissions.

Choose Results

- ⊟ Global Statistics
  - ⊟ Ethernet
    - └ Delay (sec) ⬅
  - ⊟ Traffic Sink
    - ├ End-to-End Delay (seconds)
    - ├ Traffic Received (bits)
    - ├ Traffic Received (bits/sec)
    - ├ Traffic Received (packets)
    - ├ Traffic Received (packets/sec) ⬅
  - ⊟ Traffic Source
    - ├ Traffic Sent (bits)
    - ├ Traffic Sent (bits/sec)
    - ├ Traffic Sent (packets)
    - ├ Traffic Sent (packets/sec) ⬅
- ⊟ Node Statistics
  - ⊟ Ethernet
    - ├ Burst Duration (sec)
    - ├ Burst ON/OFF
    - ├ Burst Size (packets)
    - ├ Collision Count ⬅
    - └ Delay (sec)

Cancel   OK

Configure the Simulation

Here we need to configure the duration of the simulation:

1. Click on the **Configure/Run Simulation** button:

2. Set the duration to be **2.0 minutes**.

3. Click **OK**.

Duplicate the Scenario

The network we just created utilizes only one hub to connect the 16 stations. We need to create another network that utilizes a switch and see how this will affect the performance of the network. To do that we will create a duplicate of the current network:
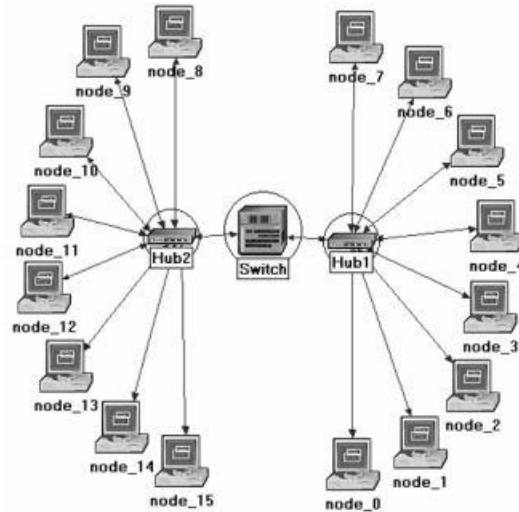
1. Select **Duplicate Scenario** from the **Scenarios** menu and give it the name **HubAndSwitch** ⇒ Click **OK**.

2. Open the **Object Palette** by clicking on . Make sure that **Ethernet** is selected in the pull-down menu on the object palette.

3. We need to place the shown hub and switch in the new scenario.
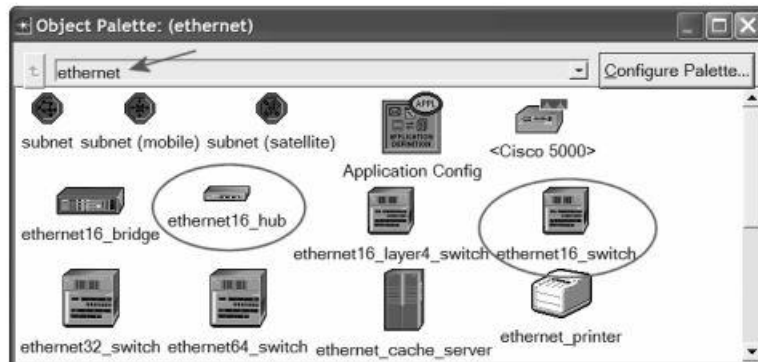
4. To add the **Hub**, click its icon in the object palette ⇒ Move your mouse to the workspace ⇒ Click to drop the hub at a location you select. Right-click to indicate you are done deploying hub objects.

5. Similarly, add the **Switch** and then close the **Object Palette**.

6. Right-click on the new hub ⇒ **Edit Attributes** ⇒ Change the **name** attribute to **Hub2** and click **OK**.

7. Right-click on the switch ⇒ **Edit Attributes** ⇒ Change the **name** attribute to **Switch** and click **OK**.

8. Reconfigure the network of the **HubAndSwitch** scenario so that it looks like the following one.

a. To remove a link, select it and choose **Cut** from the **Edit** menu (or simply hit the **Delete** key). You can select multiple links and delete all of them at once.

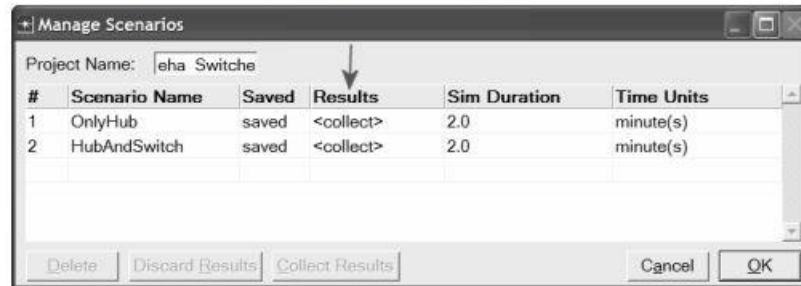b. To add a new link, use the **10BaseT** link available in the **Object Palette**.

9. Save your project.

Run the Simulation

To run the simulation for both scenarios simultaneously:

1. Select **Manage Scenarios** from the **Scenarios** menu.

2. Change the values under the **Results** column to `<collect>` (or `<recollect>`) for both scenarios. Compare to the following figure.

Manage Scenarios

Project Name: eha Switche

#	Scenario Name	Saved	Results	Sim Duration	Time Units	
1	OnlyHub	saved	`<collect>`	2.0	minute(s)	
2	HubAndSwitch	saved	`<collect>`	2.0	minute(s)	

Delete | Discard Results | Collect Results | | | Cancel | OK

3. Click **OK** to run the two simulations. Depending on the speed of your processor, this may take several minutes to complete.

4. After the two simulation runs complete, one for each scenario, click **Close**.

5. Save your project.

View the Results

To view and analyze the results:

1. Select **Compare Results** from the **Results** menu.

2. Change the drop-down menu in the lower-right part of the *Compare Results* dialog box from **As Is** to **time_average**, as shown.


3. Select the **Traffic Sent (packets/sec)** statistic and click **Show**. The resulting graph should resemble the one below. As you can see, the traffic sent in both scenarios is almost identical.
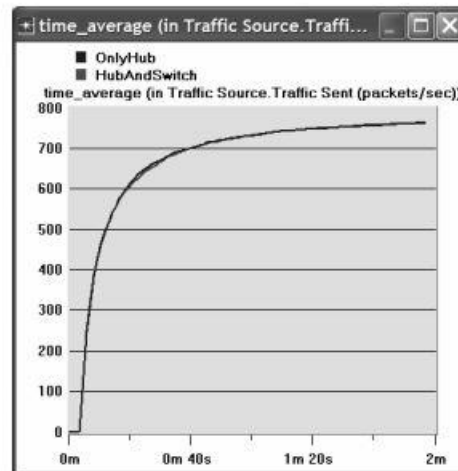
Select the **Traffic Received (packets/sec)** statistic and click **Show**. The resulting graph should resemble the one below. As you see, the traffic received with the second scenario, **HubAndSwitch**, is higher than that of the **OnlyHub** scenario.
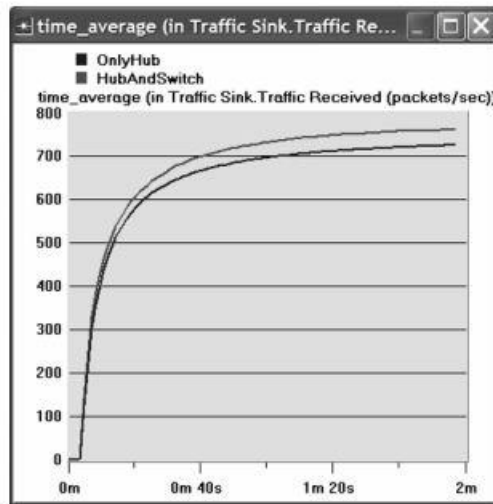

4. Select the **Delay (sec)** statistic and click **Show**. The resulting graph should resemble the one below. (*Note:* Result may vary slightly due to different node placement.)
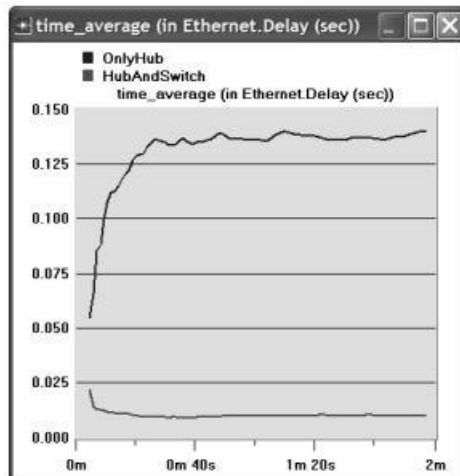
5. Select the **Collision Count** statistic for **Hub1** and click **Show**.

6. On the resulting graph right-click anywhere on the *graph area* ⇒ Choose **Add Statistic** ⇒ Expand the hierarchies as shown below ⇒ Select the **Collision Count** statistic for **Hub2** ⇒ Change **As Is** to **time_average** ⇒ Click **Add**.
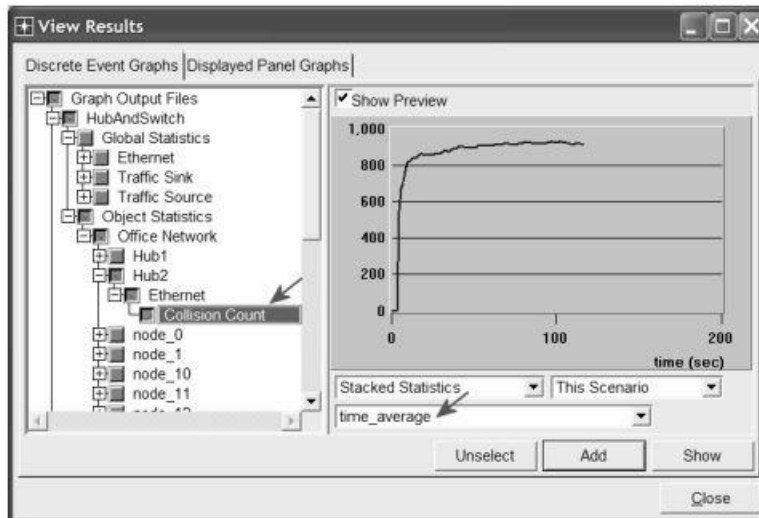
7. The resulting graph should resemble the one below.
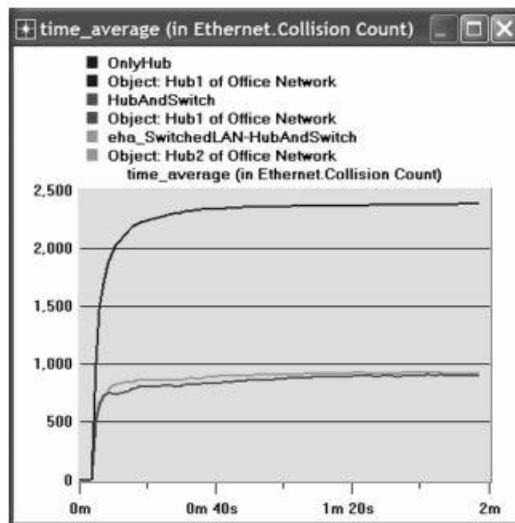
8. Save your project.

1) Explain why adding a switch makes the network perform better in terms of throughput and delay.

2) We analyzed the collision counts of the hubs. Can you analyze the collision count of the "Switch"? Explain your answer.

3) Create two new scenarios. The first one is the same as the **OnlyHub** scenario but replace the hub with a switch. The second new scenario is the same as the **HubAndSwitch** scenario but replace both hubs with two switches, remove the old switch, and connect the two switches you just added together with a 10BaseT link. Compare the performance of the four scenarios in terms of delay, throughput, and collision count. Analyze the results. Note: To replace a hub with a switch, right-click on the hub and assign **ethernet16_switch** to its **model** attribute.