User Manual
for
1G Ethernet BGP Simulator

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List of Abbreviations

Abbreviation	Definition
EDS	Ethernet Delay Simulator
BGP	Border Gateway Protocol

ASN	Autonomous System Number

Product Manual

Features

The EBS v2.1.xx Software features are broadly categorize into three Sub-system:

1. Traffic Simulation sub-system
2. Border Gateway Protocol (BGP) sub-system
3. LAN

1. Traffic Simulation sub-system

- Handle Traffic Bandwidth Control and Shaping
- Each IP Address maintains its own profile of Bandwidth Shaping
- Simulation of Real-time Delay,Jitter,Packet Corruption, Duplication,Reordering,Loss on constant basis or depending on Correlation.

2.Border Gateway Protocol (BGP) sub-system

- Perform Routing Decision Dynamically based on number of networks available at that instant.
- Adding Neighbors, Networks to System.
- Forwarding of packets based on routes created dynamically.
- View Routes Advertised to/by Neighbors.
- Assign Preference(Weight) to a particular path from list of available Multiple paths

3.LAN

- Able to Detect and Configure Scalable number of network interfaces.
- Show Status of connected/available Network Ports.
- Show whether Traffic Shaping Profile is active for a particular interface at that instant.

System Requirements

Operating System : Ubuntu 12.04 or higher

Command-line Terminal : gnome-terminal

Web Browser: Mozilla Firefox 37+ ,Google Chrome 40+

Apache Tomcat Server : version 7.0.xx

Java : version 1.6 update 38

Linux Kernel version : 3.8.0-29-generic

Hardware Requirement : EDS-1G

RAM size : 512MB(Minimum)

Number of Network Cards supported : Scalable

Prerequisites

1. Ensure that **gnome-terminal** is installed into your system. If not installed ,you have to run the setup manually from command-line.
2. Ensure that your web browser is updated with the latest version .
3. Ensure the Ipv4 Forwarding is enabled.Or try this command by logging as root user to Set this feature

```
$ echo 1 > /proc/sys/net/ipv4/ip_forward
```

Installation

Take the “EBS-2.1.xx.tar.bz2” archive file and copy it onto your home folder. Extract it by Clicking Right button of Mouse..A Sub-menu will be opened ,in that menu search option “Extract here” and click it to extract archive content on home folder.Go to the extracted folder “EBS-2.1.xx”

Ensure that you have **gnome-terminal** installed on your system .Go to the extracted folder and Double Click the **RunSetup_64bit** application.A terminal window will get open and it will ask your choice. Select option “1” for installation.It will ask sudo password to Elevate Privileges.Entering the correct **sudo** password will install application into system.If setup is not installed change user “rwx”(Read,Write,Execute) permissions of all the files in the folder to be “777” from command line as shown below.

```
1.Install
2.Uninstall
3.Debug
Enter your choice:
1
[sudo] password for user:
```

You may also run the **setup.sh** script from command line as

```
$ tar -xvf EBS-2.1.xx.tar.bz2
$ cd EBS-2.1.00
$ sudo chmod 777 *
```

[Please Provide **sudo** user password]

```
$ sudo ./setup.sh install
```

The setup requires to execute Commands with Elevated Privileges therefore while the setup script is running it will ask for **sudo** password. After entering the password setup will compile the Application and add necessary files to '**/home/$USER/EDS2'** folder

While installation setup will install necessary libraries by downloading them from Internet.So please ensure the Target system is connected to internet.

There is a short-cut '**eds_bgp**' provided from Desktop .Along with that the application '**eds_bgp**' is also available as separate command from command line.

Note:If you are facing some problem during installation use the setup.sh script with **-x** flag to diagnose the issue . On directory containing EBS setup files run from common line as.

```
$ sudo /bin/bash -x ./setup.sh install
```

Un-installation

Locate the extracted folder and Double Click the **RunSetup_64bit** application.A terminal window will get open and it will ask your choice. Select option “2” for un-installation.

```
1.Install
2.Uninstall
3.Debug
Enter your choice:
2
```

Use **sudo** user privilege and uninstall the Application via **setup.sh** script from command line as

```
$ ./setup.sh uninstall
```

Execution

Login

Open browser present on the system(Mozilla Firefox 37+ or Chrome 40+ would be better) and type the ip address of the server and port number followed by /ebs (http://X.X.X.X:8080/ebs) . Page will be opened and asking for username and password to login to GUI based application Currently the administrator user name is "eds@10g" . The default password is set as "madmax13" . Once we login to EBS system , main page will show following contents:

1. **System Info**
2. **Settings**
3. **Profiles**
4. **Statistics**
5. **Routing Tables**
6. **Graph**
7. **Help**
8. **Administration**
9. **Logout**
10. **Shutdown**

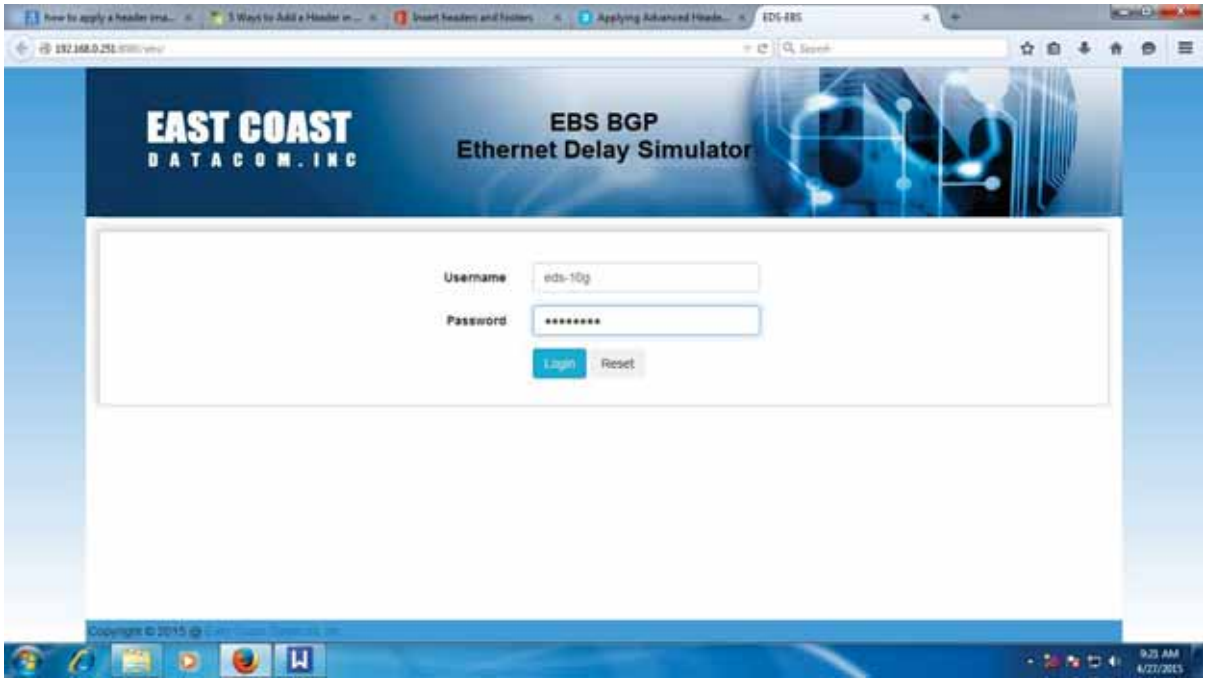


Table 0-1. Main Menu

We Can also access the system Remotely from other systems by applying url in following format.

http://192.168.0.251:8080/ebs/

The IP Specified is the IP Address of Management Port.It will ask for EDS password. EDS password is by default set as "madmax13". Entering this password will show the Main Menu of EBS application..

1 System Info

From the Home Screen System Specific Information will be displayed ,for example. Kernel Version, Software version.System uptime,Build information.

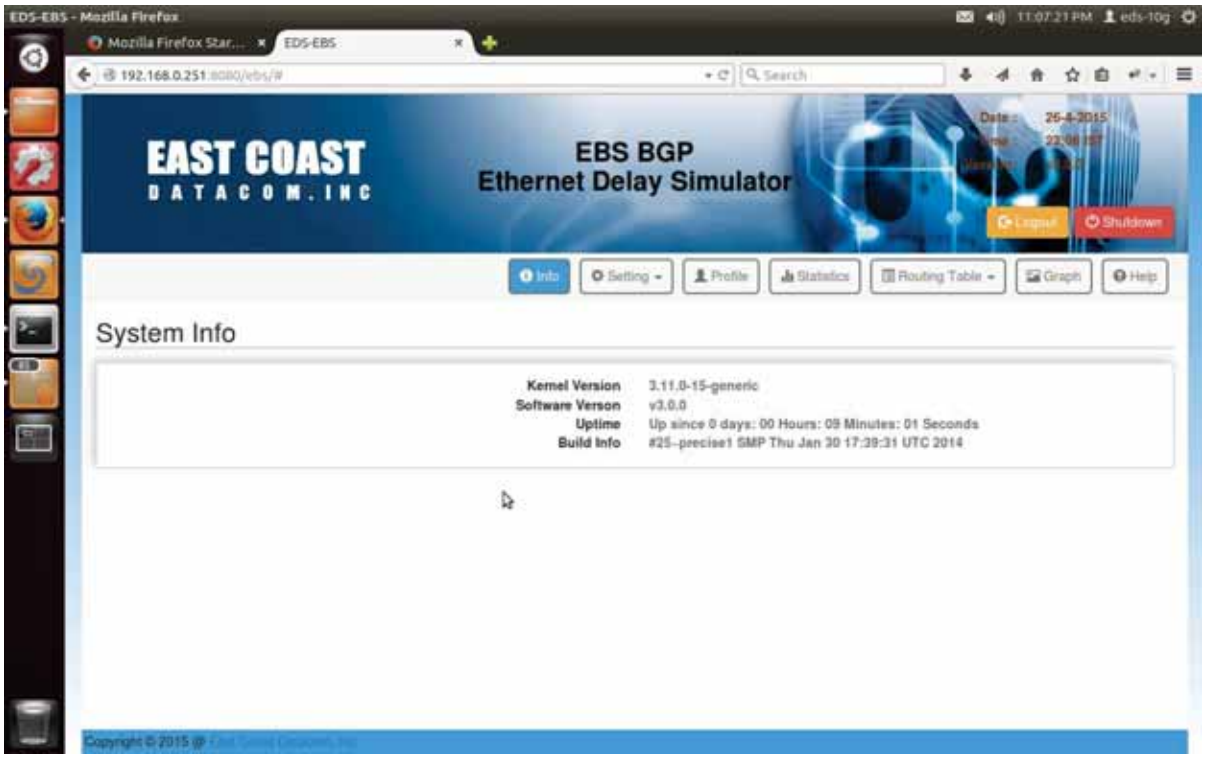


Table 1-1. System Info

2 Settings

Set your mouse pointer to Settings Menu.This option configures the IP Addresses of entire EBS system.Basically there are three types of settings available underneath

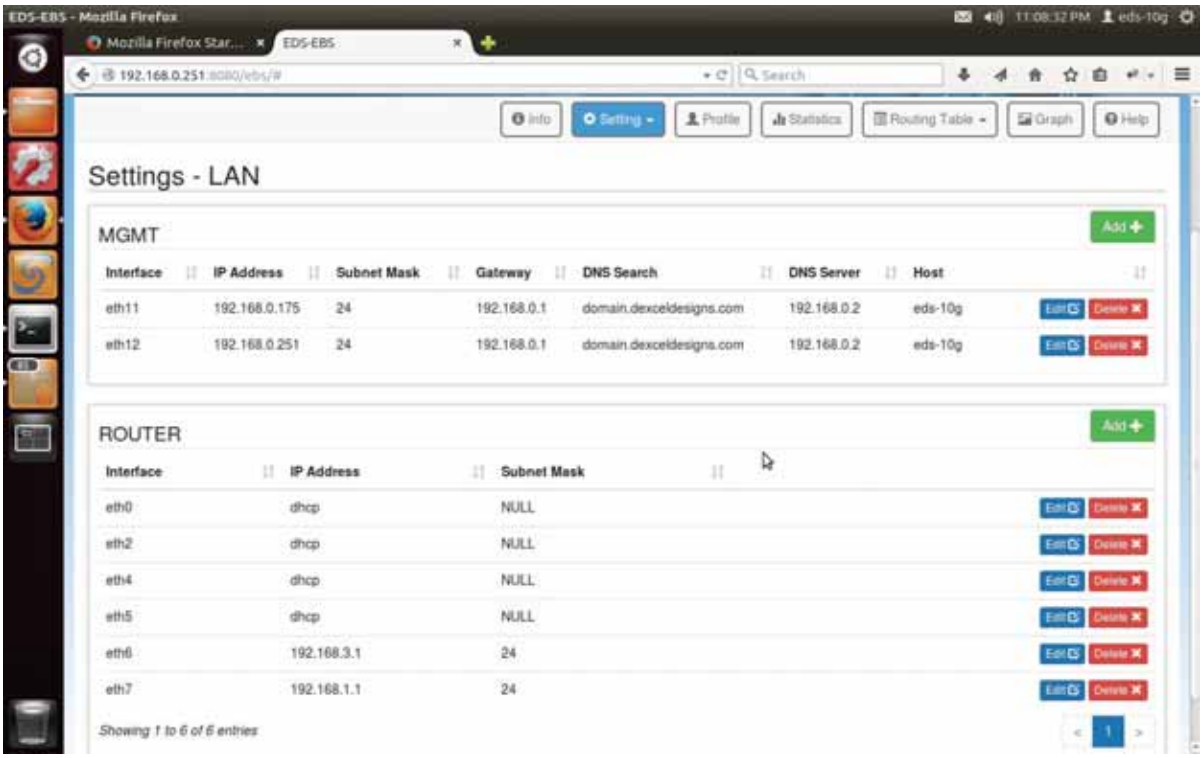
1.LAN configuration
2.Border Gateway Protocol (BGP) configuration.
3.Upgrade

Table 2-0. Settings Menu

2.1 LAN Settings

Under Settings Menu , press button “LAN” to switch to LAN settings menu. At LAN settings we will inquire about the name of interface whose IP Address we want to choose.LAN Settings is sub-divided into two sections:

- Management Port Settings
- Router Port Settings



2.1.1 Management Port Settings

This settings are meant to provide Network configurations that ensures internet access to Supermicro System and provide mechanism to upgrade and diagnose the System by Programmer.

Normally a private class IP network is used so that Supermicro system is accessible remotely from intranet.

If a local DNS server is managing that Private network , then Supermicro System can access internet via local DNS server.

Management Setting comprises of three main options:

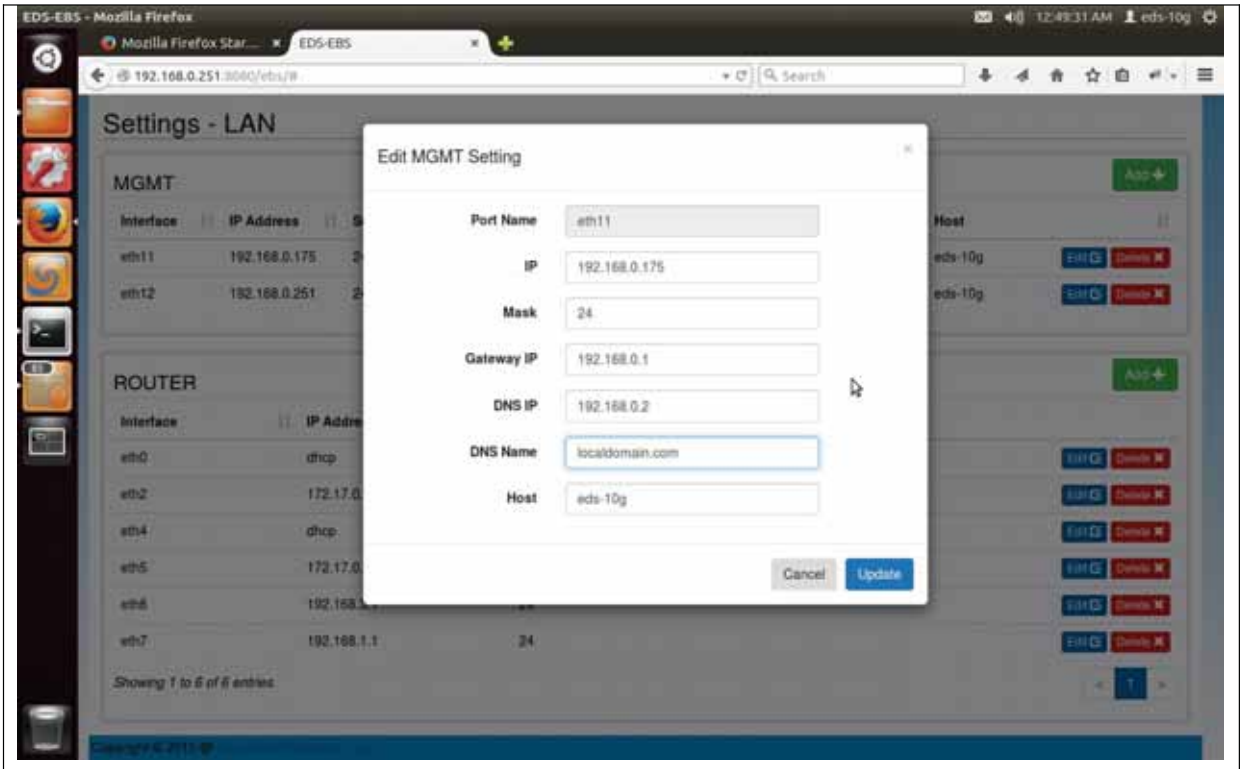
- Add
- Delete
- Edit

Add and Edit will open same kind of Pop-up Menu, difference is Add will have list of available Management Interface as the first text Field while Edit will fetch the existing values of Interface details keeping the Interface field as un-editable(Freeze).There are two Management Ports available .URL to access the Configurations of EDS System has IP address from among one of the two Management Ports IP addresses. Delete Option will Delete a particular interface Details and set of default values will get assigned .
Management port setting requires following details :

- Interface Name
- IP Address
- Subnet Mask
- Gateway IP
- DNS IP
- DNS Name
- Hostname

Note :Configuring the Management Port requires sufficient knowledge of the Required fields of Management Port Details.Improper settings may hinder your Internet connection of EDS System . Be sure and specific to what are you going to do with Management Port.

A separate documentation is provided on how to configure Management Port in the “doc “ folder of source file.



Management Port Settings

2.1.2 Router Port

Router Ports are meant to establish connection between two different Networks. There can be a scalable number of Router ports , depending of number of Network cards inserted before starting the EDS System.

Just like Management ports, it also supports three types of operations:

- Add
- Delete
- Edit

As the number of Router Ports is dynamic and it changes from the need of user, so the list of Router Ports may .also increase or decrease with use.

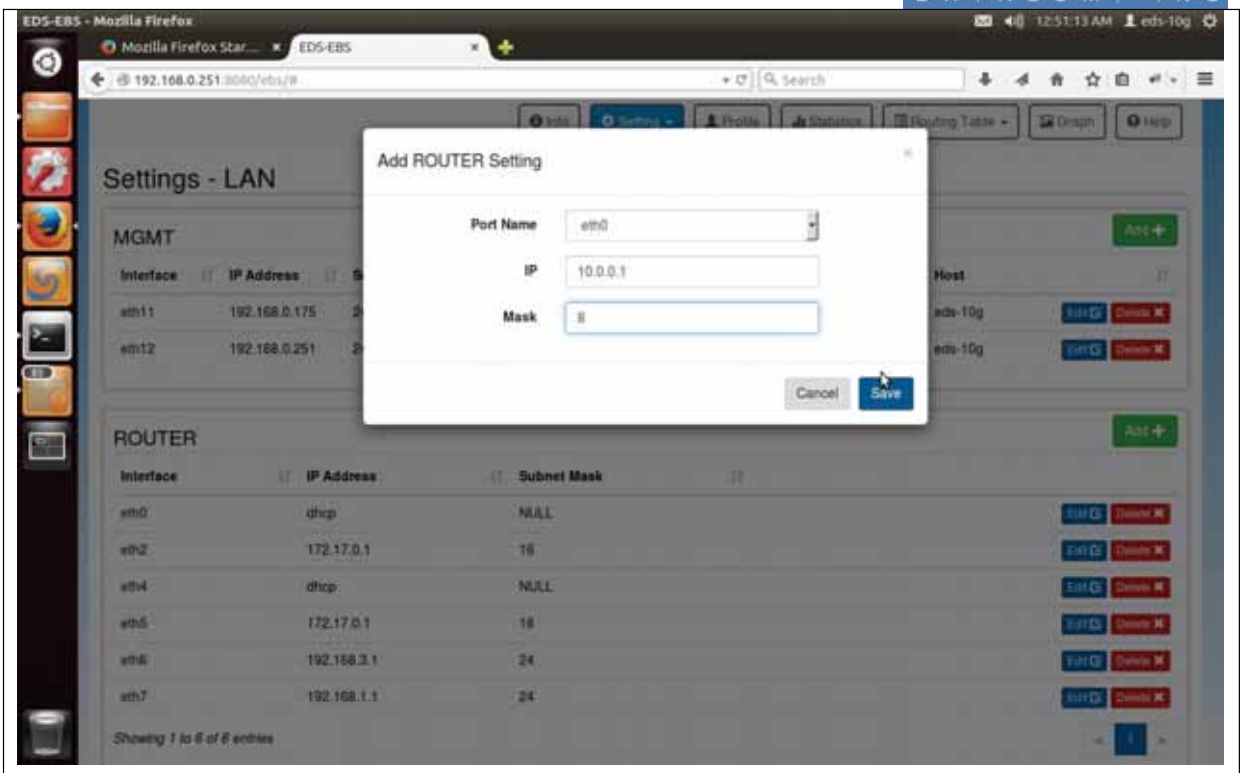
Router Port Setting requires following details:

- Port name
- IP Address
- Subnet Mask

Clicking on Add Option will show a pop-up menu with names of ports in drop-down menu.

Editing will freeze the Port Name field, keeping IP address and Subnet mask Editable.

Clicking on Delete Option will write default settings on the Port.



Router Port Settings

How to Check which Ethernet interface is connected before assigning IP?
To get the name of Ethernet interface ,plug the first end of LAN cable to some existing system Take second end of the connected cable and insert into one of the interfaces. Select Option “2” from Settings Menu (**2.2 LAN Status**) to check which Ethernet port link goes to LINK UP state. Then Return back to Settings menu.
Again go to to LAN Settings Sub-menu **[2.1]**to set the IP Address of just observed Ethernet Port.

2.2 LAN Status

From Settings Menu switch to view LAN status by selecting option “Status ”

The current state of all the available interfaces will be displayed with following information:
1.IP Address
2.MAC Address
3.Link Status
4.Link Speed Supported
5.Currently Active Traffic Shaping Profile

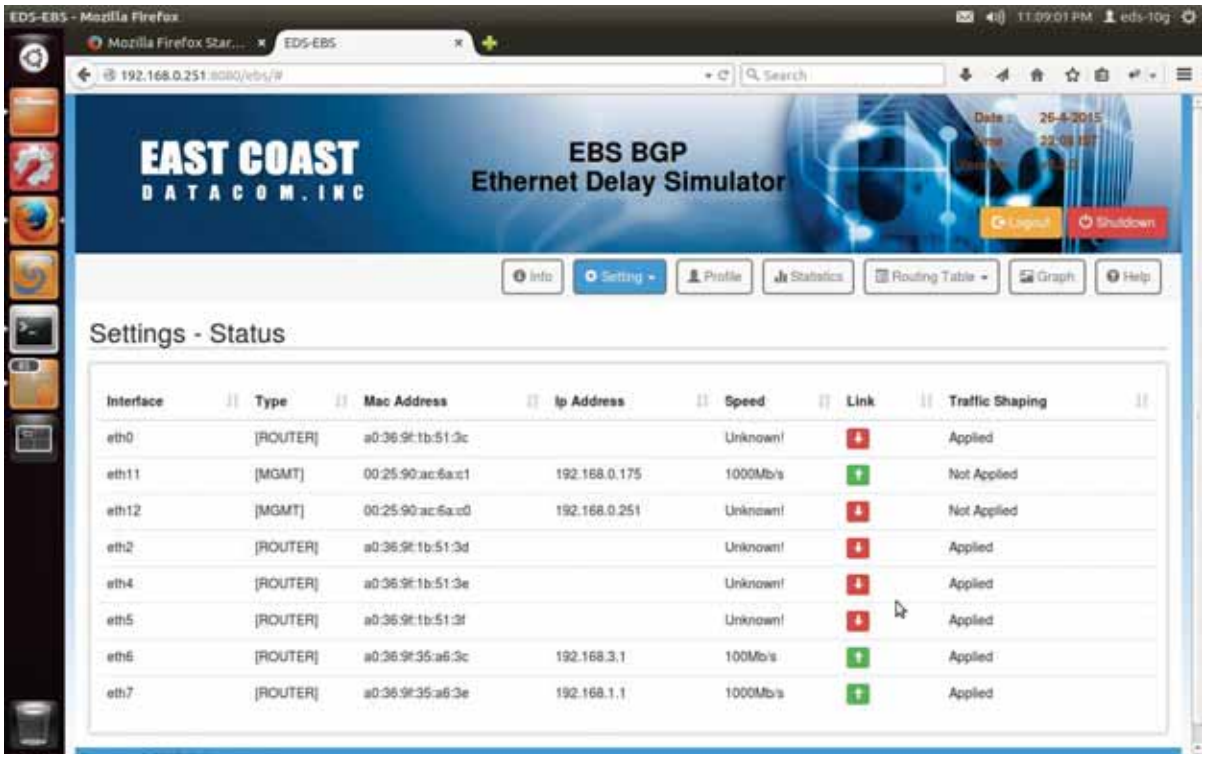


Table 2-2. LAN Status

This LAN Status Table will give the real-time status of all available ports including Management Ports too. The Management ports will be suffixed with **(MGMT)** to make them distinct from other ports of Router. If any Traffic Shaping Profile is active for the router ports ,then the Traffic Shaping Field will show “Applied” .While It is always shows “ Not Applied “ for Management Port

Note : The Speed Field will show “Unknown!” in case the network port is left Open.Traffic Shaping should be configured keeping the Link speed of ports in mind.

2.3 BGP Settings

BGP Settings will take care of all the BGP specific customization include

1.Add/enable router configuration

2.Delete Configuration

3.List of neighbors

4.Neighbors Info

5.Previous menu

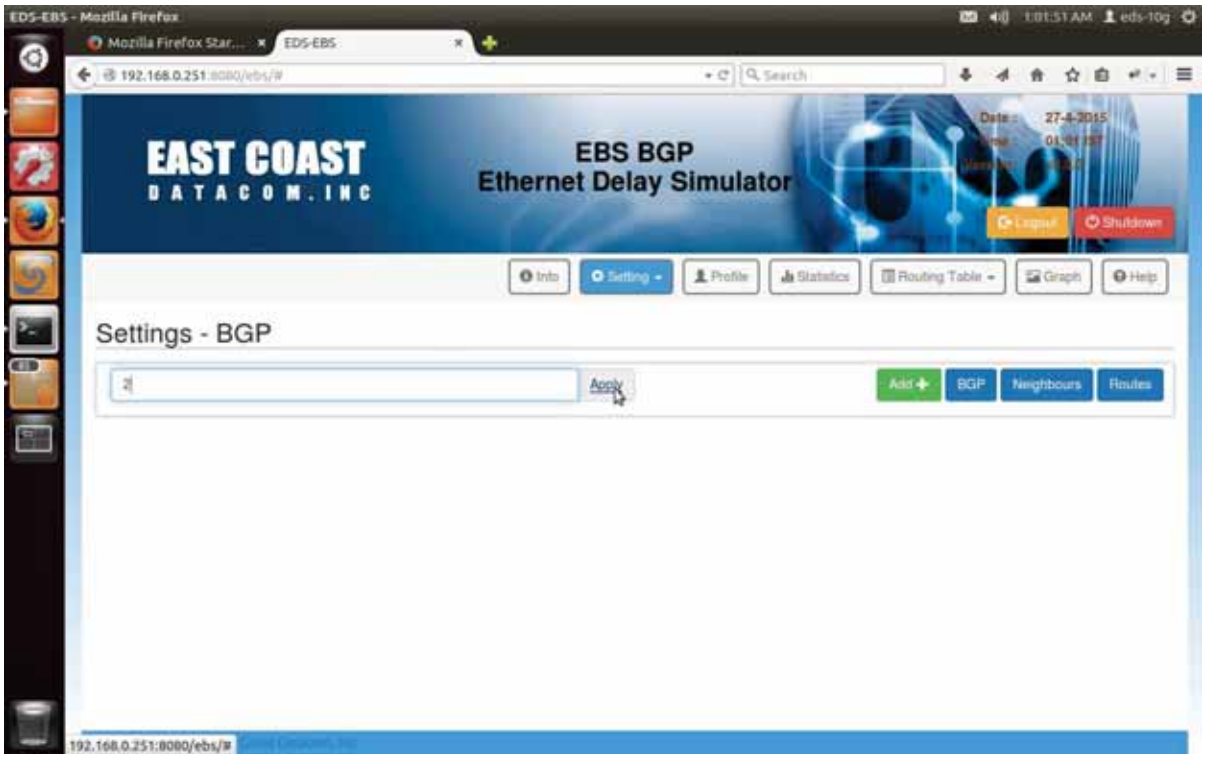


Table 2-3. BGP Settings Menu

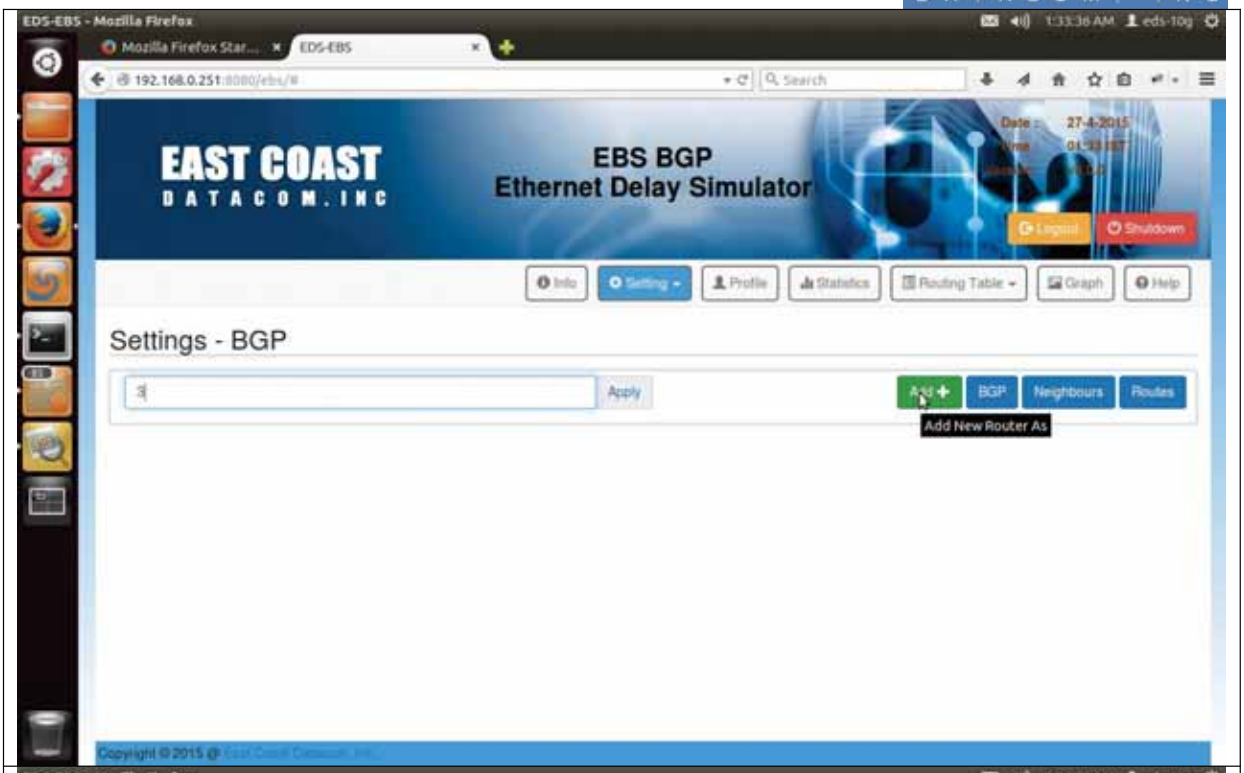
2.3.1 Add router configuration

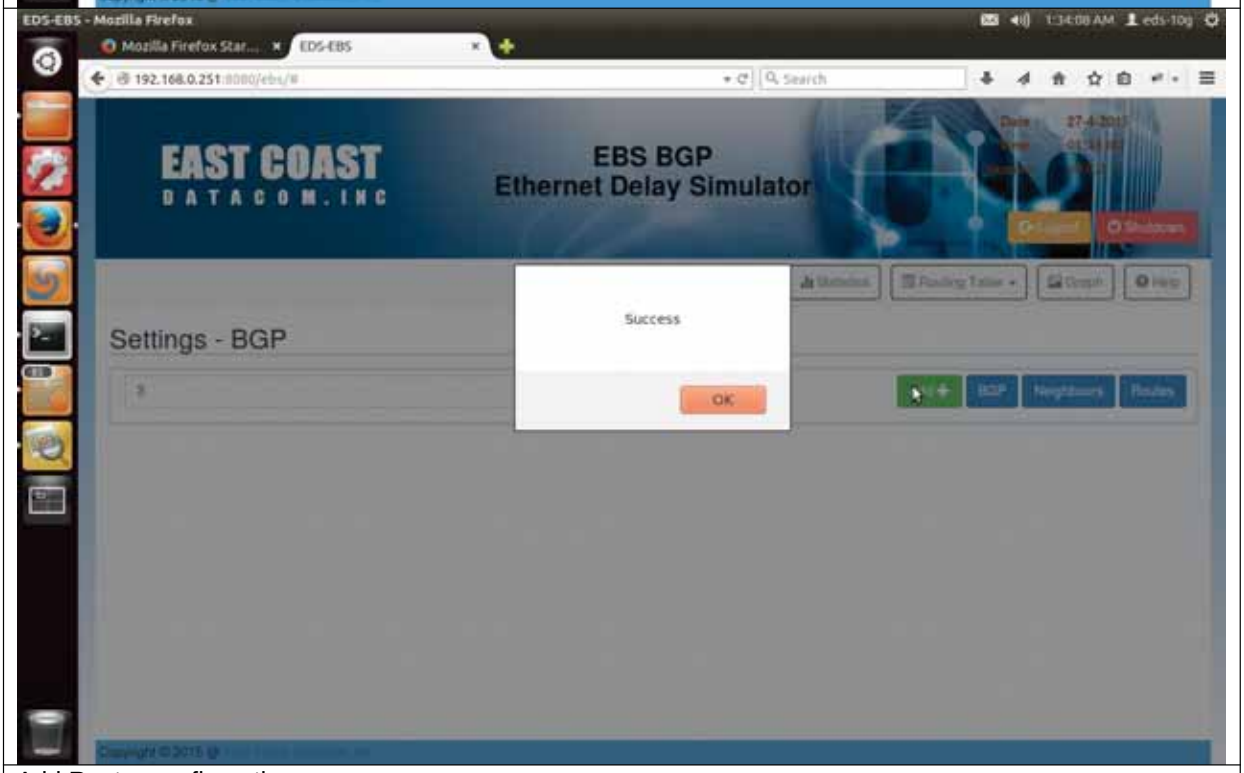
When we are configuring router for the first time then this option will ask for new Autonomous System Number ASN and once It is set then it will check with the existing router configuration.Add option will be active only when there is no AS number configured for the Router.Other wise Delete Option will replace Add option in BGP menu.

If we have deleted the router configuration then it may ask again for New ASN.

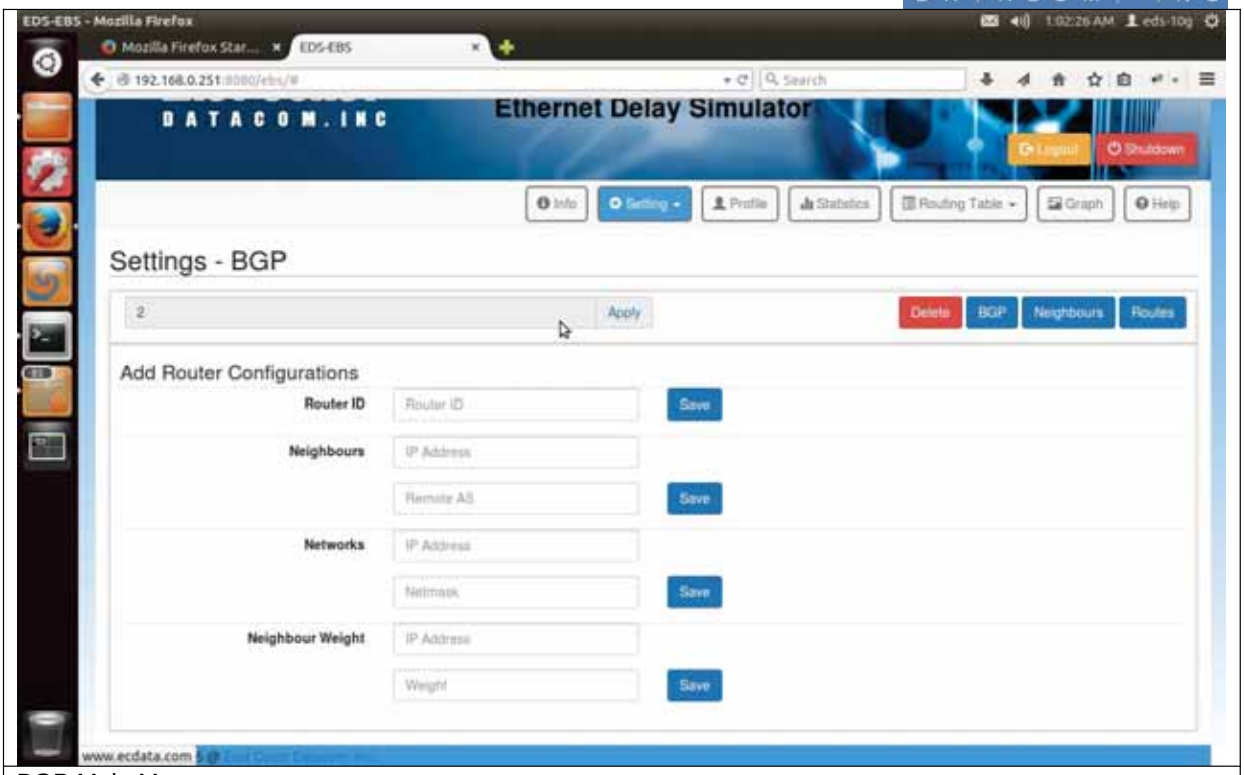
For a ASN following Parameters can be added and shown in the Submenu:

1.Router ID
2.Neighbors
3.Networks
4.Weight





Add Router configuration



BGP Main Menu

2.3.1.1 Router ID

Go to following Submenu " Main Menu->Settings ->BGP -> Add Router Configuration " and enter IP address in text Field labeled Router ID to set router id.

If all things go well, then a new router ID will be shown in a pop-up message.

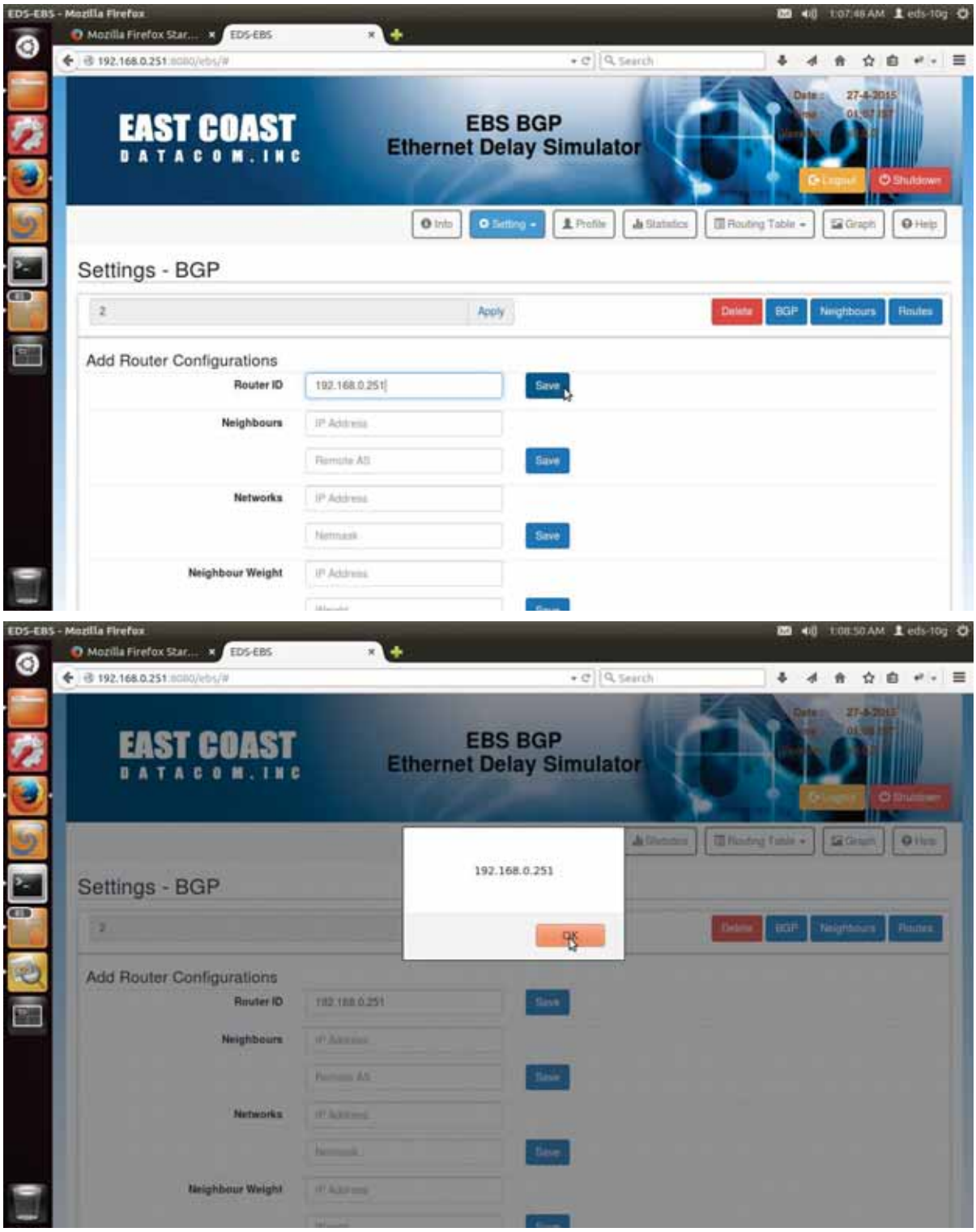


Table 2-4. Adding BGP Configuration

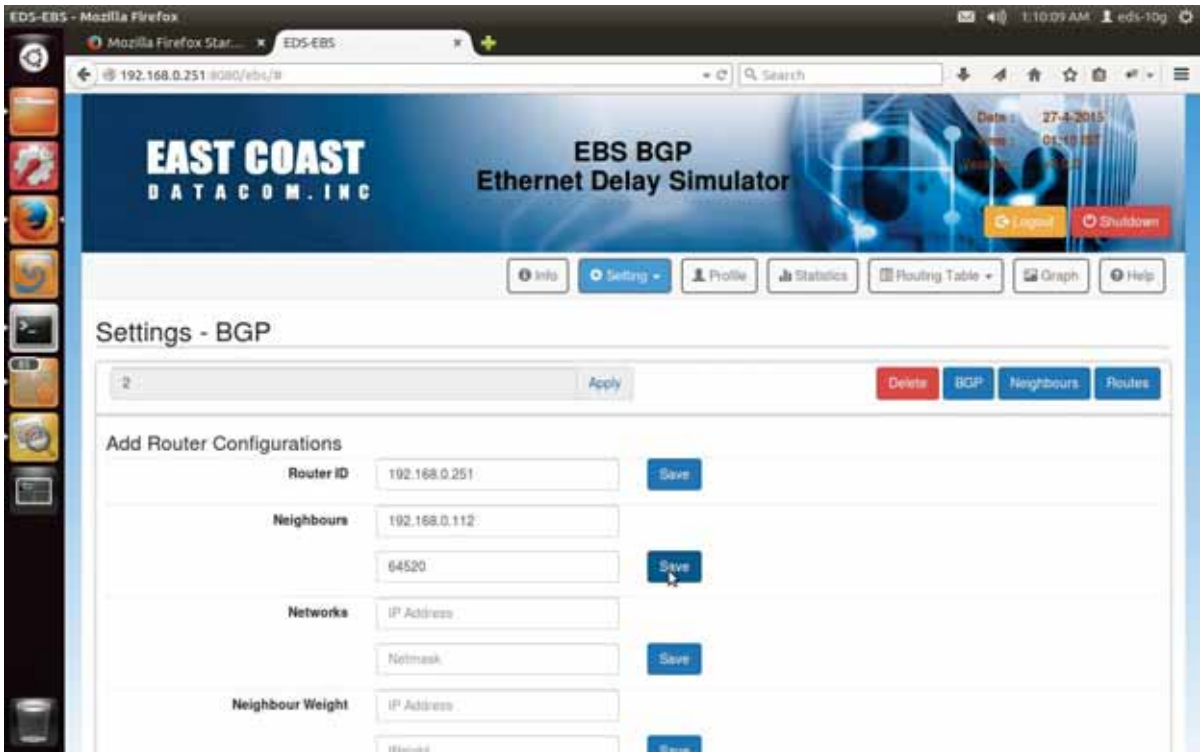
2.3.1.2 Neighbors

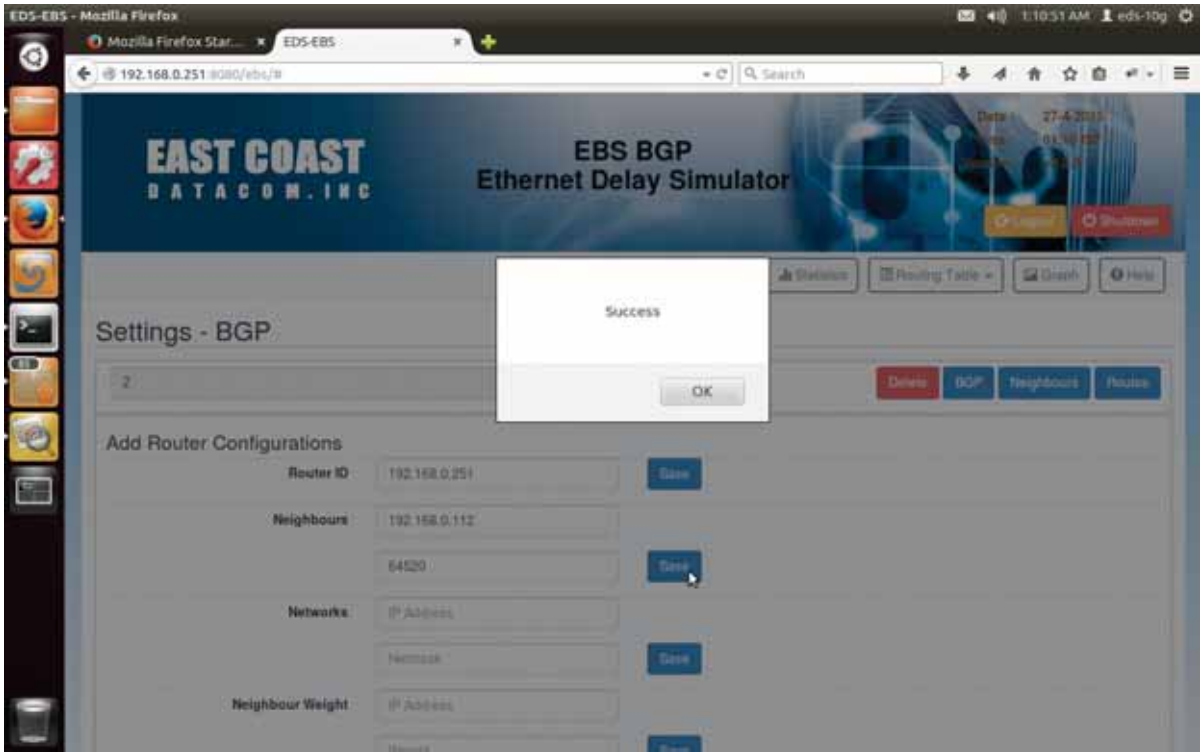
Go to following menu path " Main Menu->Settings ->BGP -> Add Router Configuration " and enter Neighbor Details as IP Address and Remote AS number to Add neighbors.

Once Add ,they can be seen in "Settings -> BGP ->Neighbors " .Press Button "Neighbors" on the top right corner of screen to view "List of neighbors " on your system

Set the same configurations on the Neighbor systems.But set neighbor as EDS-10G system ip address and Autonomous Number instead.

Once we set Neighbors at both the ends , then we can see State Prefix Received in both ends to be a Number instead of a Text. That shows Connection is established and BGP message exchange is happening.





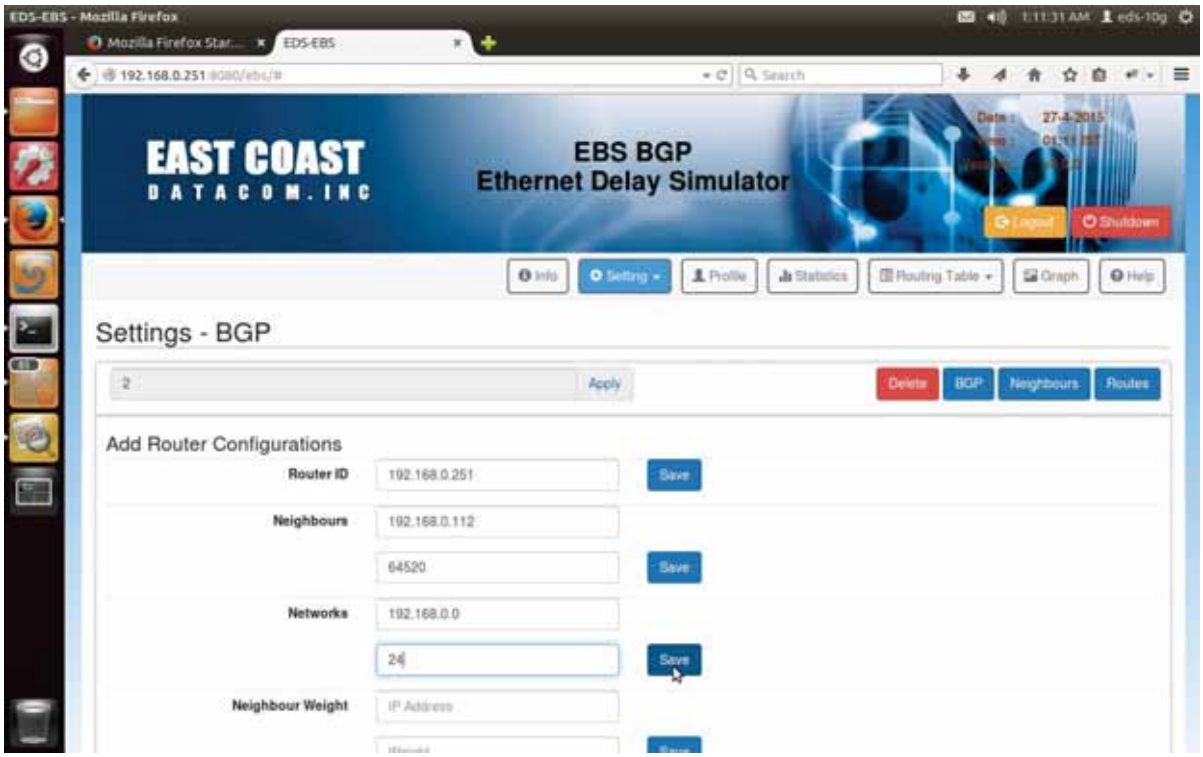
Add Neighbour

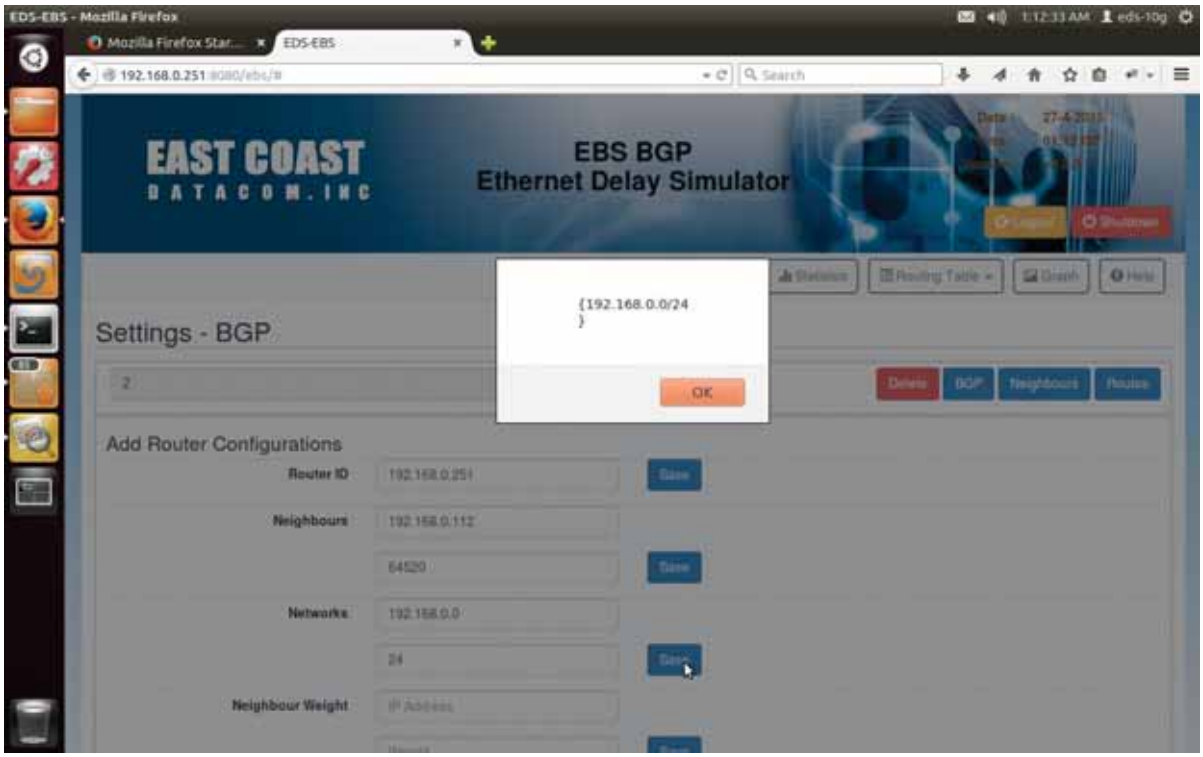
2.3.1.3 Networks

Using this option we will add/remove network in our bgp router configuration.If the neighbors are connected via a certain network,then we can specify network in their BGP configuration,so as the BGP will always choose internal path to establish connection through the particular network.Networks with internal path will set themselves as the gateway for the next HOP of network.

If the internal network is not added , then the immediate neighbor will regarded as the Default Gateway to reach the network.

After entering Network IP and Subnet-mask and pressing Save button will open up a pop-up screen showing network along with subnet mask which is added recently.



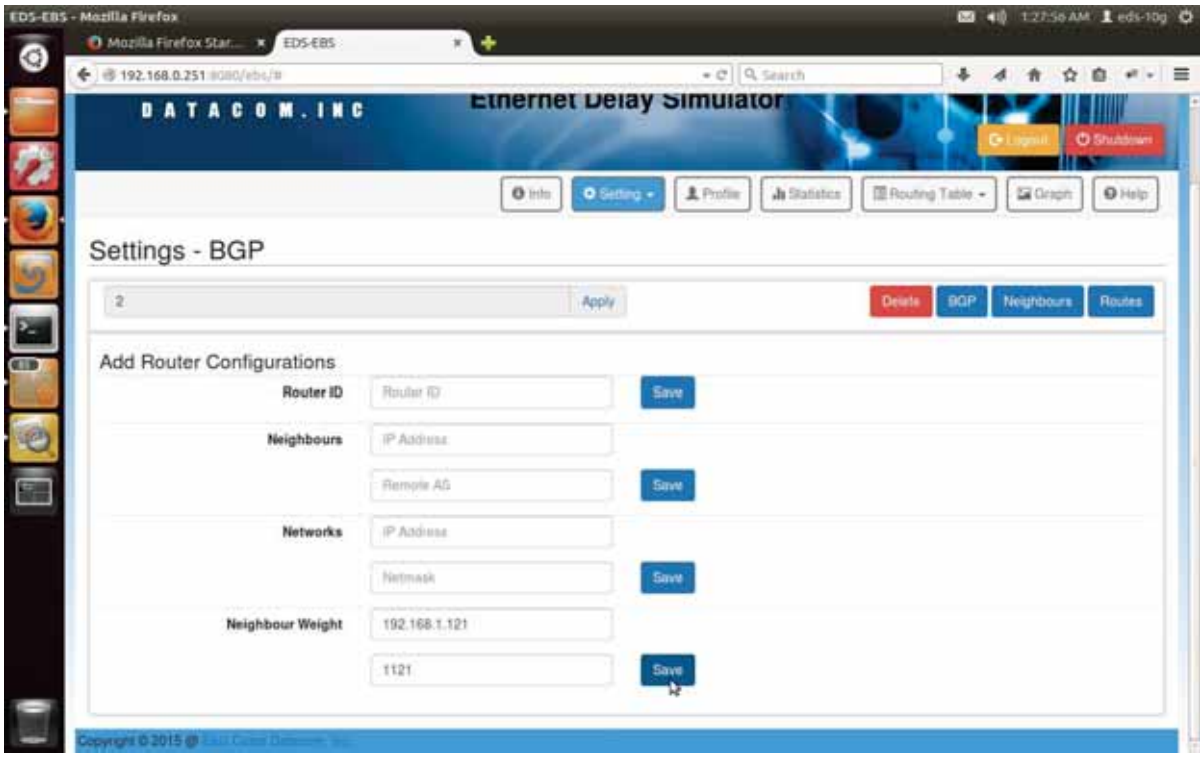


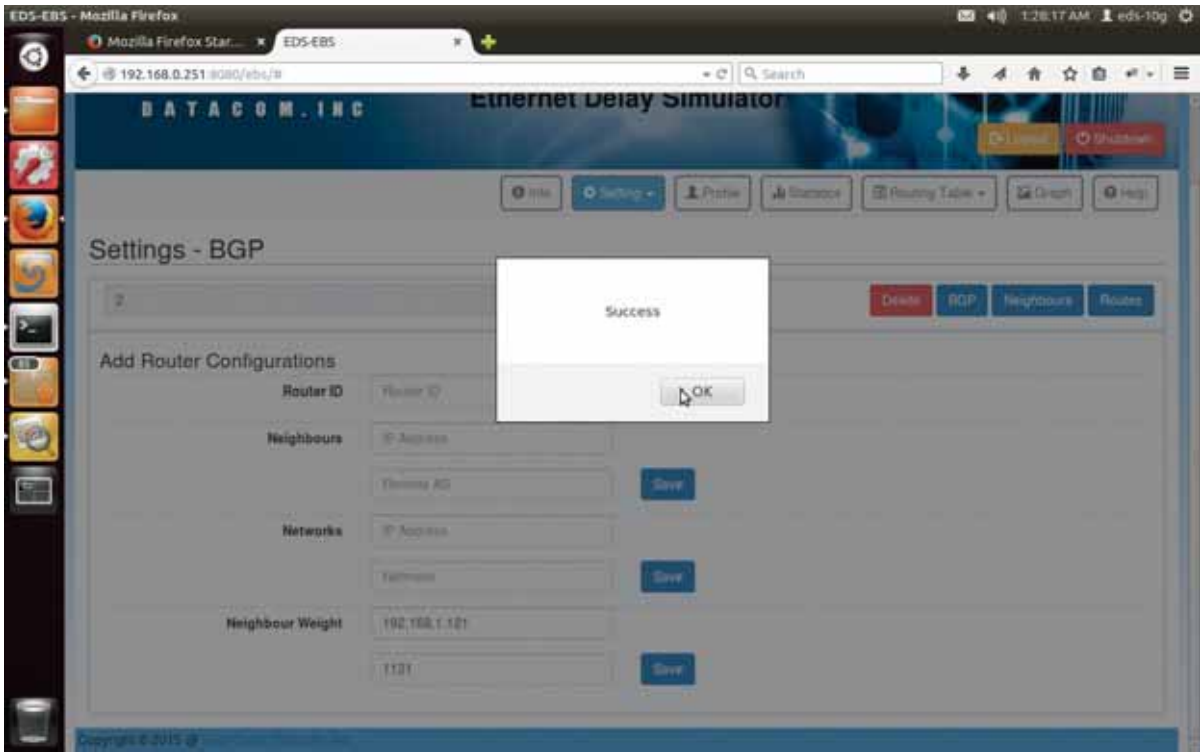
Add Network

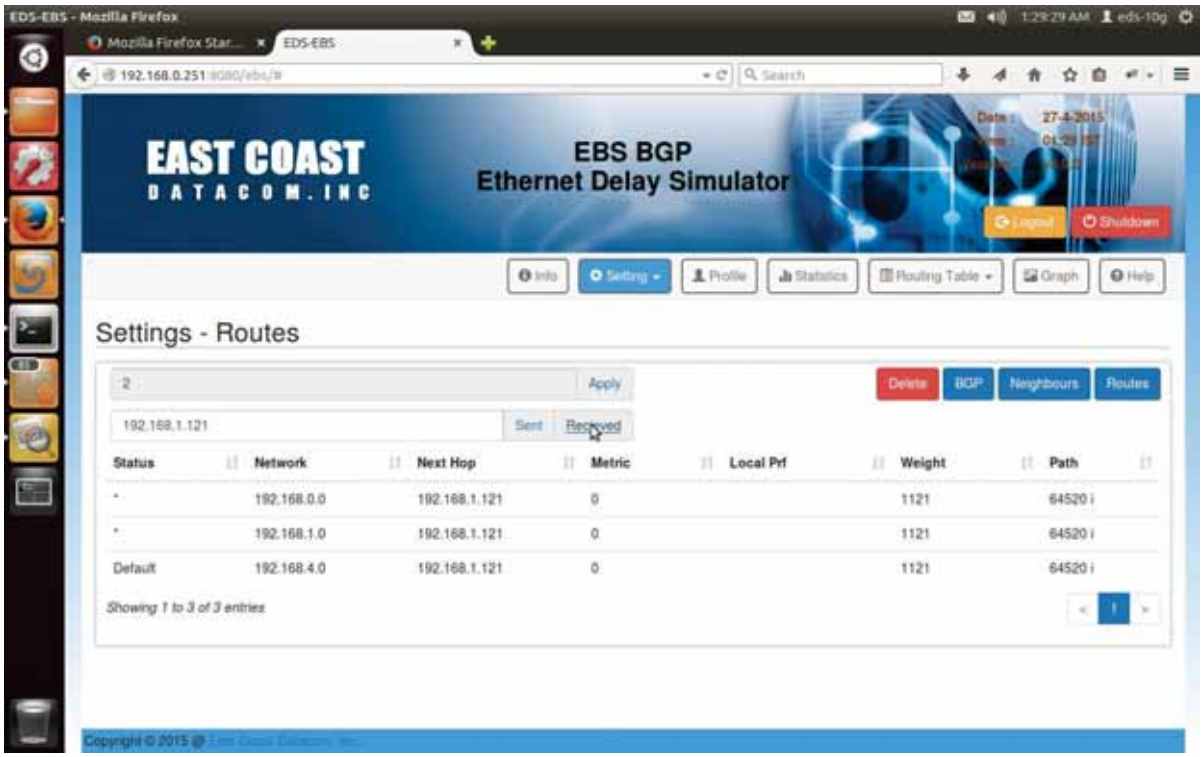
2.3.1.4 Weight

Setting the weight will override the default routing decision of BGP and a certain neighbour with highest weight is given higher preference then the rest. After setting the weight ,the bgp daemon will be restarted automatically to reflect the change

To check the updated Weight ,we need to go back to Routes Menu and check received Routes from the particular Neighbor to verify whether weight is updated for BGP daemon







Add Weight

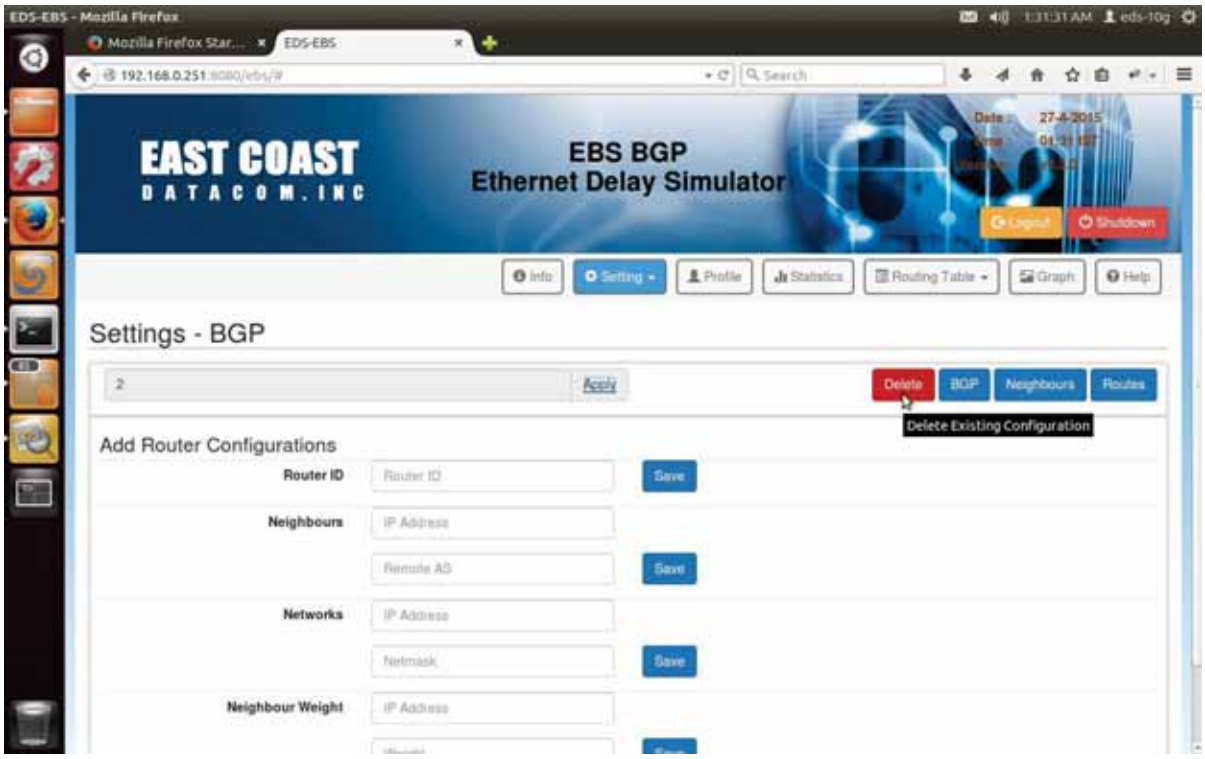
2.3.2 Delete Configuration

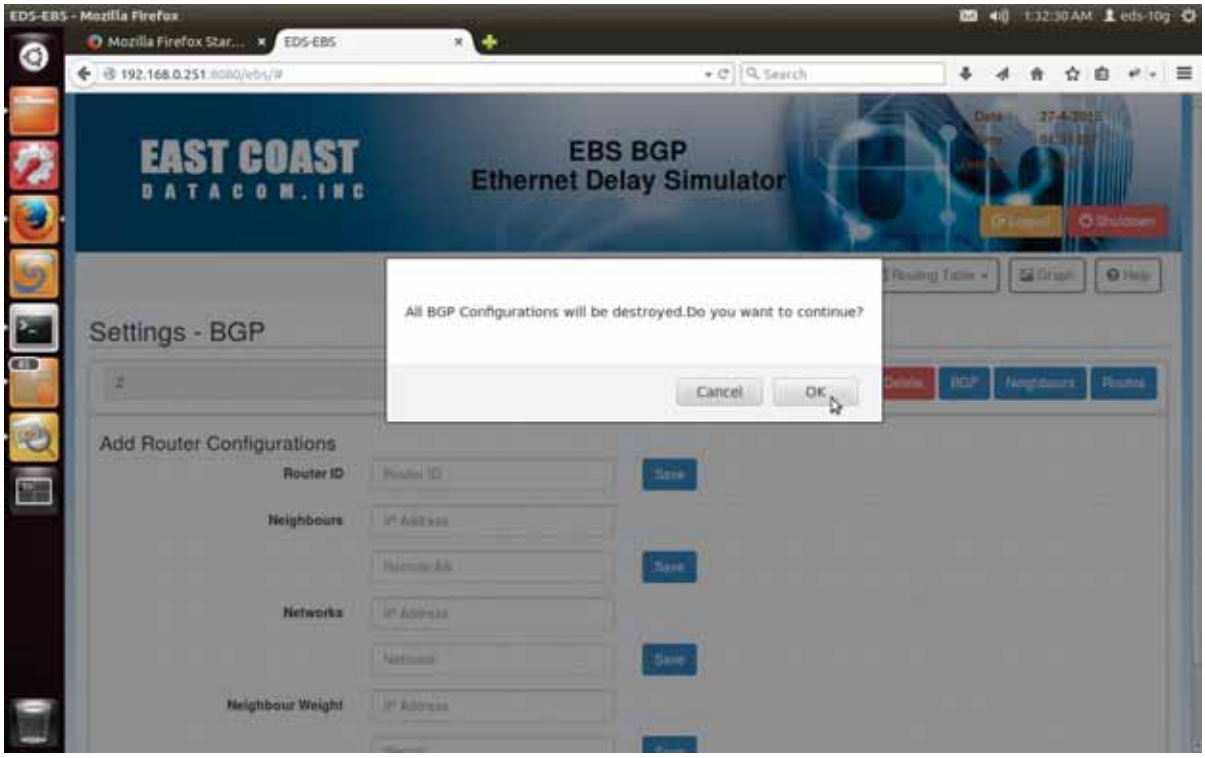
From BGP Configuration Menu select option “Delete” to delete an existing Autonomous System Number based configuration.

A warning Message will be displayed prompting for user confirmation. Remember after the deletion all the Path, Neighbors and Network will be removed from the existing Configuration.

Once deleted they can't be recovered in later point of time .Stay cautious to use this options. As the kernel routing decision will be based on this option.

After Deletion , the Add button will replace Delete button so user can enter his new configurations..





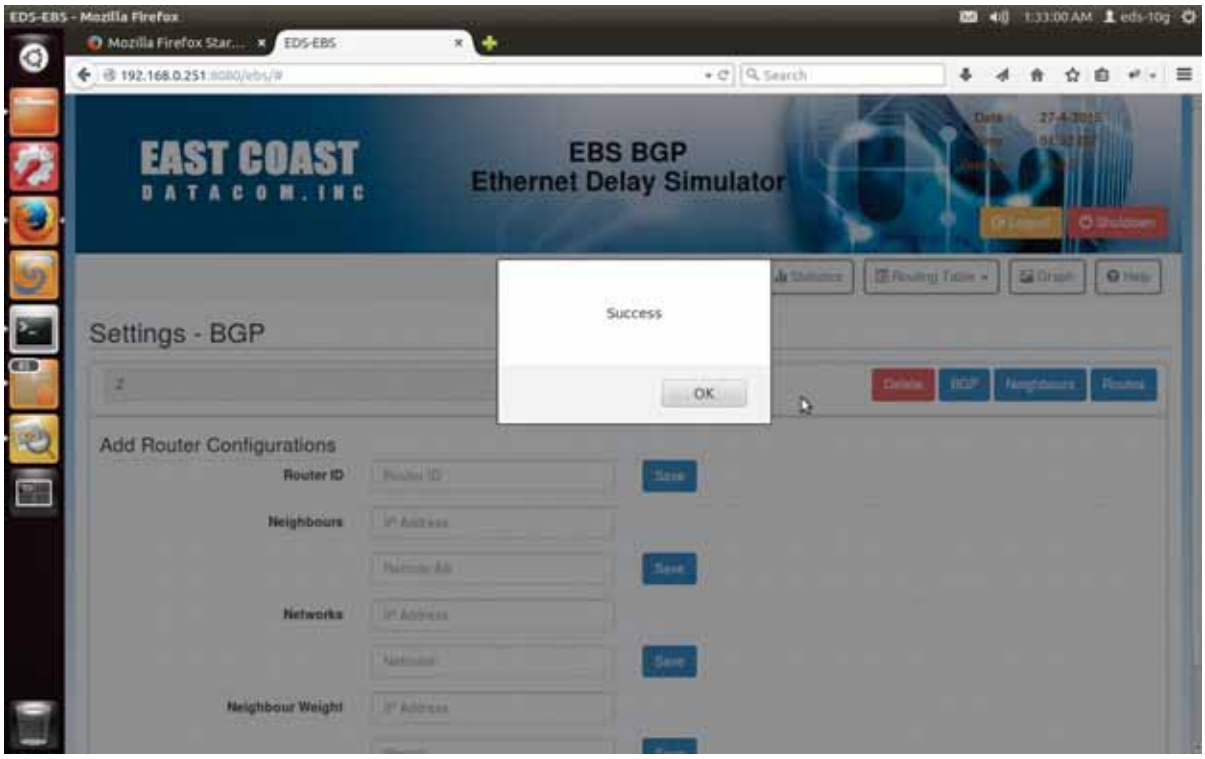


Table 2-5. Deleting BGP Configuration

2.3.3 List of neighbors

Using this option will list the available neighbors connected to our Autonomous System AS. State of Neighbors is a very important attribute for trouble shooting connections.
The Neighbors who are connected but not advertised their routes are shown state as “Active”

While the Neighbors who are advertising their routes show their State with some number.
The State is displayed as the last column on List of neighbors Table.

Adjacent Delete/Edit Buttons are provided next to every neighbor so that a user can modify Neighbor without entering much details.

Under this following two operations can be performed:

1) Edit Neighbor
2) Delete Neighbor

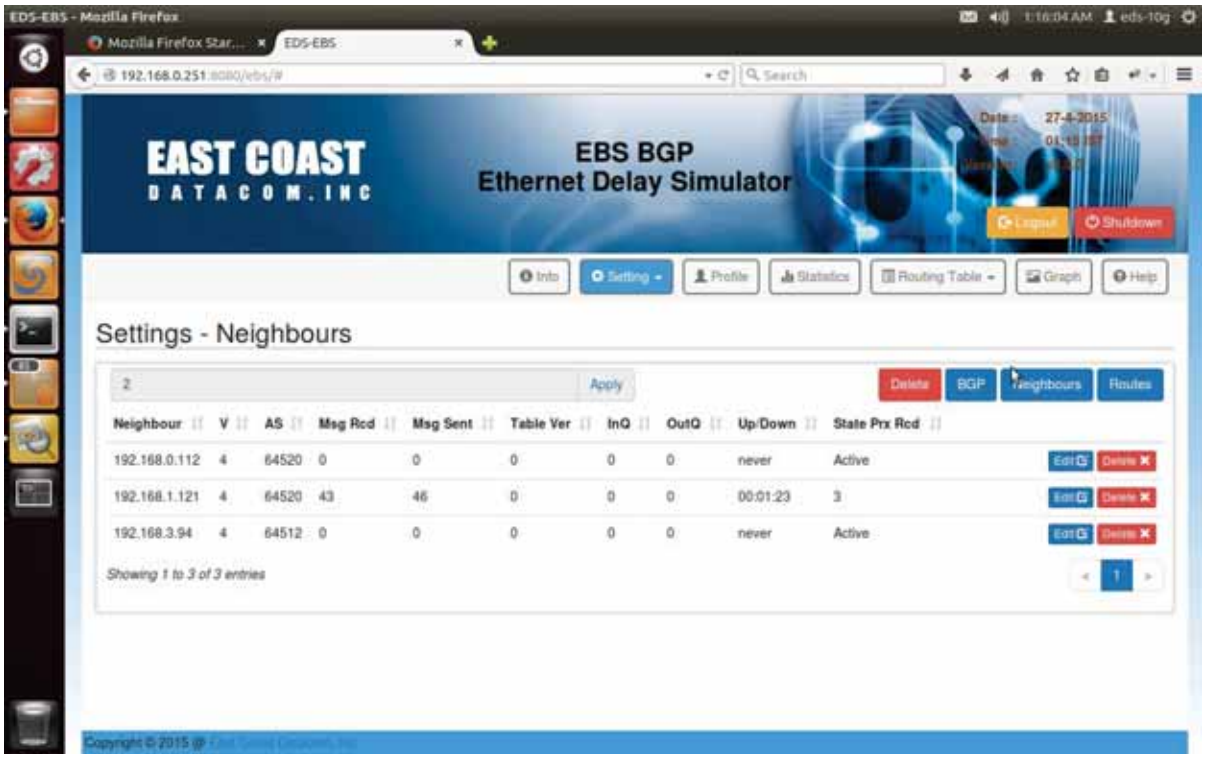
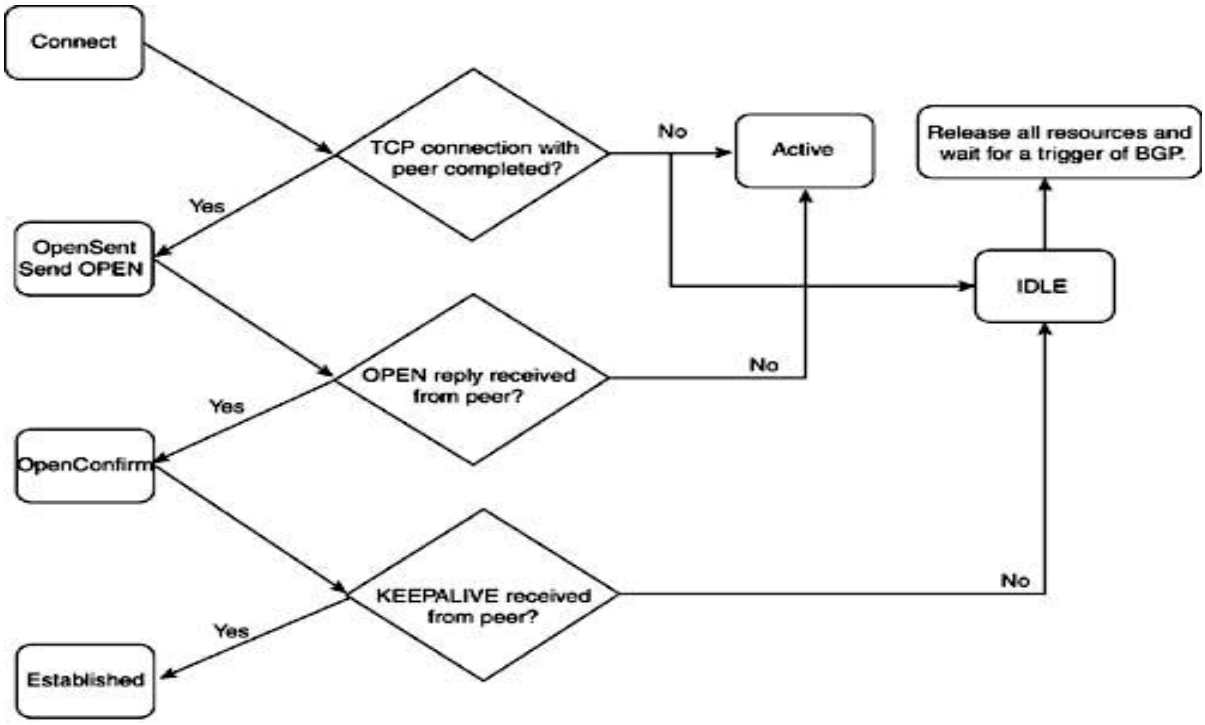


Table 2-6. List of BGP Neighbors



BGP States Diagram

BGP neighbor states

When BGP is configured with a neighbor IP address, it goes through a series of stages before it reaches the desired Established state in which BGP has negotiated all the required parameters and is willing to exchange BGP routes.

1. **IDLE State :**

Verifying route to neighbor.BGP refuses all incoming connections. No BGP resources are allocated in Idle state, and no incoming BGP connections are allowed.

2.Connect State :

BGP waits for a TCP connection to be completed. If successful, the BGP state machine moves into OpenSent state after sending the OPEN message to the peer. Failure in this state could result in either going into Active state or Connect state, or reverting back to Idle state, depending on the failure reasons.

3. Active State :

Attempting connectivity to neighbor. In this state, a TCP connection is initiated to establish a BGP peer relationship. If successful, BGP sends its OPEN message to the peer and moves to OpenSent state. Failure can result in going to the Active or Idle states.

4. OpentSent State :

Open message sent to neighbor. After sending an OPEN message to the peer, BGP waits in this state for the OPEN reply. If a successful reply comes in, the BGP state moves to OpenConfirm and a keep-alive is sent to the peer. Failure can result in sending the BGP state back to Idle or Active.

5. OpenConfirm State :

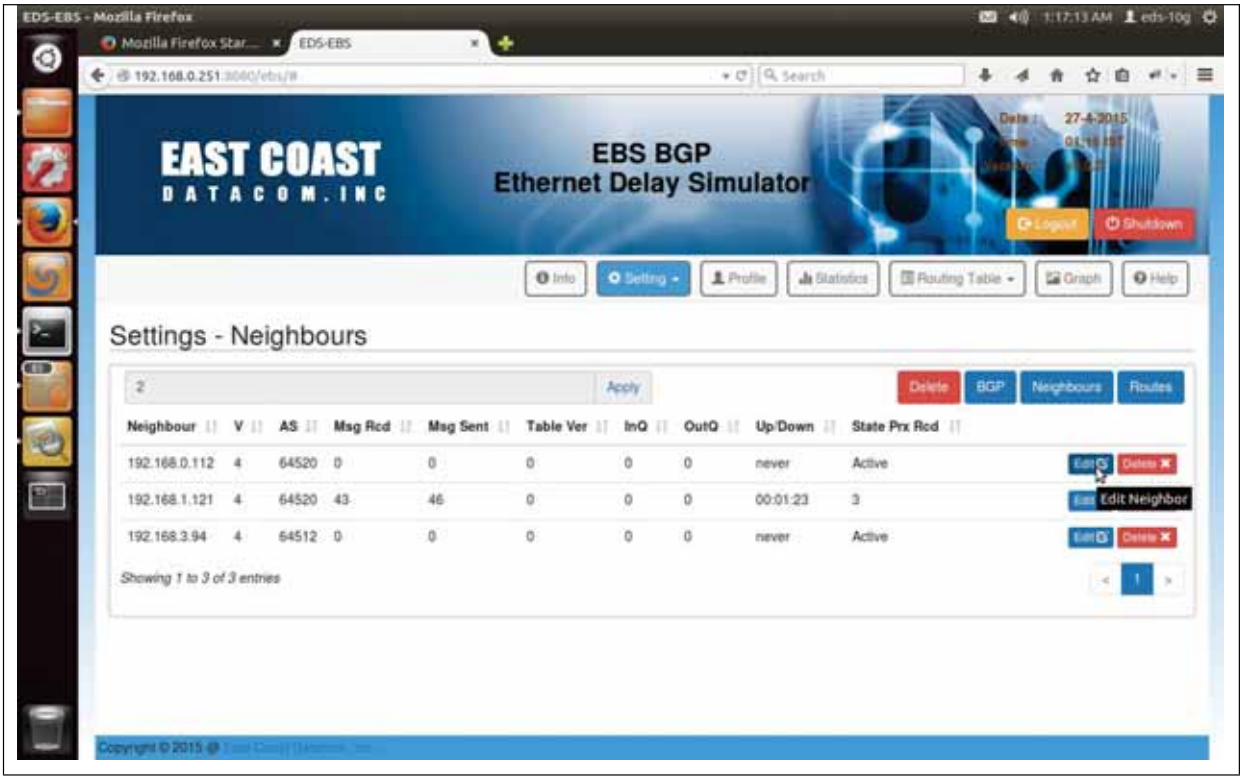
Neighbor replied with open message. The BGP state machine is one step away from reaching its final state (Established). BGP waits in this state for keep-alives from the peer. If successful, the state moves to Established; otherwise, the state moves back to Idle based on the errors.

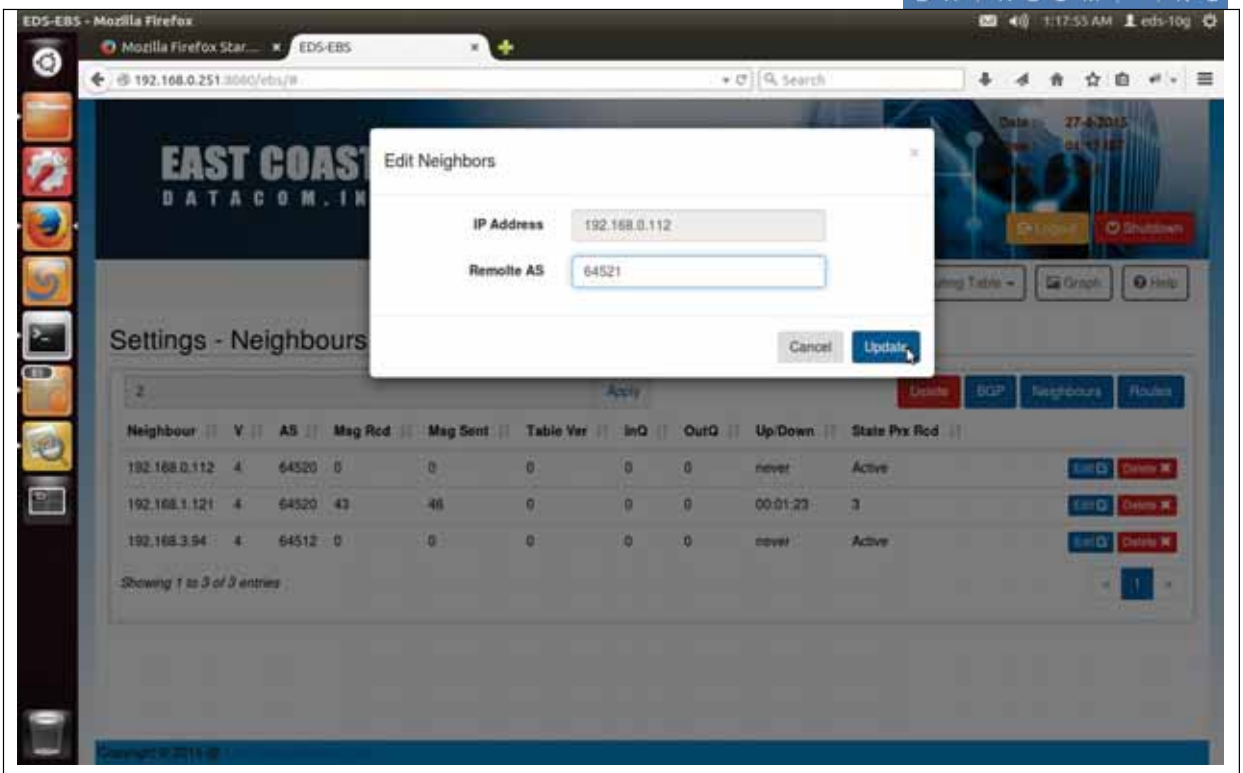
6. Established State :

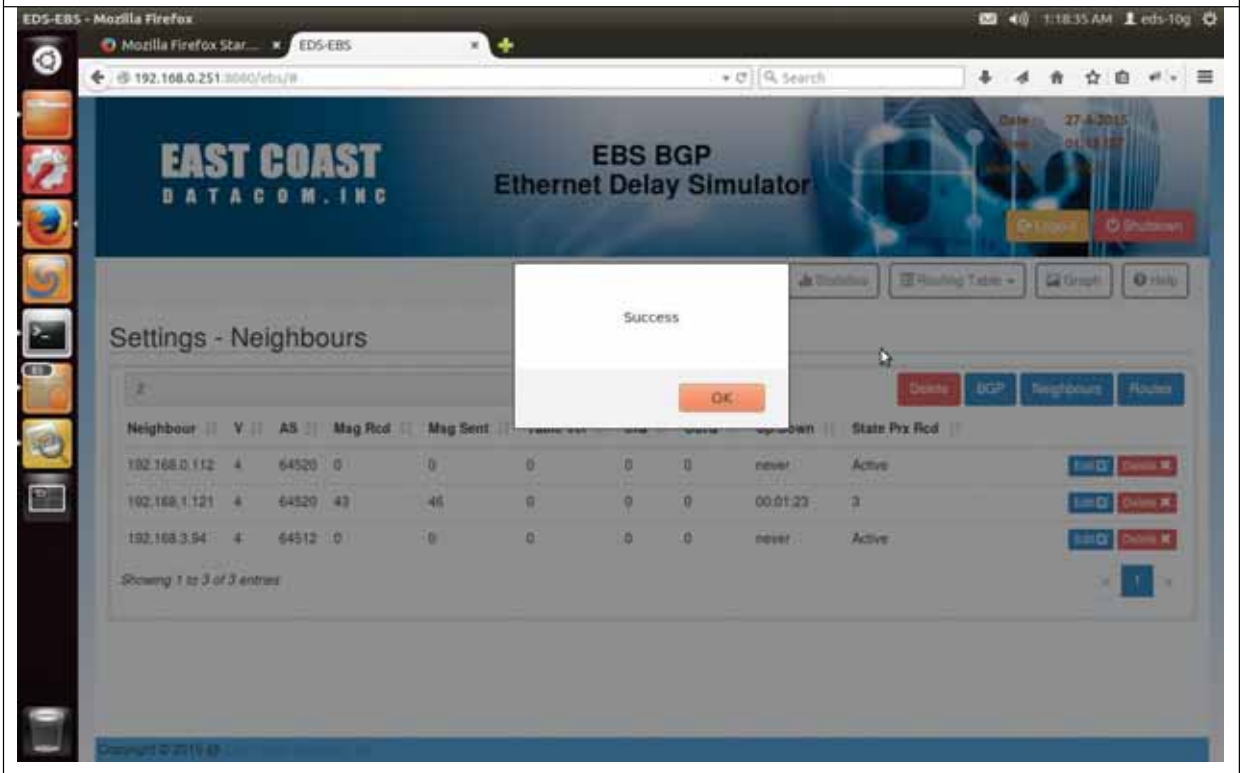
connection between neighbors established. This is the state in which BGP can exchange information between the peers. The information can be updates, keep-alives, or notification.Established State will be indicated by an integer value.

2.3.3.1 Edit Neighbor

Adjacent “Edit” Buttons to Neighbors will be used to edit AS number of already added Neighbor.



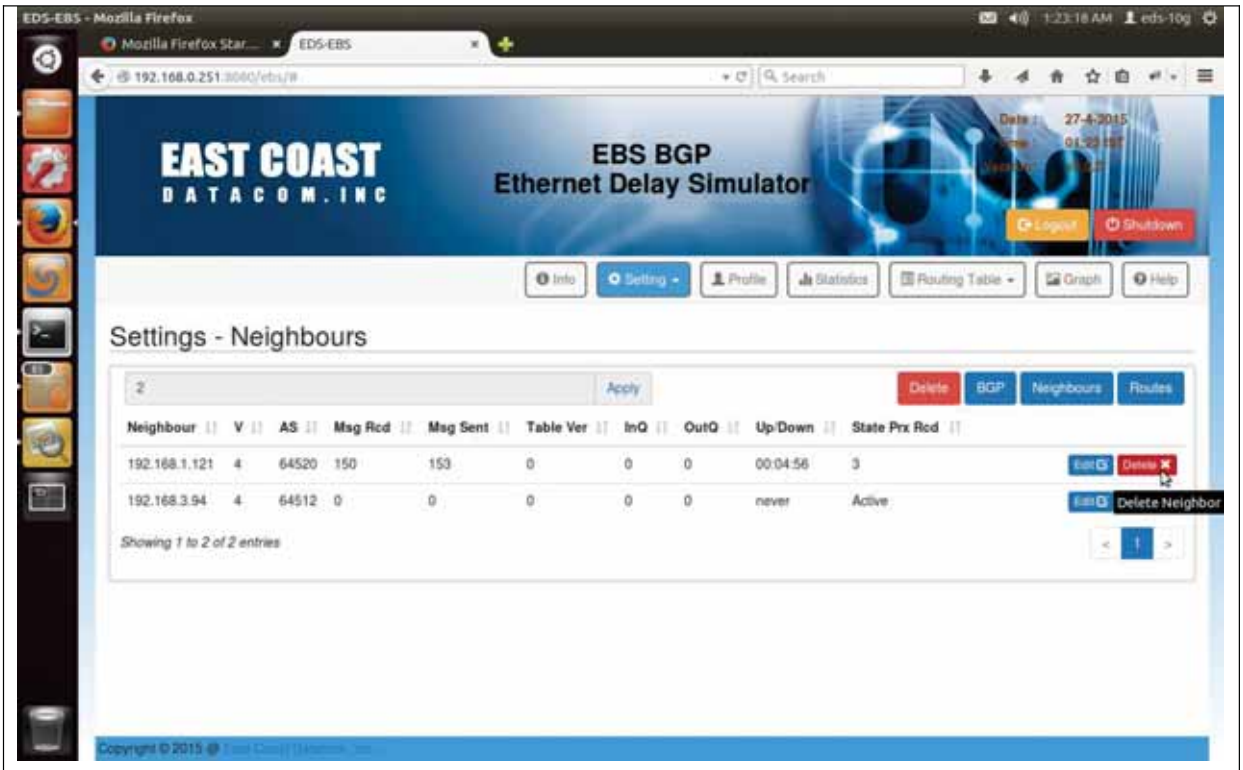




Edit Neighbor.

2.3.3.2 Delete Neighbor

Adjacent Delete Button will remove the neighbor.



Delete Neighbor

2.3.4 Routes

This options can provide a valuable insight into BGP neighbors .This option will show the list of routes shared between EDS-System and its neighbors.
To get the list of routes sent to neighbor use option “Sent”
To get the list of routes sent by neighbor use option “Received”

To Delete the network from BGP system , adjacent Delete Buttons are provided in the Sent Routes option. We can’t delete any received Routes ,hence Received Routes menu has no such buttons

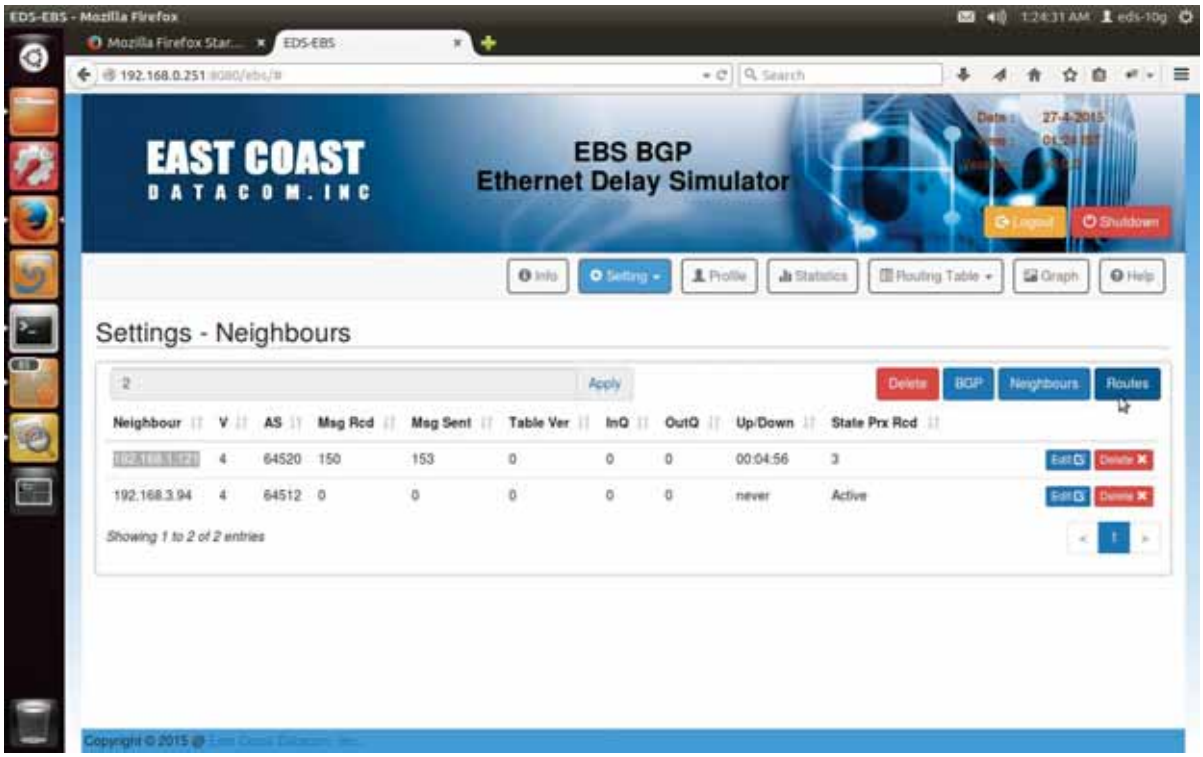
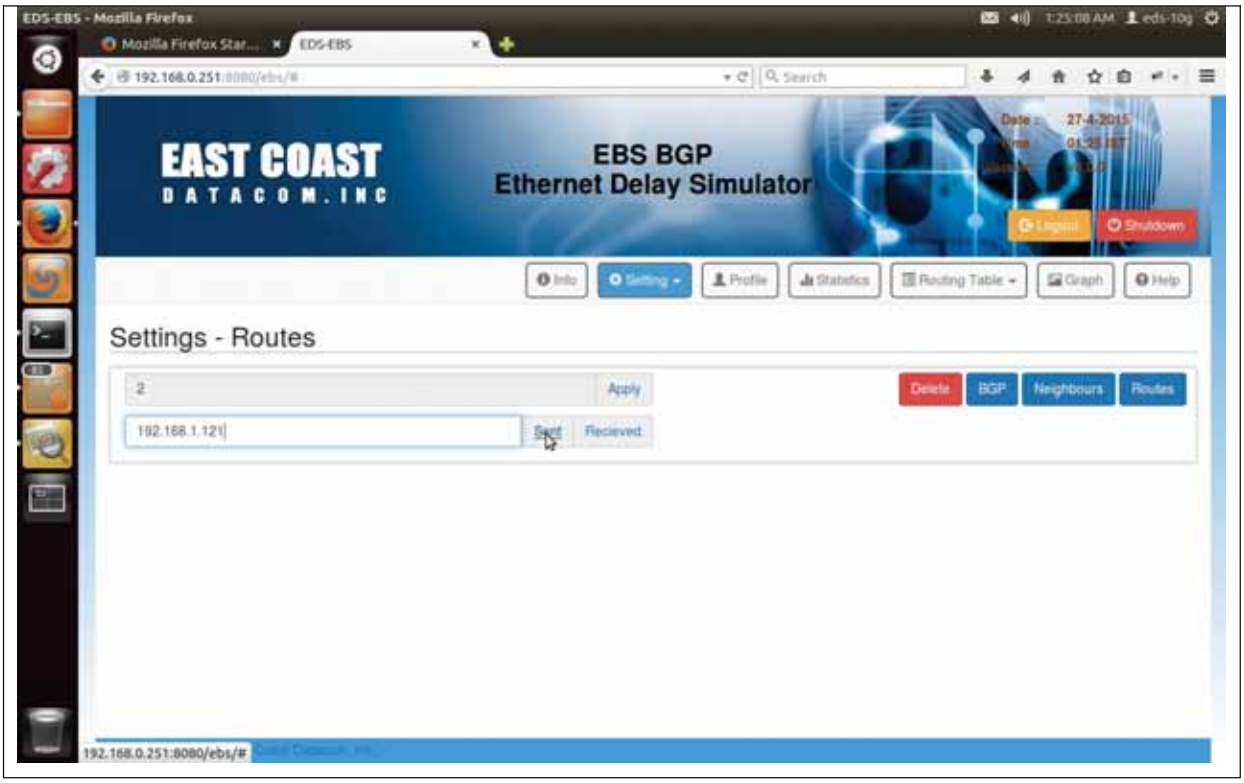
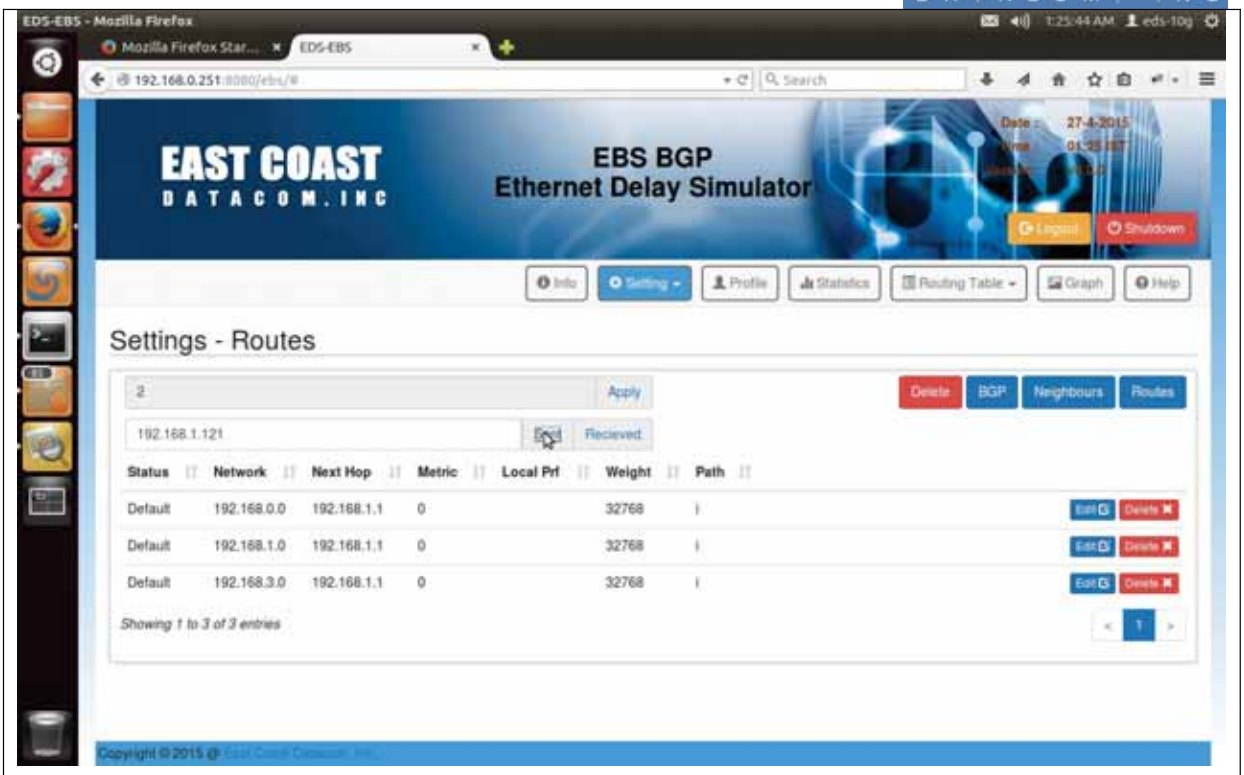


Table 2-7 Routes

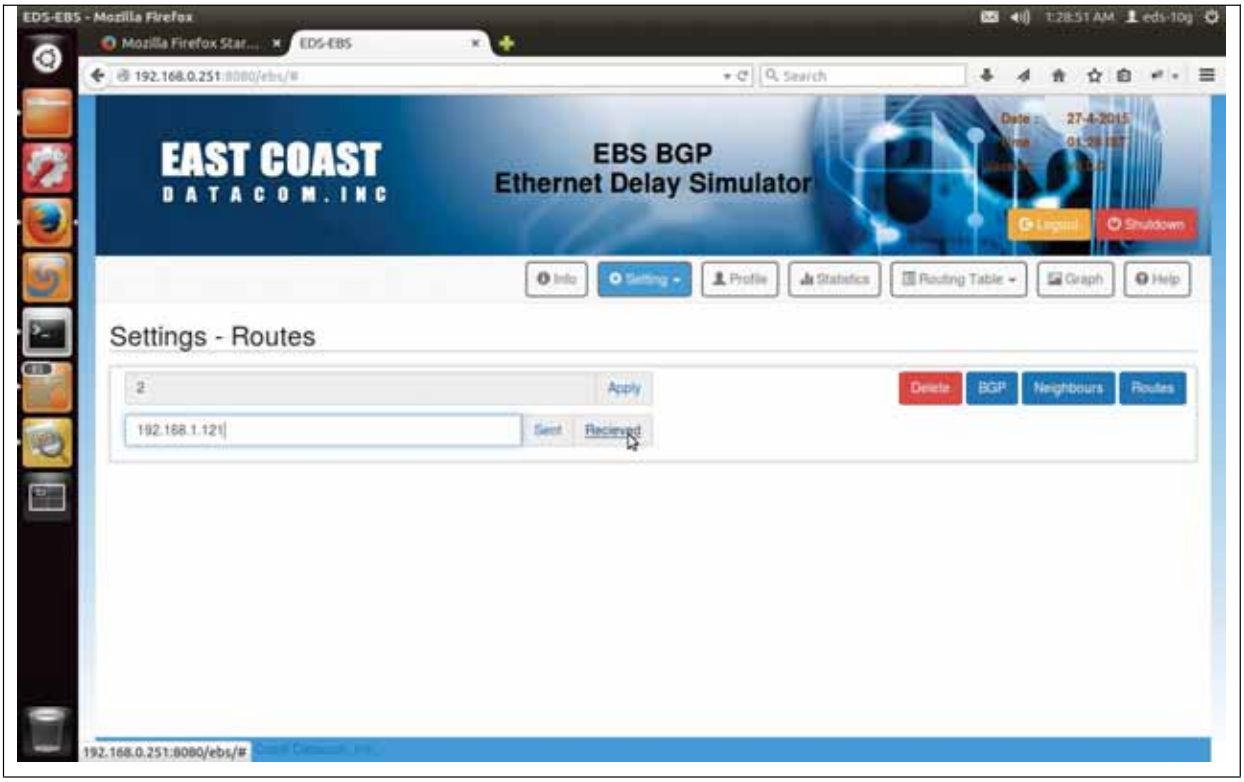
Sent Routes

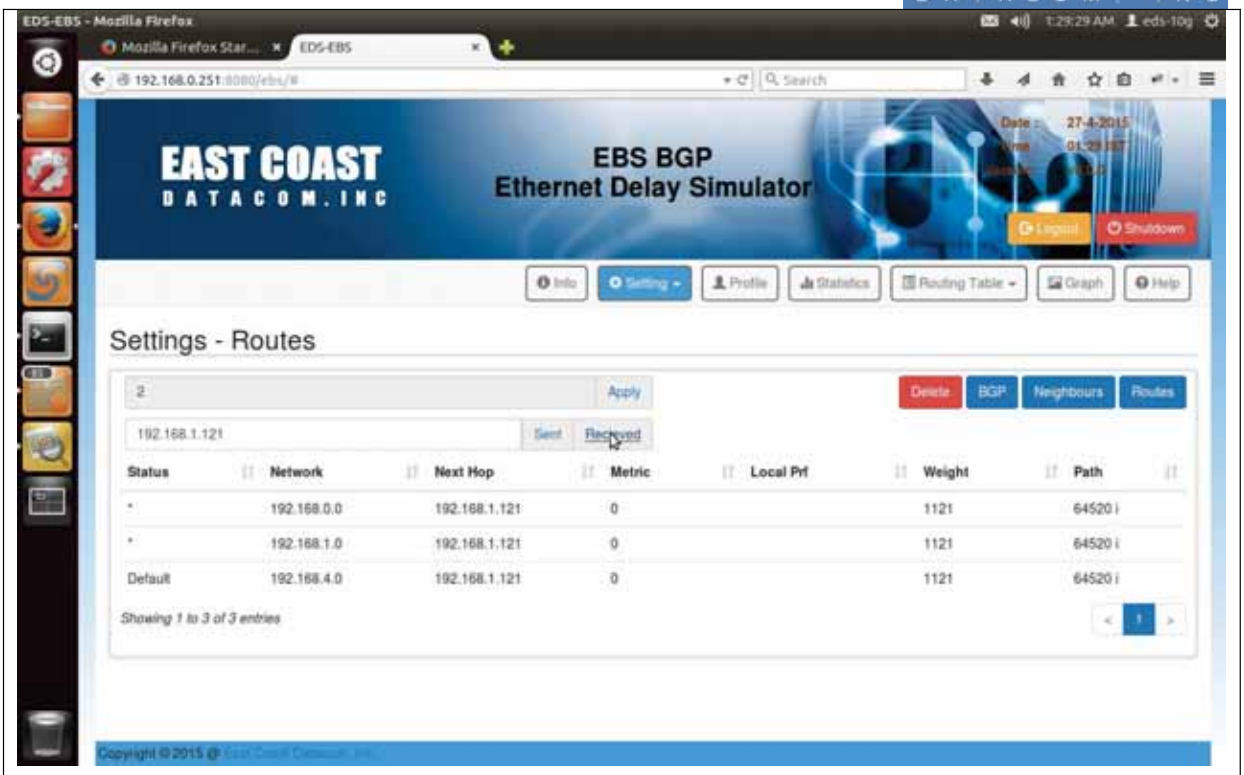




BGP Sent Routes

Recieved Routes





BGP Received Routes

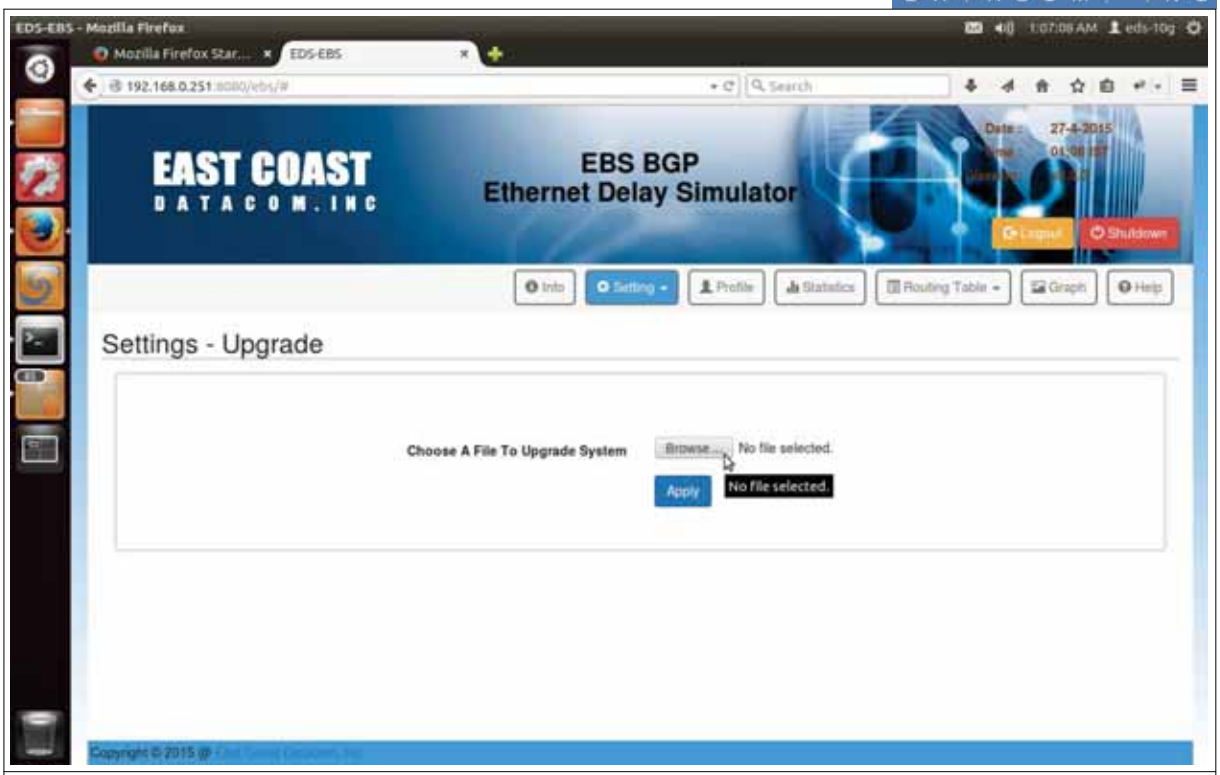
How to Test BGP Dynamic Decisions?

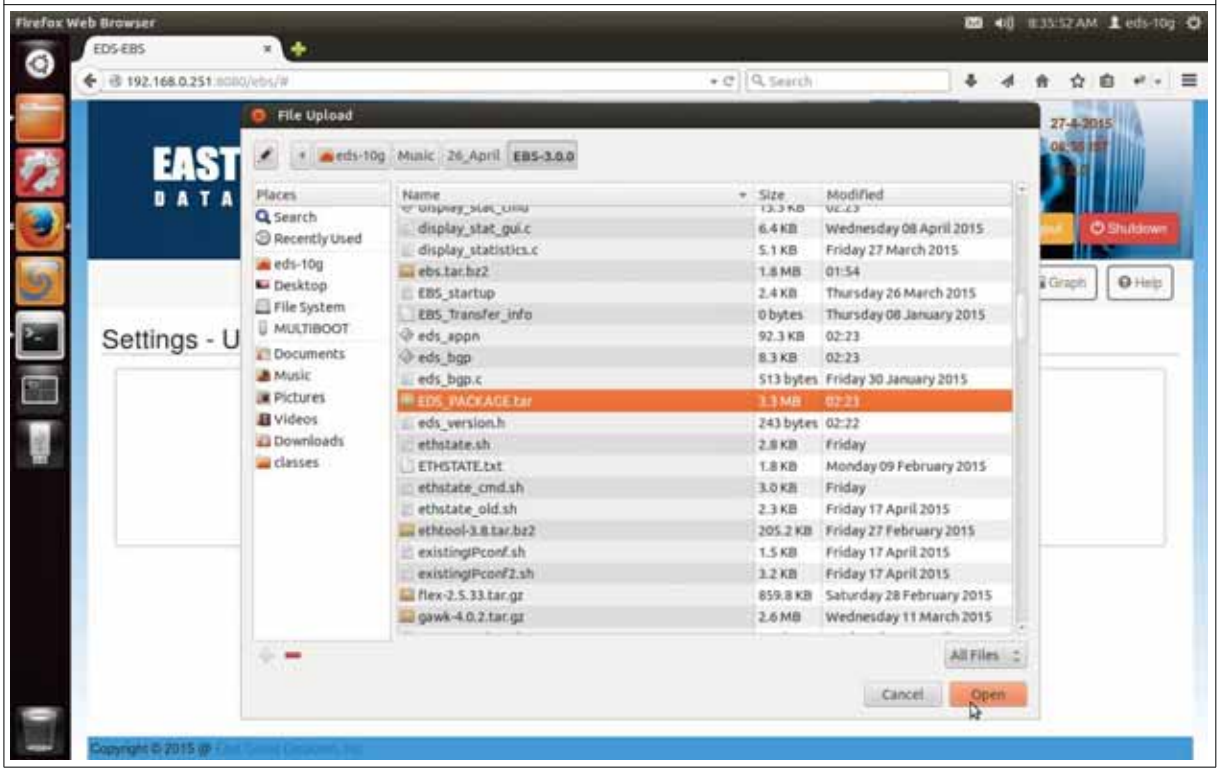
Test setup for BGP Dynamic Decision is provided at the end of section [**5.3] .**

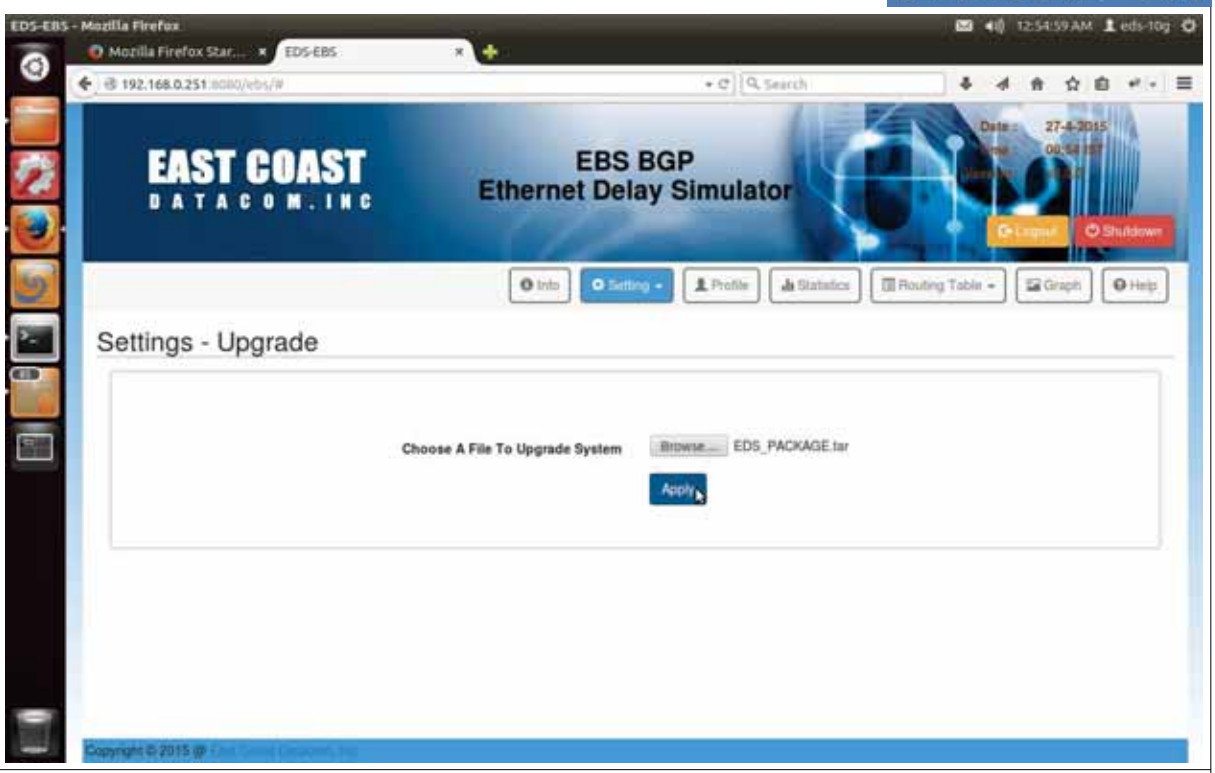
2.4 System Upgrade

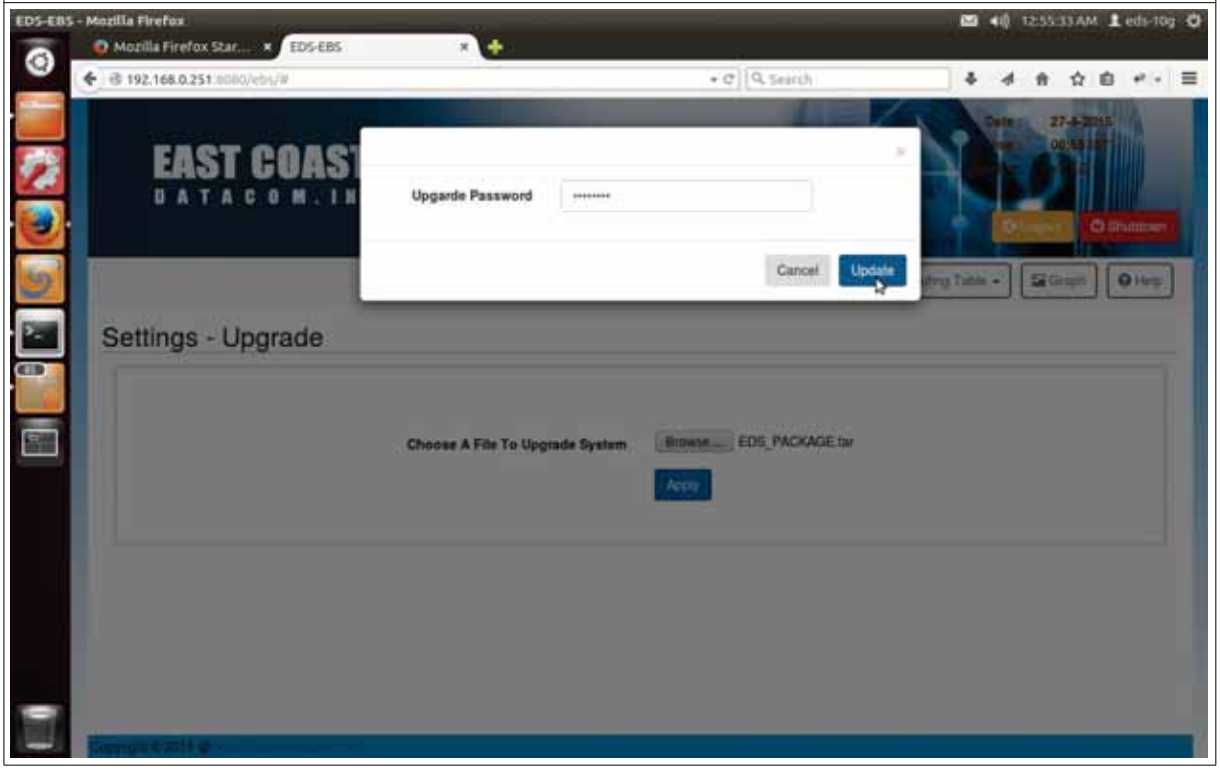
System Upgrade requires following set of steps to be performed:

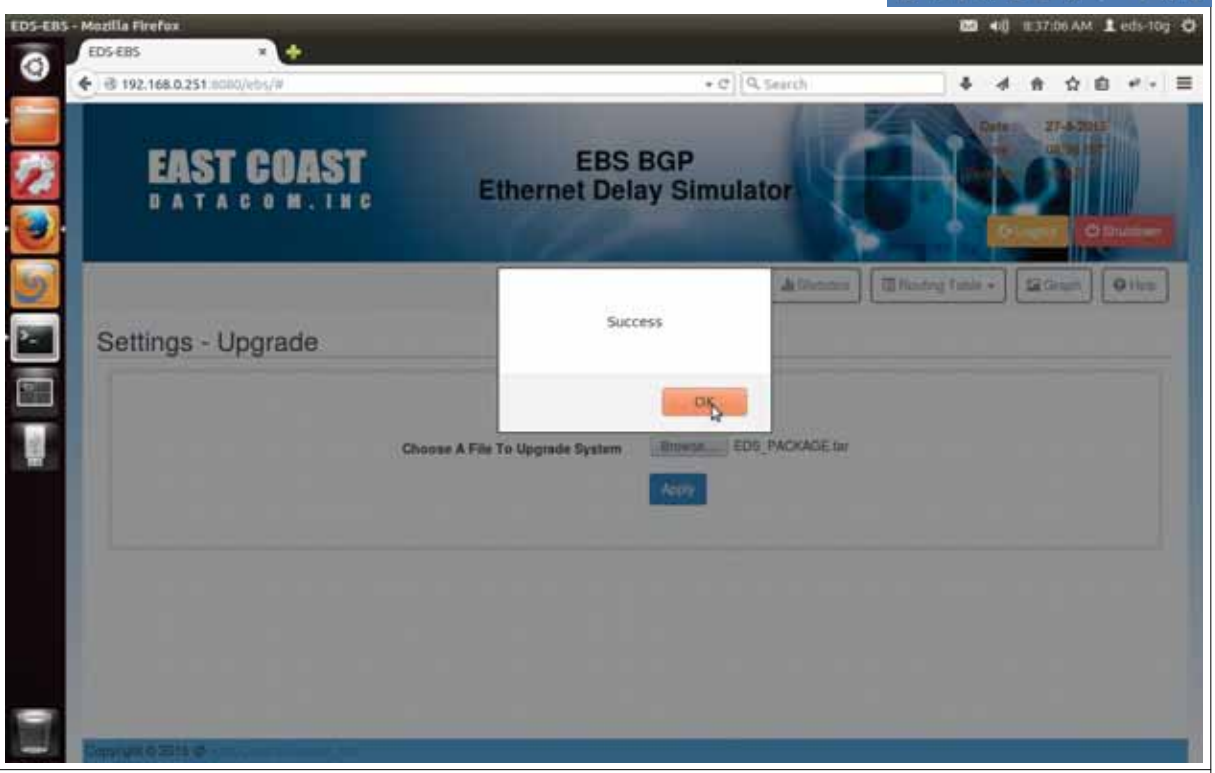
1) To upgrade software, download the upgrade file package named **EDS_PACKAGE.tar**
2) From the Settings Menu select option Upgrade to switch to Upgrade Menu.
3) Upgrade Menu will have Browse Button , which will be used to locate the downloaded upgrade file.
4) After Selecting the upgrade file, click Apply Button on Upgrade menu to apply the changes.
5) It will prompt for upgrade Password. , enter “madmax13” and press Update.
6) If the password and File is found valid , then a message will be displayed as “Success”.So far only Binary files and scripts have been transferred .But server is still running with old configuration.
7) To upgrade Server , we need to stop a server first and run a script in Linux command prompt.
8) Go to the EDS-BGP home folder by typing following command in LInux terminal as.{ `cd ~/EDS2` }
9) Run the following script with root user privileges as { `sudo ./update_gui.sh` }.
10) While installing the new configurations , script can ask for Server IP Address. It is best to give one among the IP Address of the Management Port IP Addresses .
11) Once , the script has completed its work ,restart the EDS-10g server.

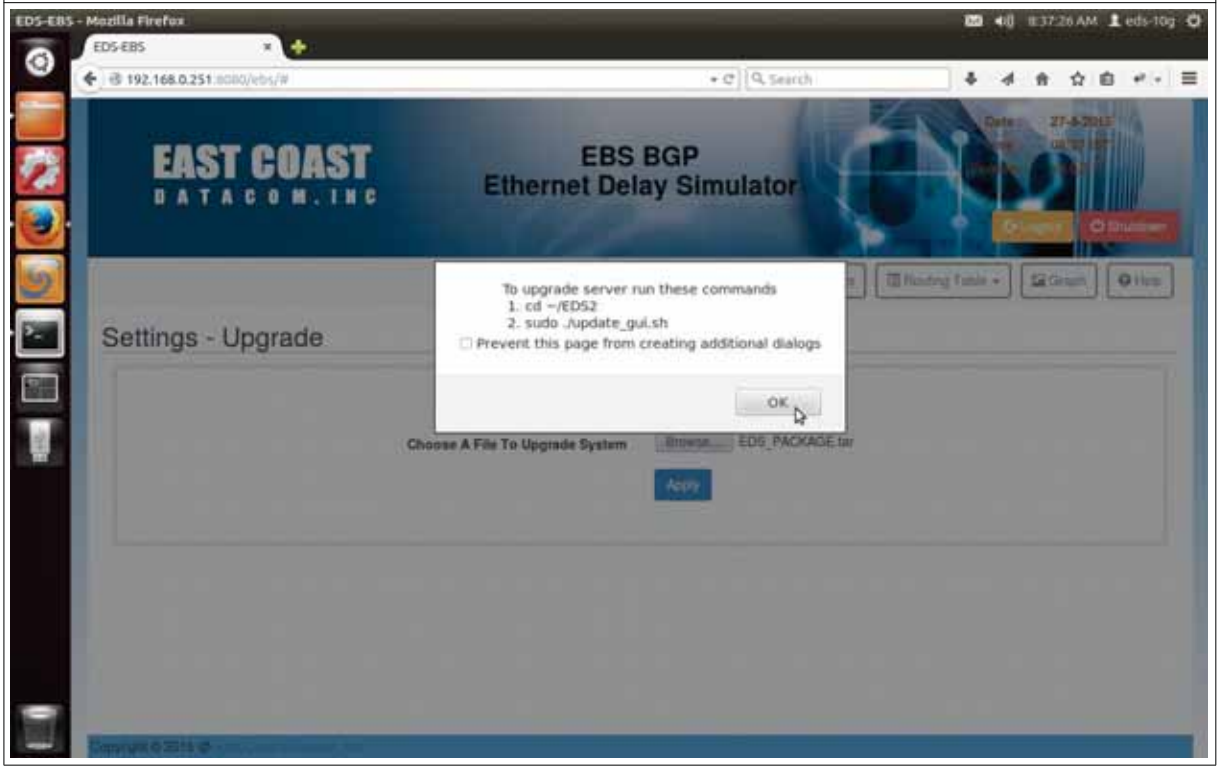


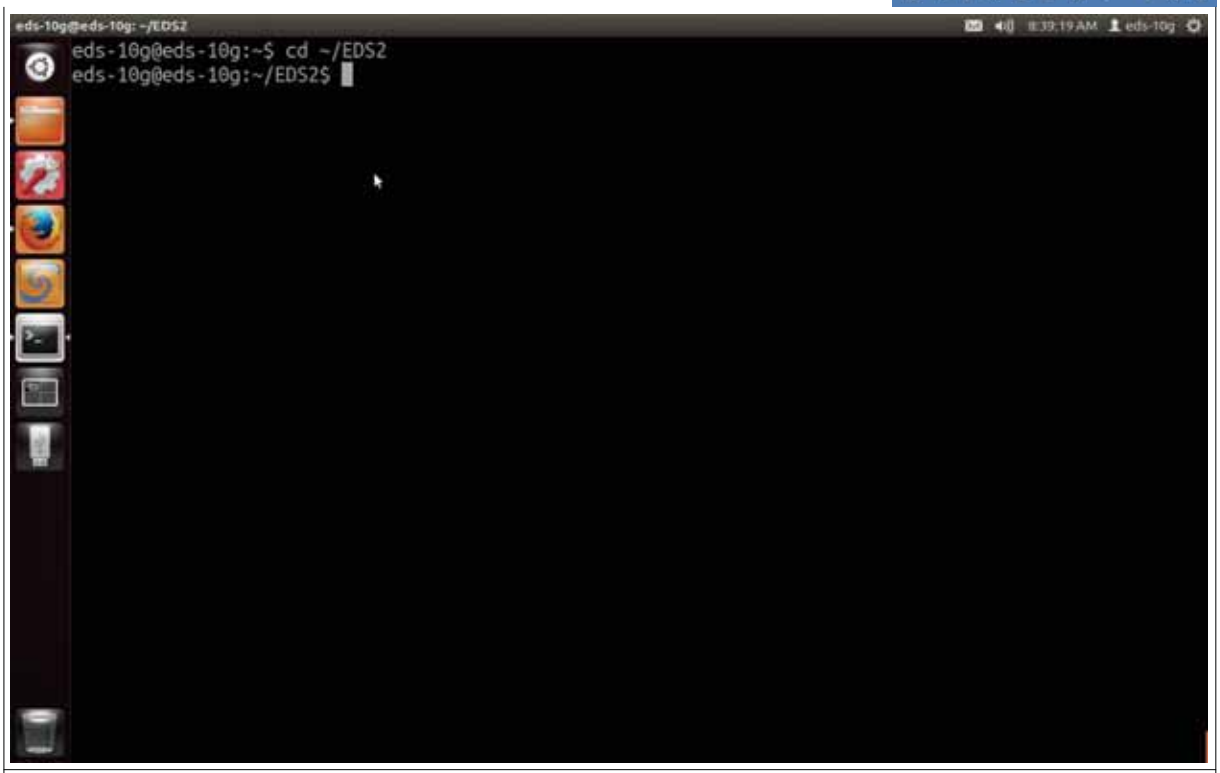


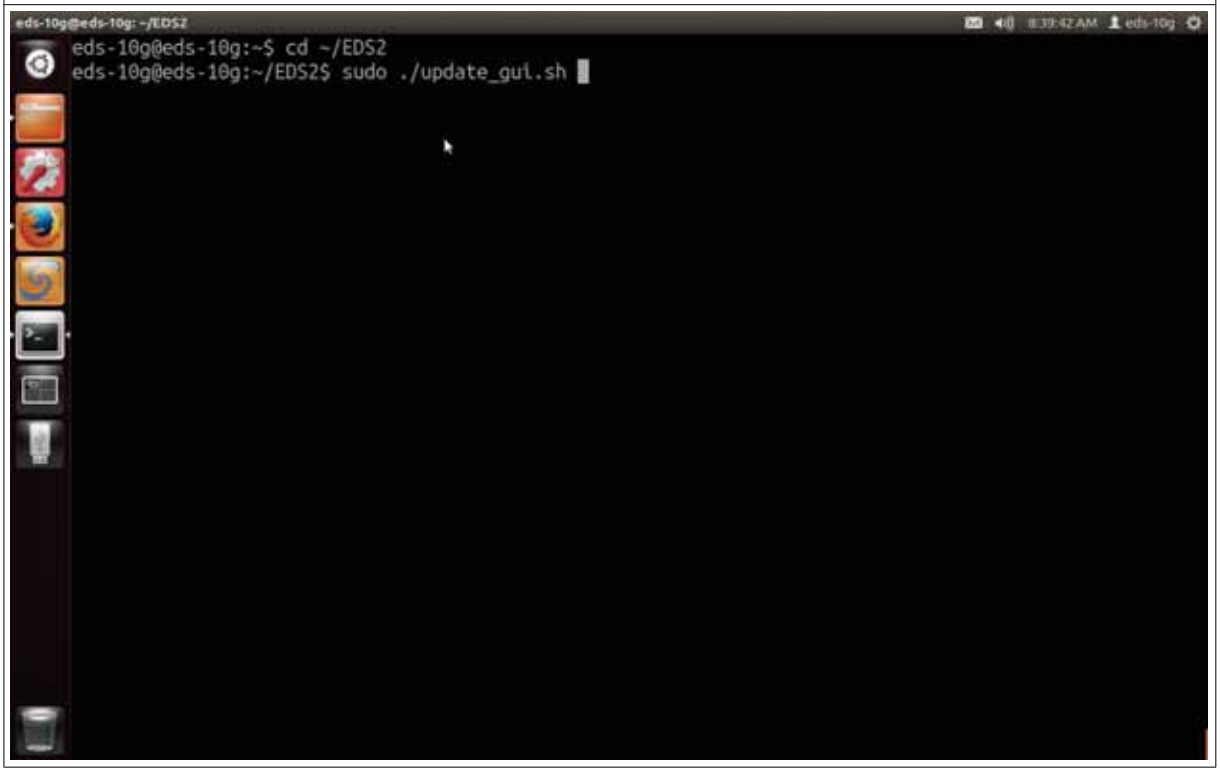


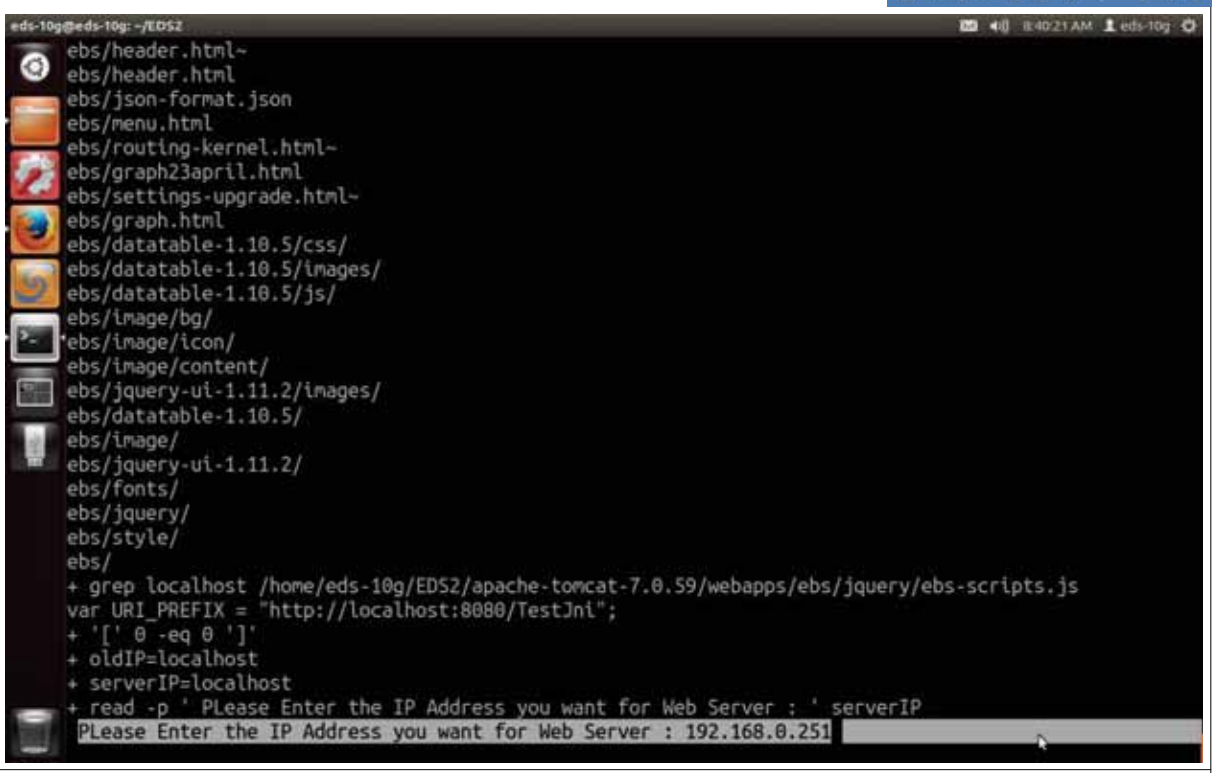












System Upgrade

3 Profiles

We use profiles names for storing Bandwidth Limit and other traffic parameters .Each profile can be applied to Multiple Source and Destination IP Addresses pairs. Apart from Bandwidth various other types of simulations can be possible as : Delay ,Packet loss ,Bit-wise Error ,Duplication,Re-ordering.
After setting the Profile parameters from “View Profiles” Menu ,we need to apply them to Source and Destination IP Address from “Apply Profile” Submenu.
Profiles has following sub-menus:

1. View Profile
2. Apply Profile

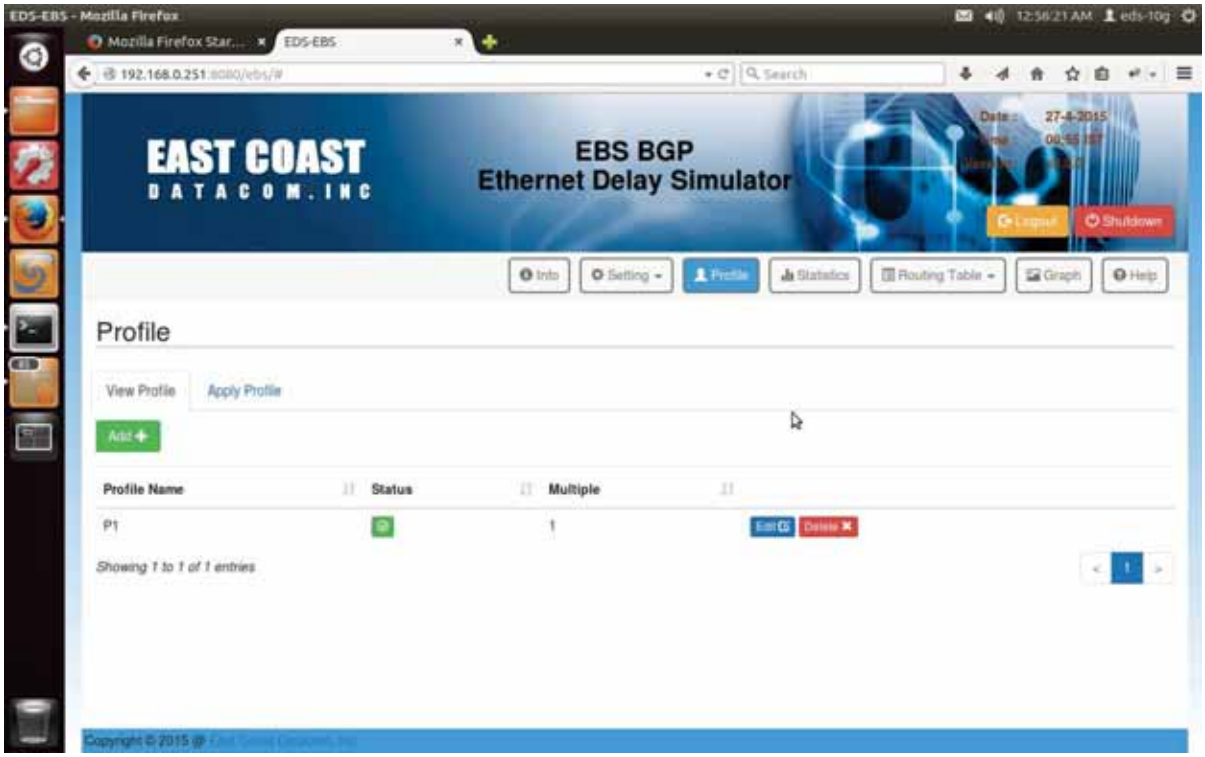


Table 3-0. Profiles Menu

3.1 View Profile

Use this option to Add/Edit/Delete a new profile in EBS system.Adding the profile will ask the new profile Name and Traffic Shaping Parameters just like:

1.Interface Name
2.Bandwidth
3.delay
4.loss
5.reorder
6.duplication
7.Bit Error(corrupt)

Each Profile thus created is applied to all the Router Interfaces.These Profiles first need to be created so as to be applied in the later order of applying profile in “Apply Profile” submenu.
Please provide the parameters under the specified Range only else it will revert back to previous Menu

without setting up the parameters. Again enter the parameters in proper format and range.
Also while specifying Reordering parameters please ensure you have specified delay parameters already else the setting will fail to set parameters and revert to previous Menu
While specifying percentage it is not recommended to Enter percent Suffix(**%**) as it is understood as a default.

Note : Adding the parameters for a profile will directly not apply them to Traffic Shaping Sub-system .We have to save them first so that they can be available when we want to apply the profiles to interfaces in later point of our application execution. To apply a profile there is a separate section **Apply Profile** present that will guide you on how to apply an existing profile to interface.
But if we Delete a profile while the profile is running then it will be stopped by application first before deleting Profile.
View Profile supports three operations:

1) Add a new profile
2) Edit an existing Profile
3) Delete an existing Profile.

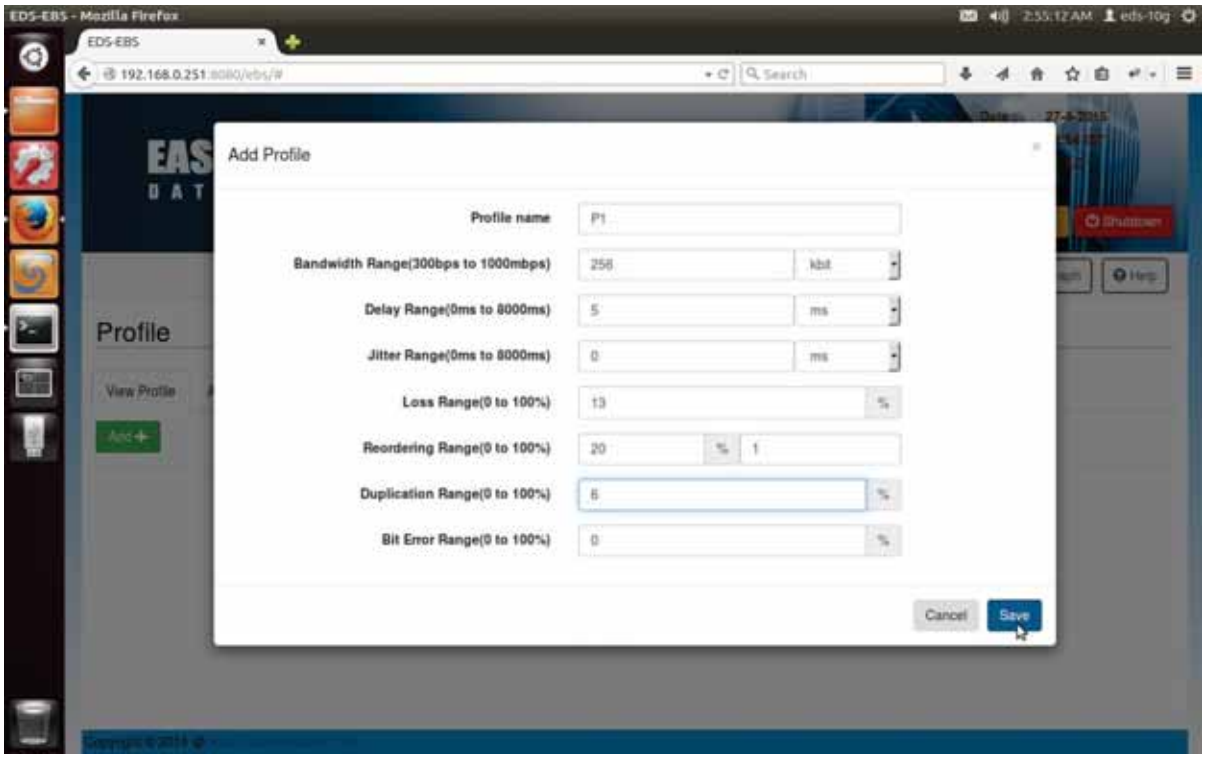
3.1.1 Add new Profile

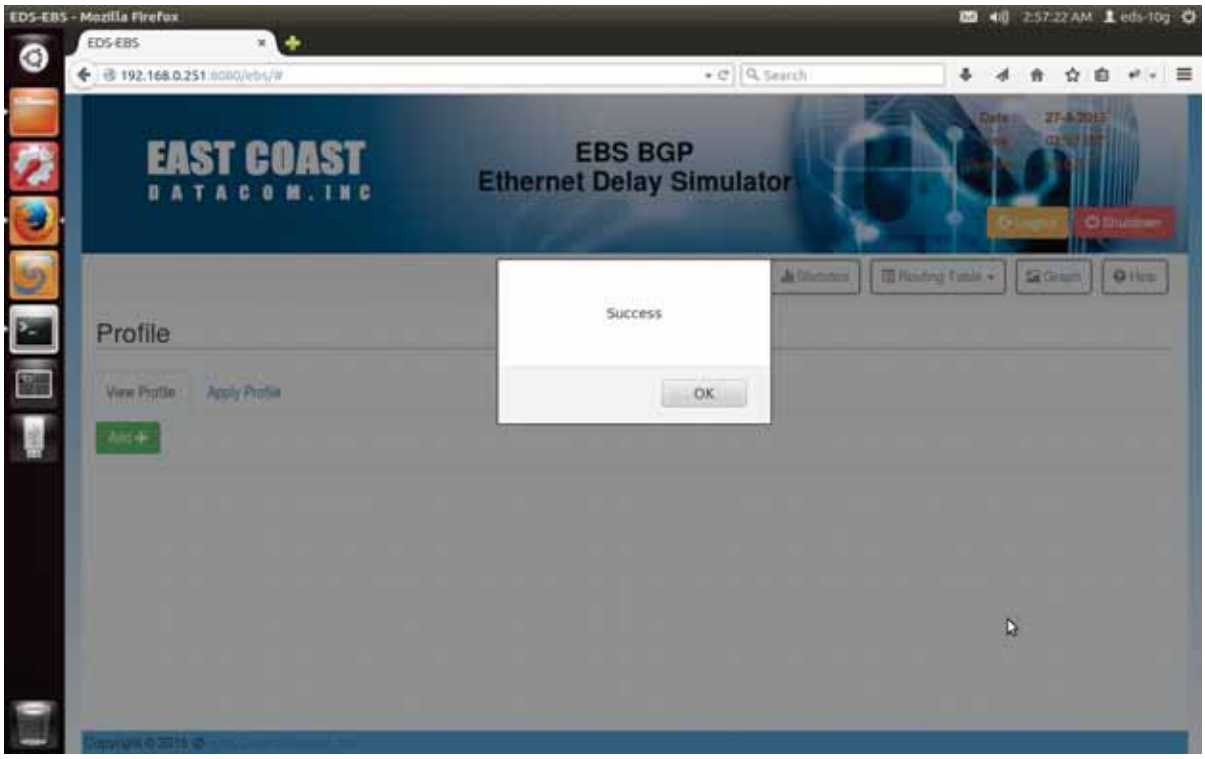
Press Add Button in “View Profile” menu to add new Profile name and corresponding traffic shaping parameters.

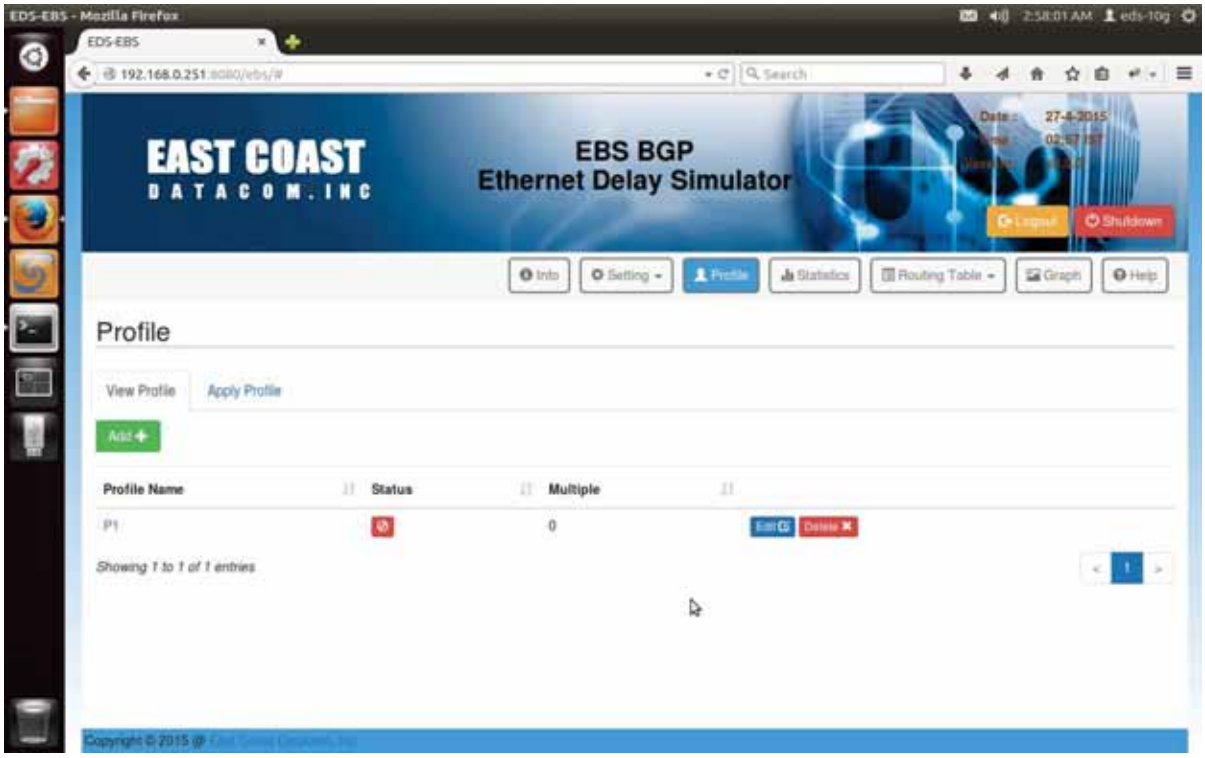
Pressing Add Button will open up a pop-up screen where we need to enter Profile details and save them via “Save” Button.

Pressing the Save Button will show “Success” message on successful Addition of a profile.Along with that new profile gets added in List of Profile with default Status and Multiple Fields.

When we apply the new profile from “Apply Profile” Tab , then it will show active status by displaying Green icon along with Multiple field incremented to 1.







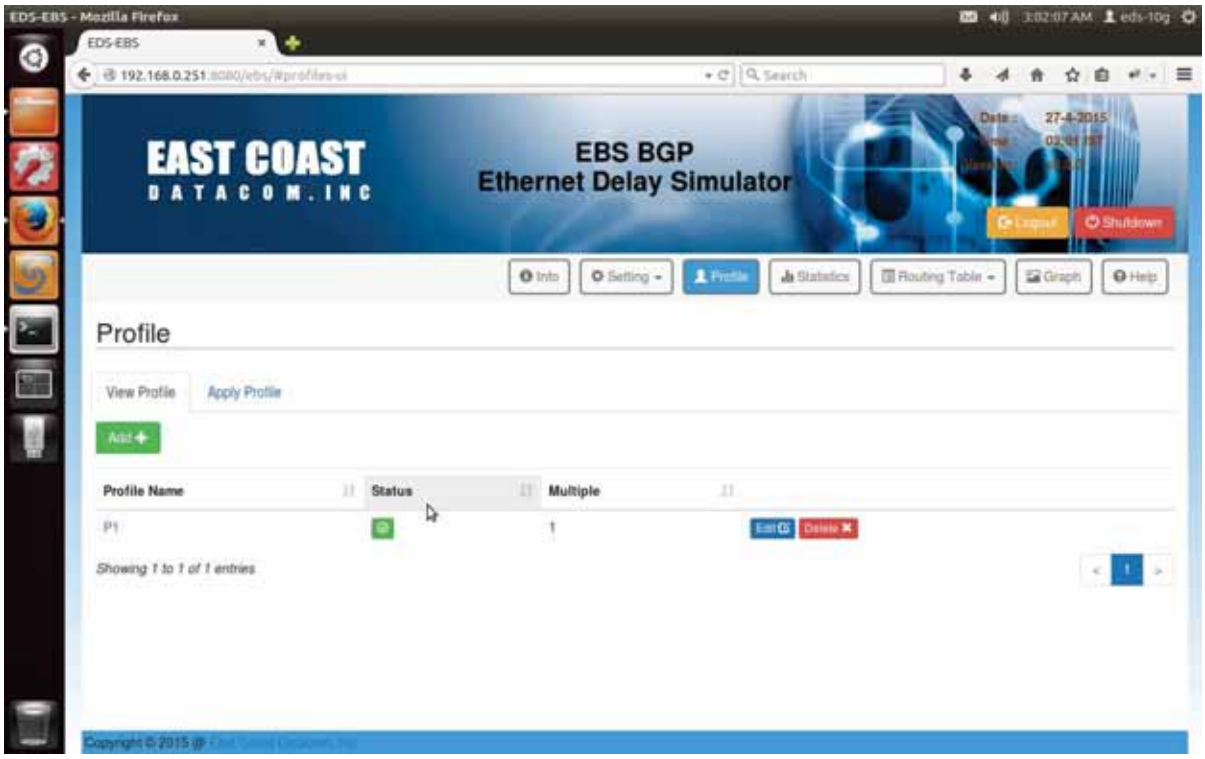


Table 3-1 Add Profile

3.1.2 Edit Profile

Use button “Edit” adjacent to each profile in “View Profiles” Menu to edit the Traffic shaping parameters of currently existing profiles.Pressing the “Edit” button will open up a pop-up menu having list of parameters for selected Profile.
After editing we need to save them. Application will automatically apply them on Traffic Shaping Sub-system to reflect the changes.To apply the edited profile we should press Button “Save” from Edit Profile Pop-up screen .
The new changes can be visible from “Statistics” Menu.

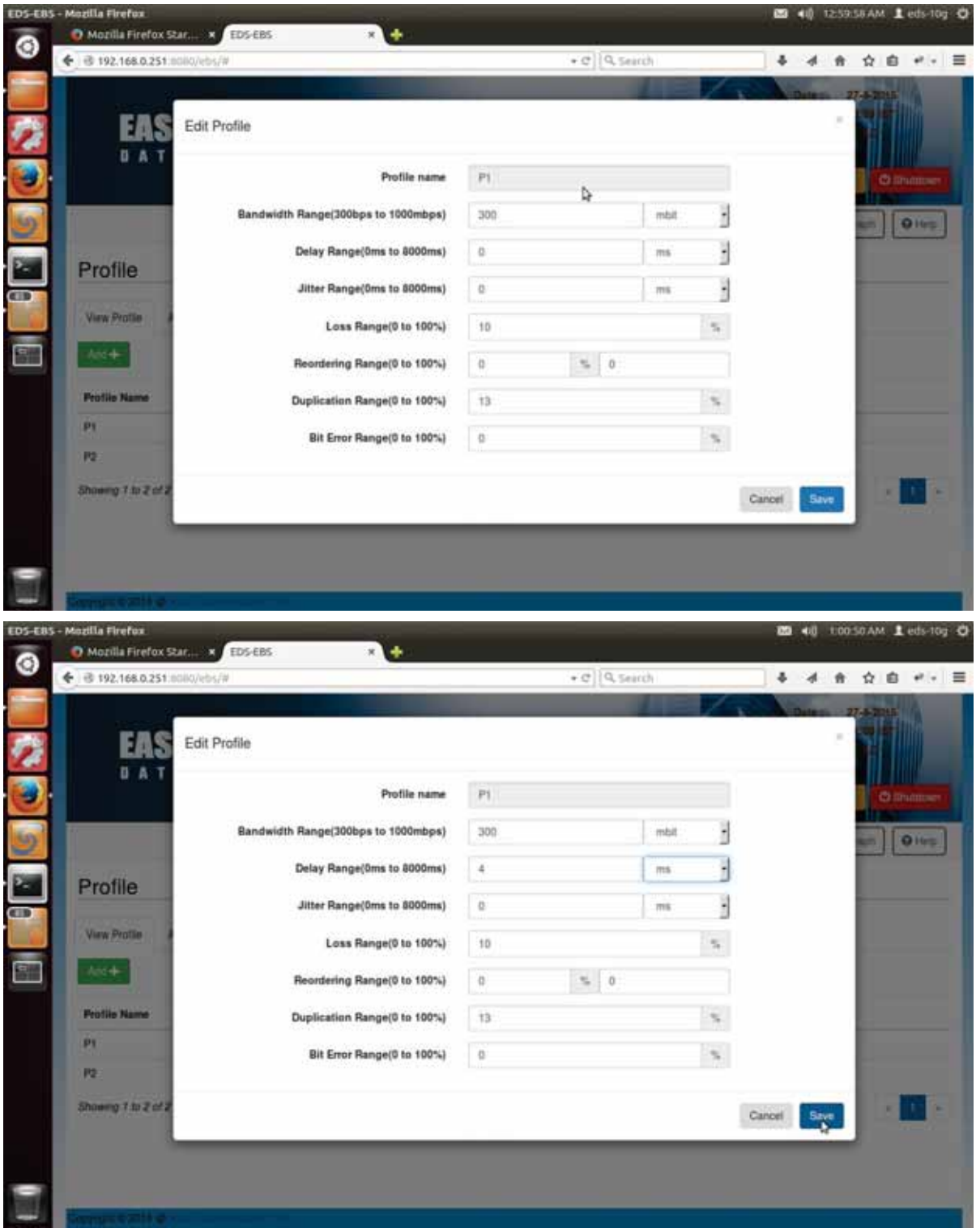
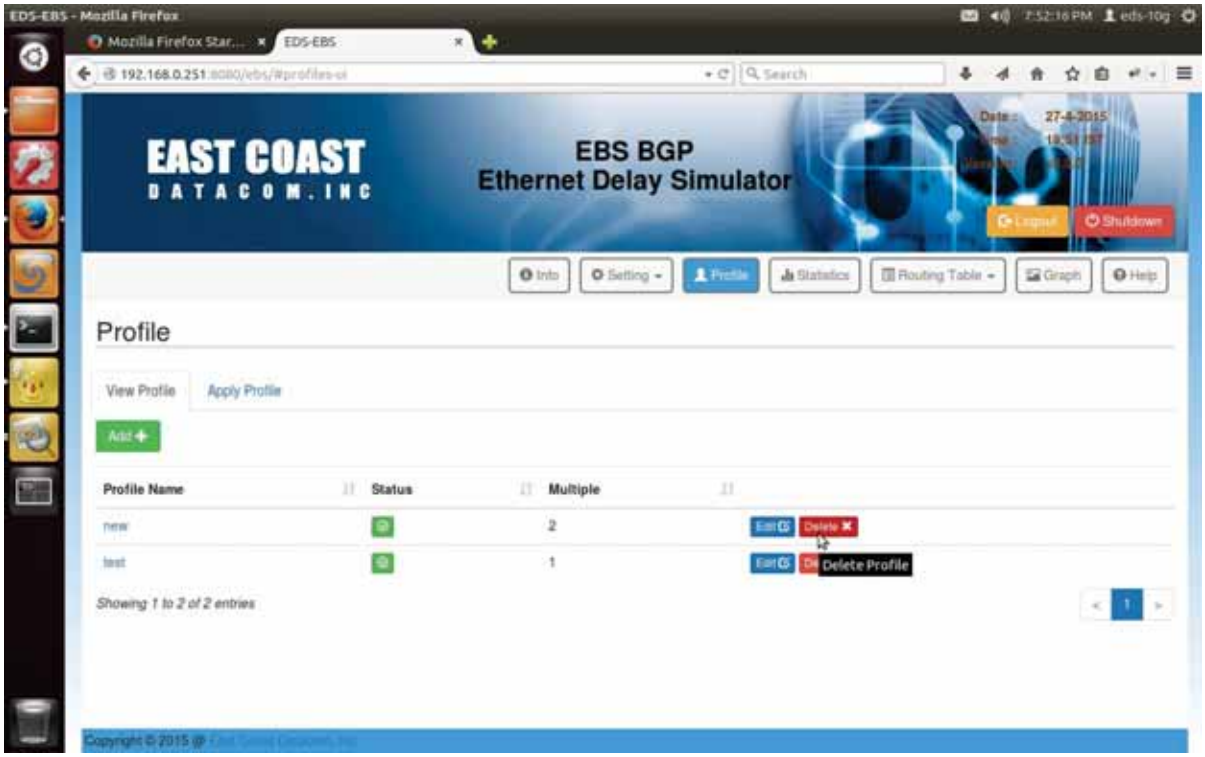
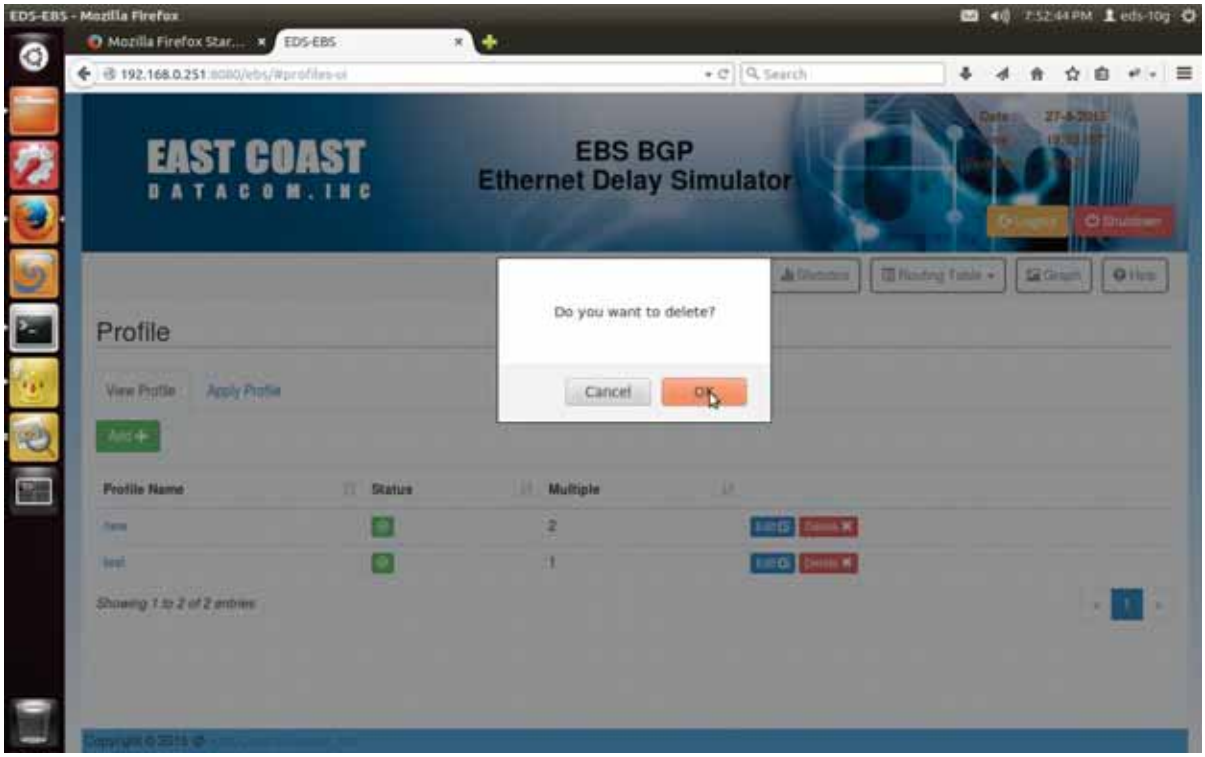


Table 3-2. Edit Profile

3.1.3 Delete Profile

Delete Button is present in front of every profile.Pressing which , will delete the corresponding profile.
A warning message will get pop-up prompting for user confirmation, applying which will delete the Profile.
Pressing the “Delete” button will Stop simulation for all the Source-Destination IP pairs on which that profile was applied.
This can be verified from the “Apply Profile” Tab or Statistics Menu.





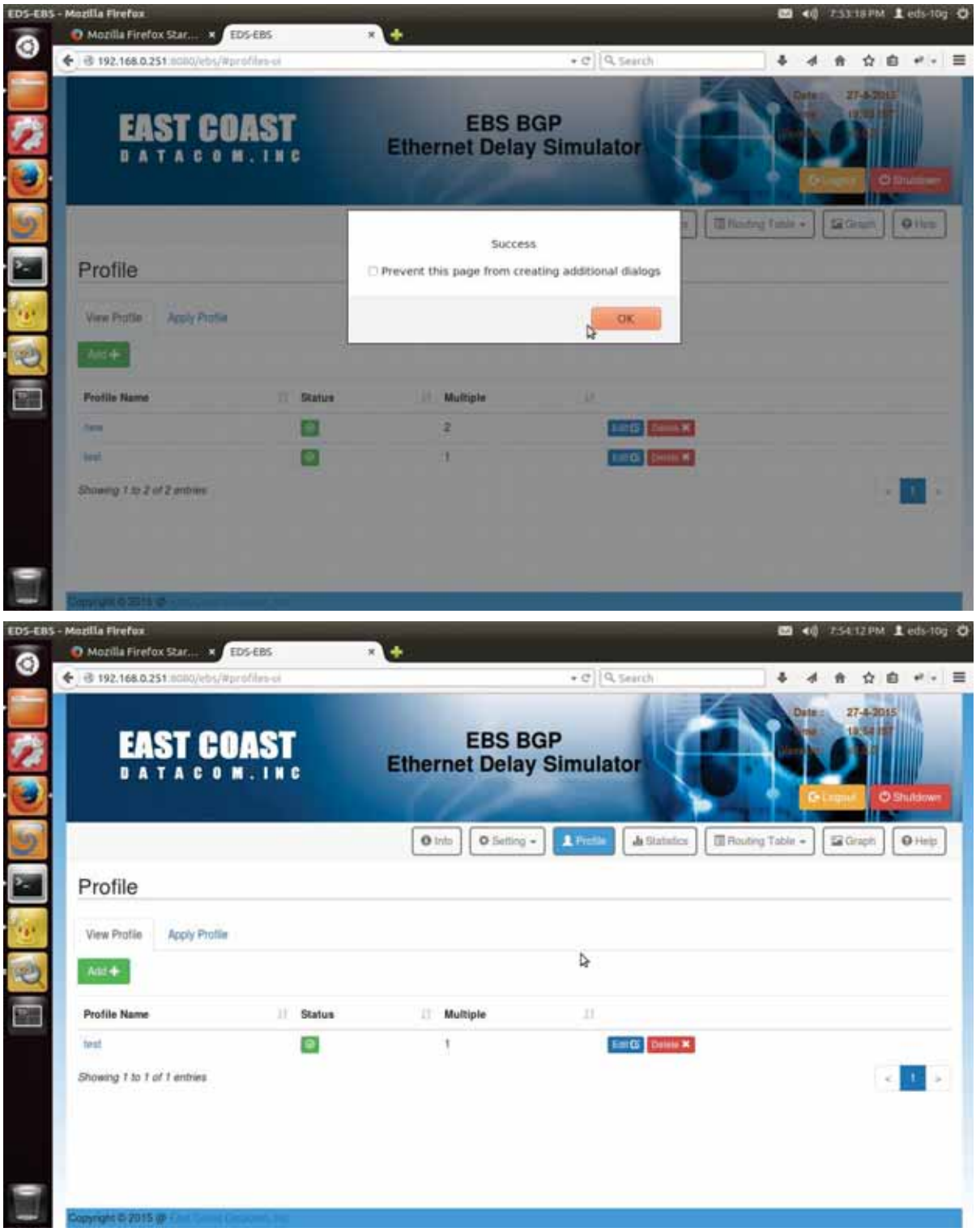
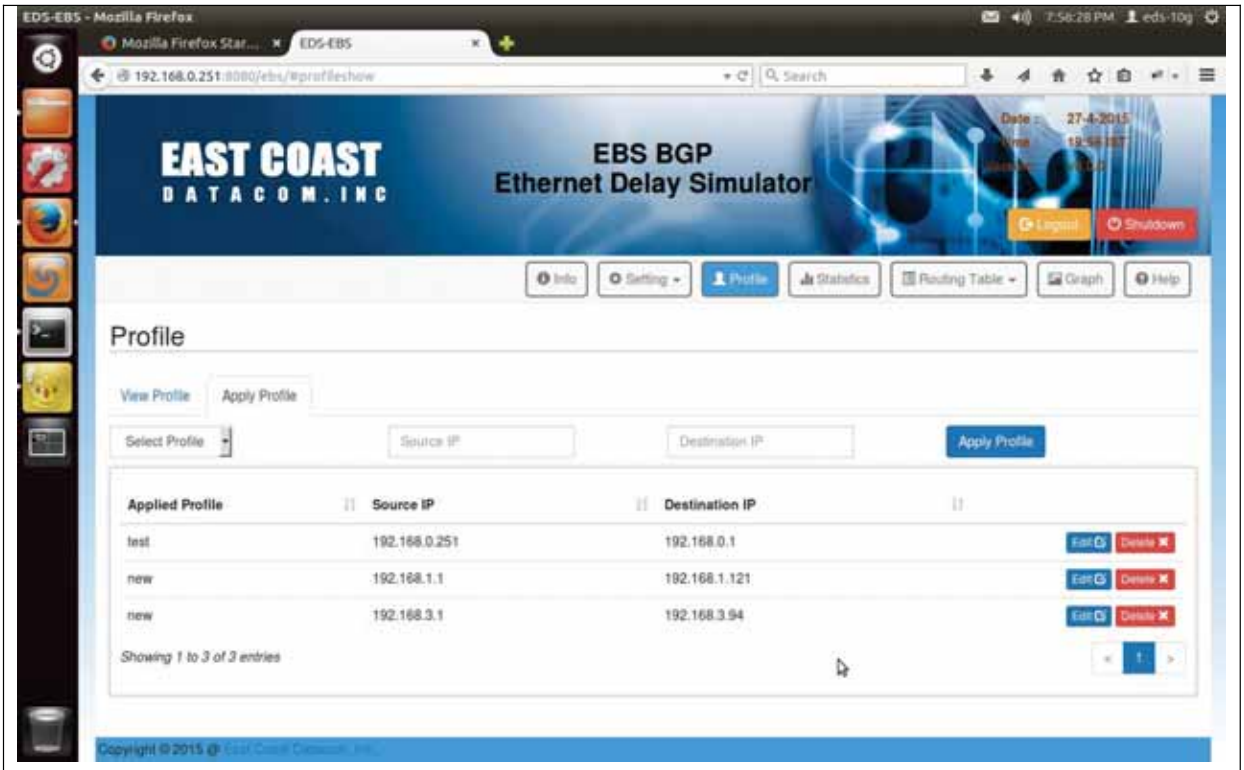
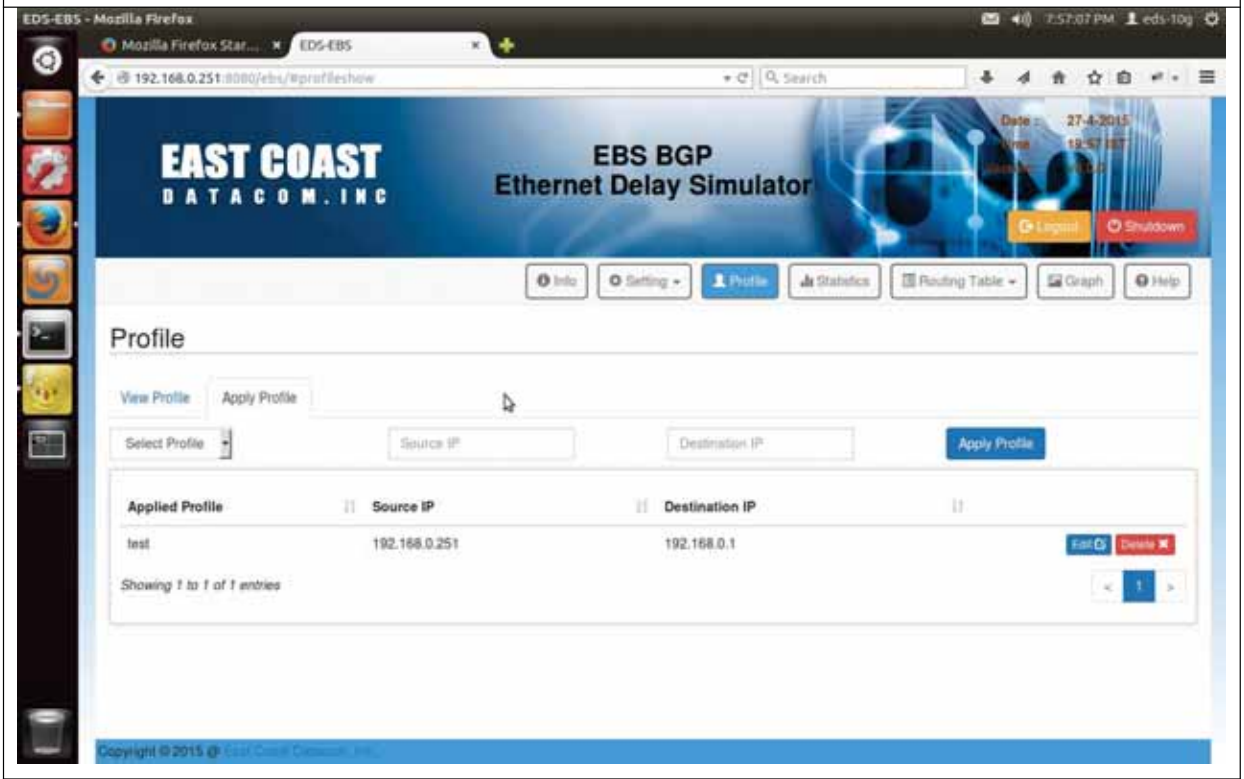


Table 3-3. Delete Profile

Apply Profile Menu before and after Deleting a profile





Apply Profile Menu before and after Deleting a profile

3.2 Apply Profile

After adding/ editing the profile in View Profile Menu we use this option to Shape the Traffic from list of existing profiles.
Pressing Apply Profile Tab will show a submenu having three fields:

1. List of Profile
2. Source IP Address
3. Destination IP Address

Along with these three fields, there are two optional user input fields which will take subnet mask as input for Source IP & Destination IP Addresses respectively.

4. Source Subnet Mask
5. Destination Subnet Mask

These two fields will only get activated when we check the Subnet mask check-box , otherwise these fields will remain inactive.Selection of Subnet Mask will apply the same profile over whole network range as defined by subnet mask values. The subnet masks can be applied over CIDR networks.

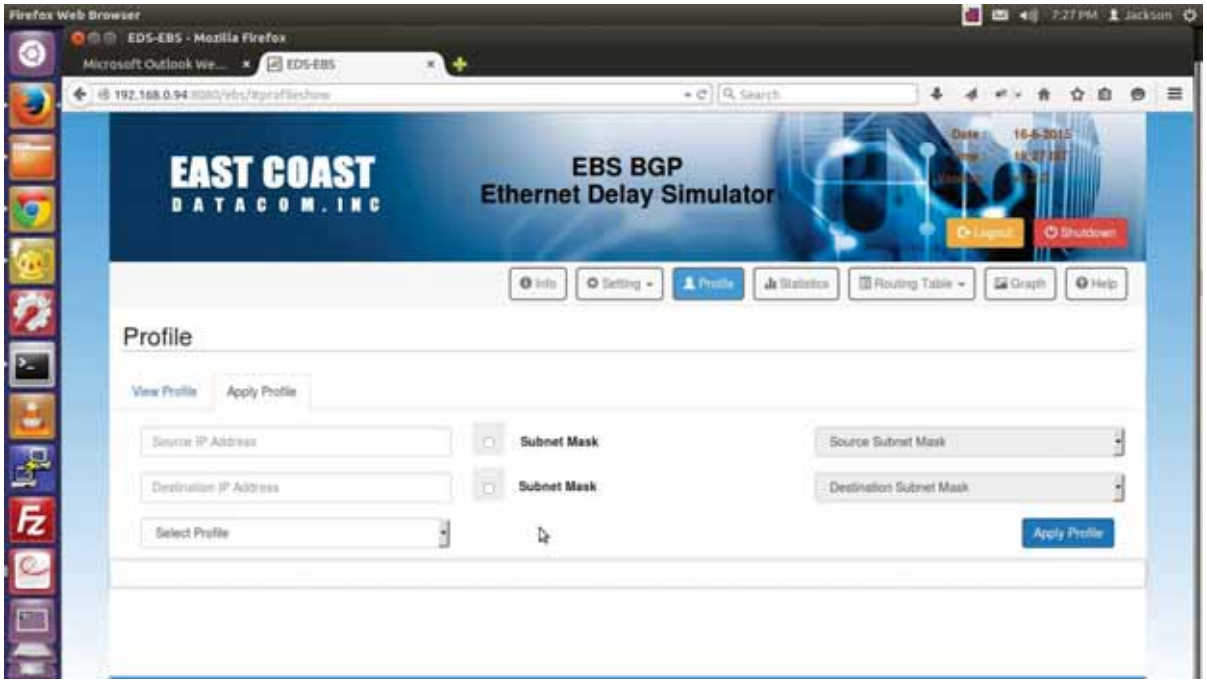
Underneath these fields lies a Table that will show profile to IP Address pairs mapping .In short , applied profile for pair of Source and Destination IP Addresses.
Following Actions can be performed to pair of Source and Destination IP Addresses

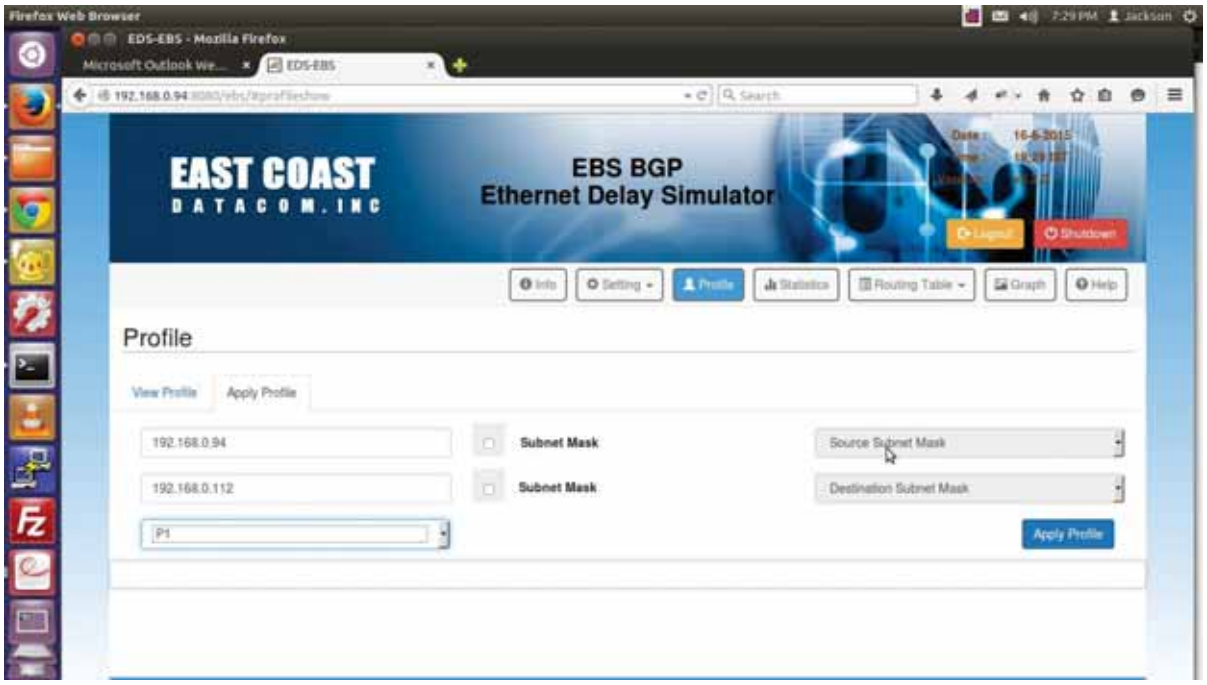
1. Start Profile
2. Change Profile
3. Stop Profile
4. Toggle Profile

3.2.1 Start Profile.

After entering Profile name ,Source and Destination IP Addresses ;and pressing “Apply Profile” button will start a profile for Source and Destination IP Addresses.

This can be verified by “Statistics” Menu.





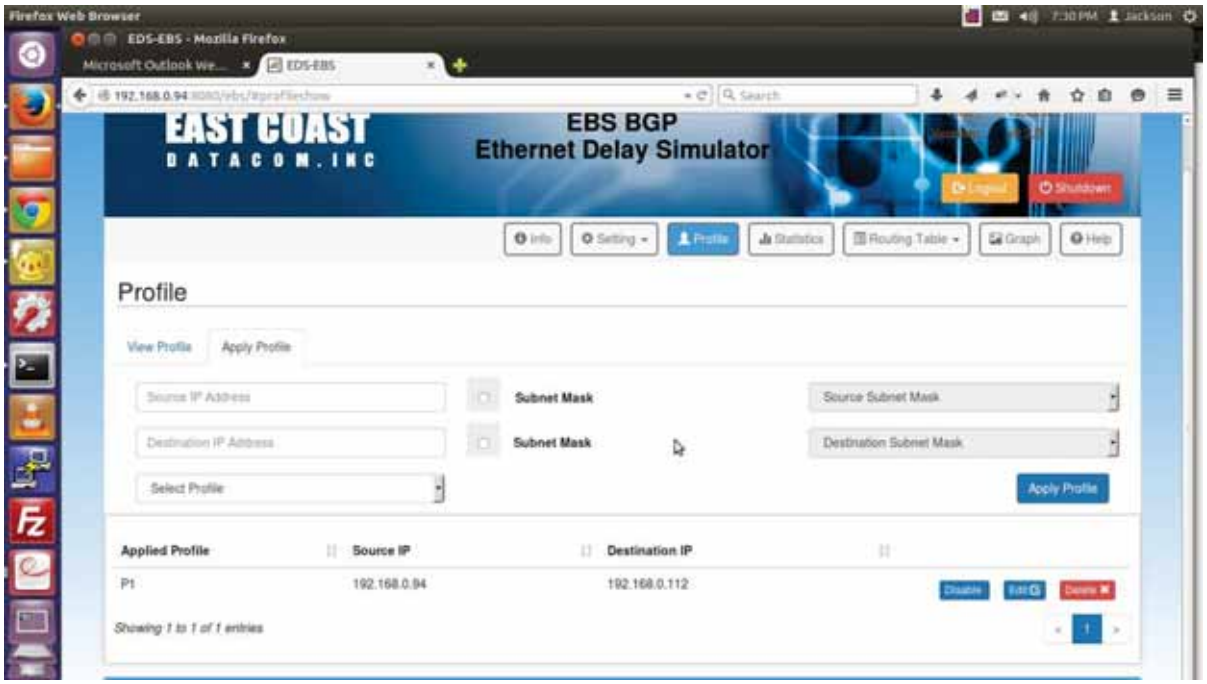
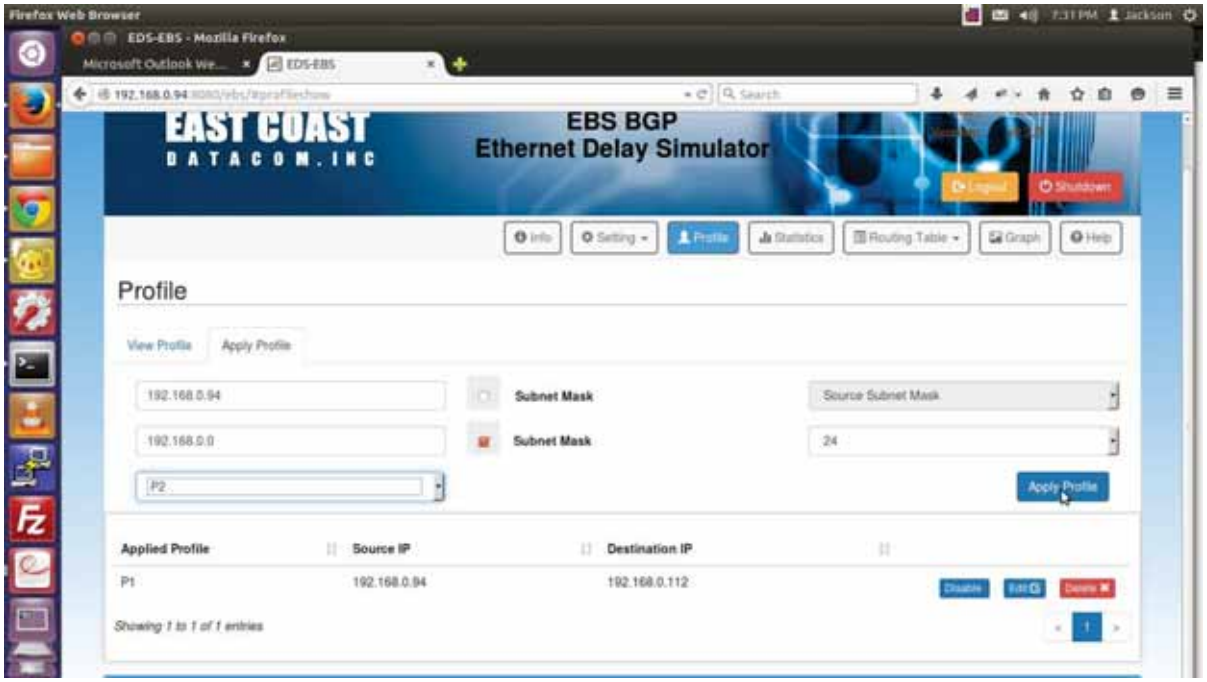
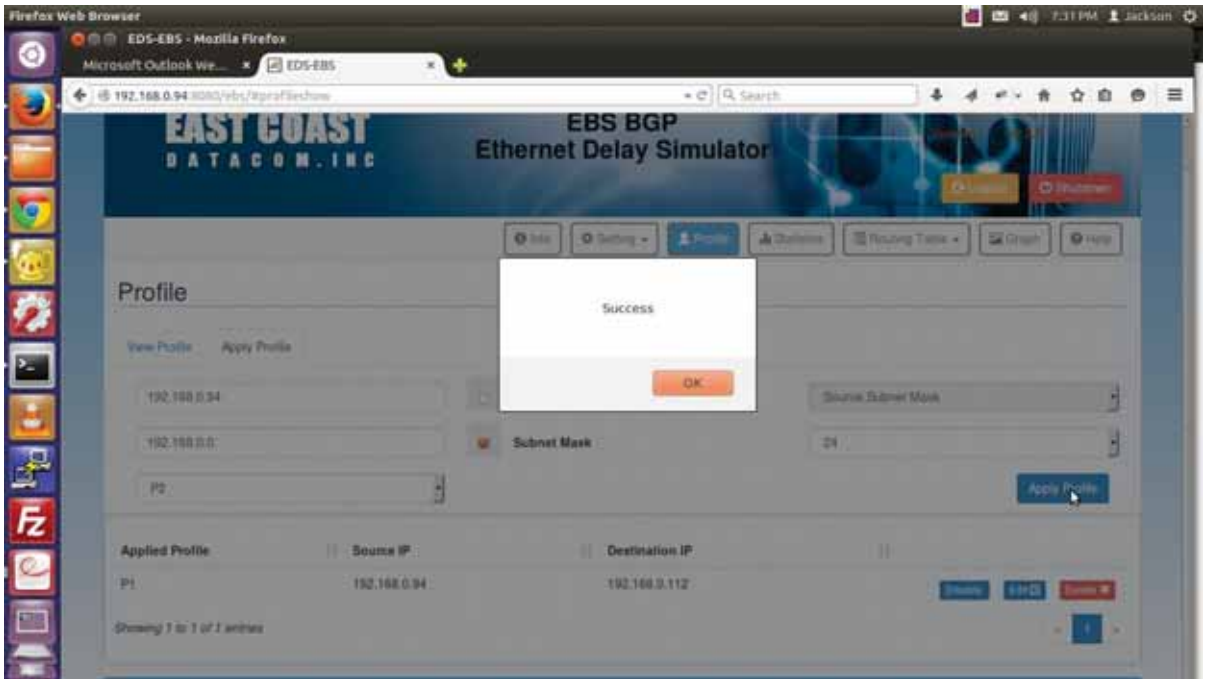


Table 3-4(a). Apply Profile for Single IP Address

Apply Profile over Subnet Mask





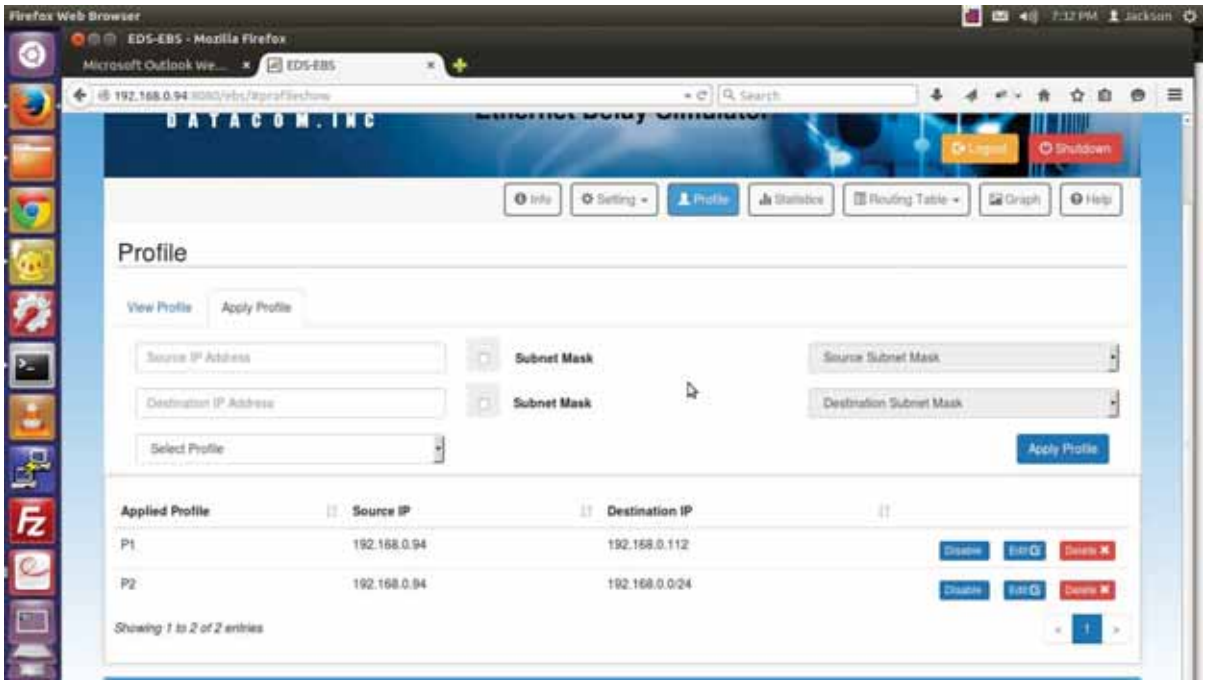


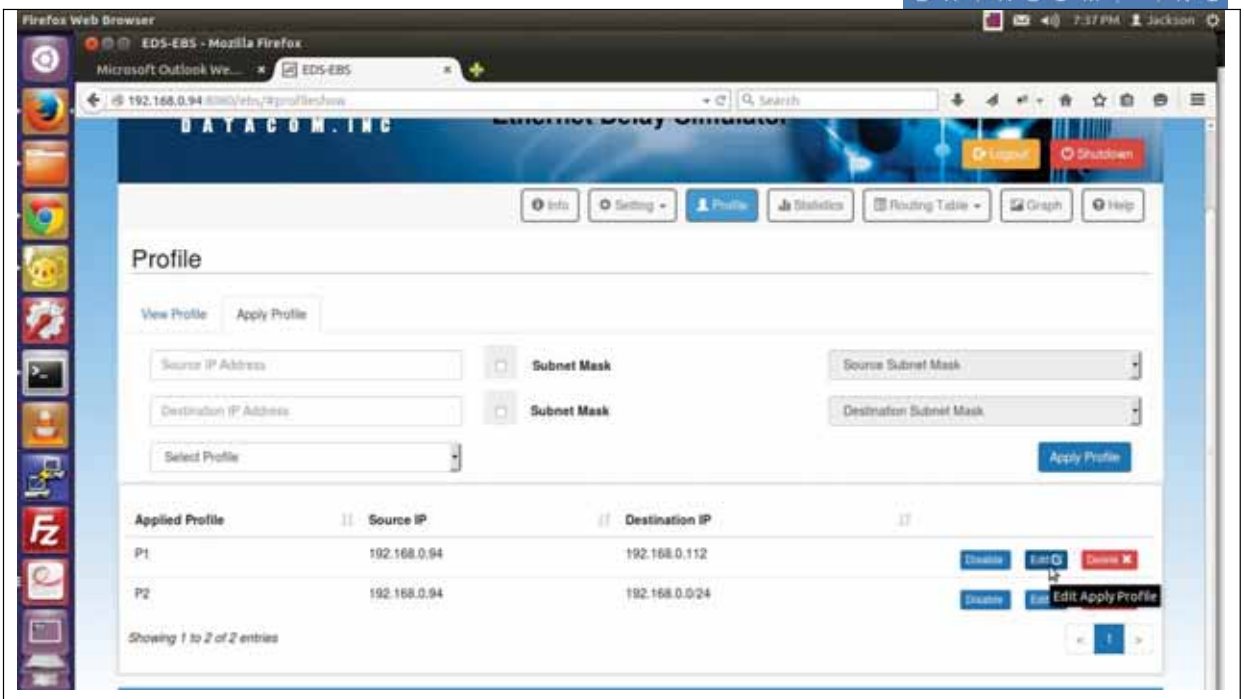
Table 3-4(b). Apply Profile for IP Addresses over Subnet Range

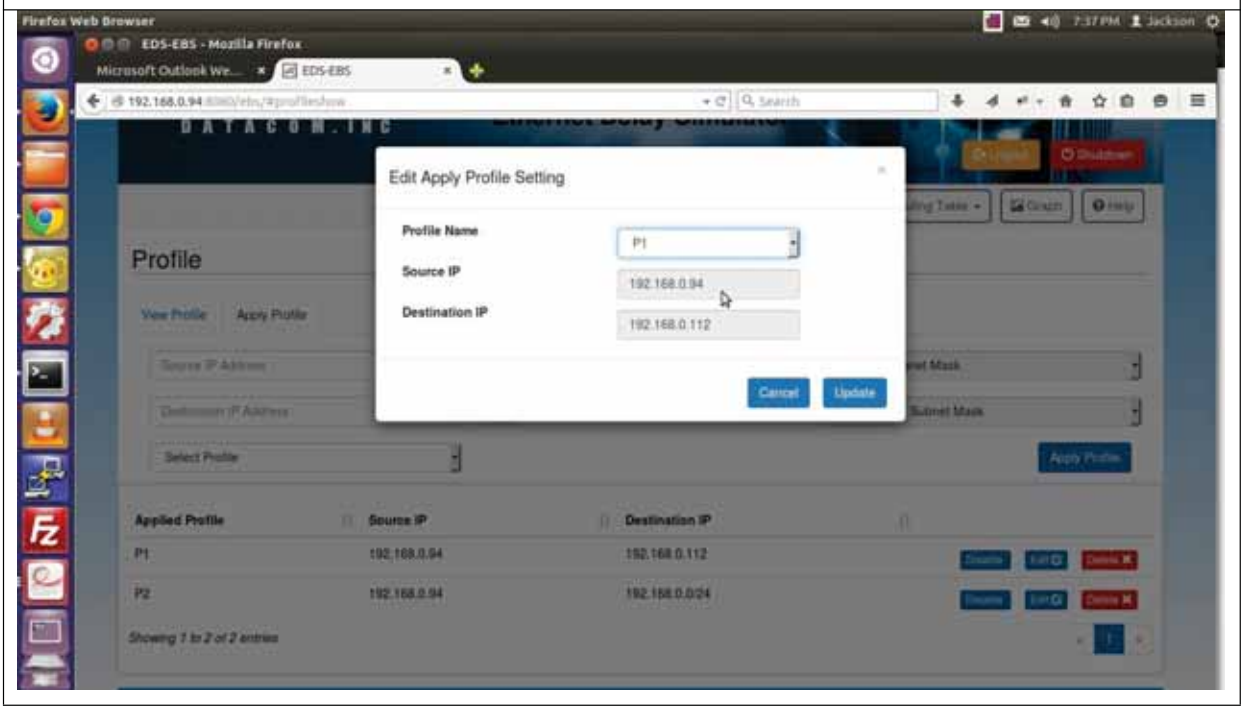
3.2.2 Edit Applied Profile

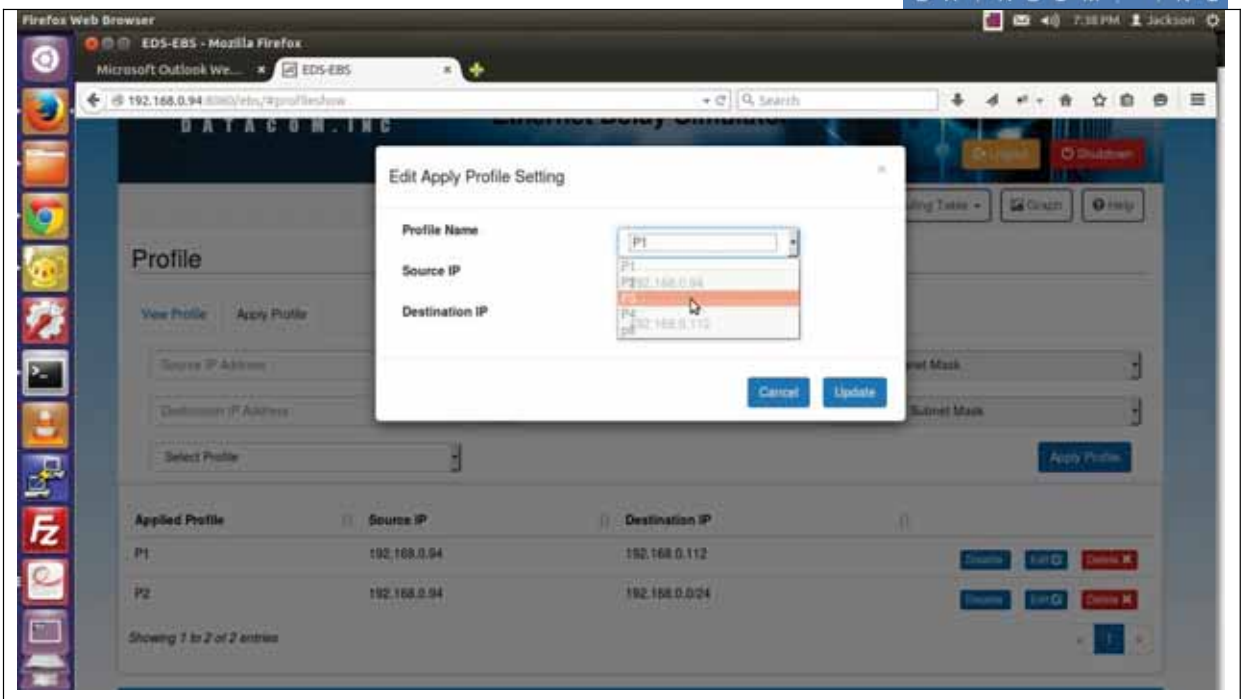
In Apply Profile Menu, from the table of Applied profiles rows ,we can reconfigure a profile for a Source-Destination IP pair onto which Profiles are already applied.

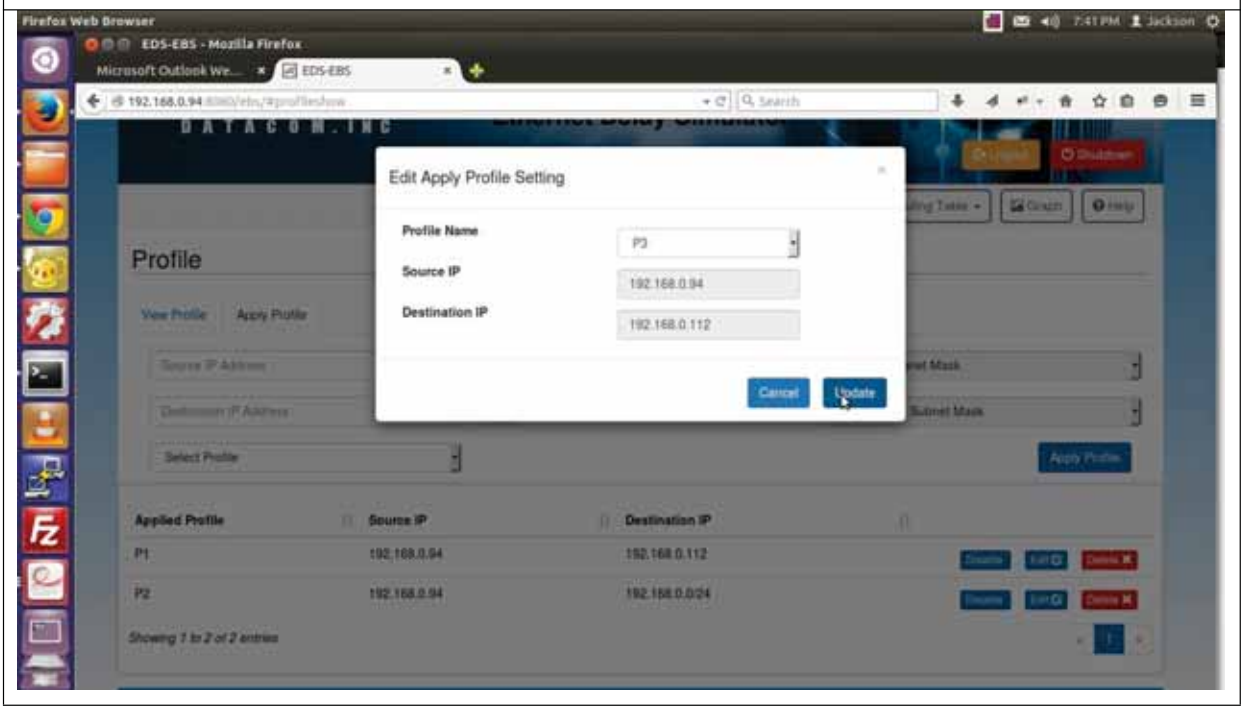
Pressing “Edit” Button will show a pop-up window where we can re-configure some other Profile for Selected Source-Destination IP Pair.

Leaving the Profile Name, all other fields will remain un-editable for user.









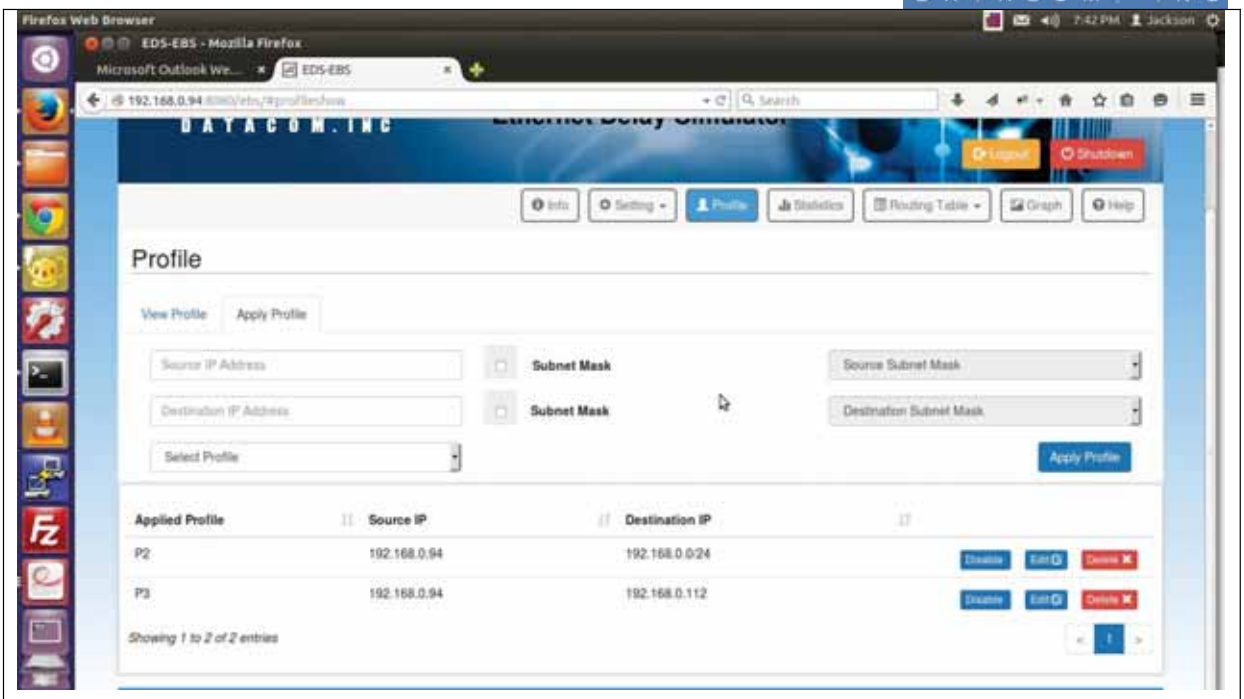
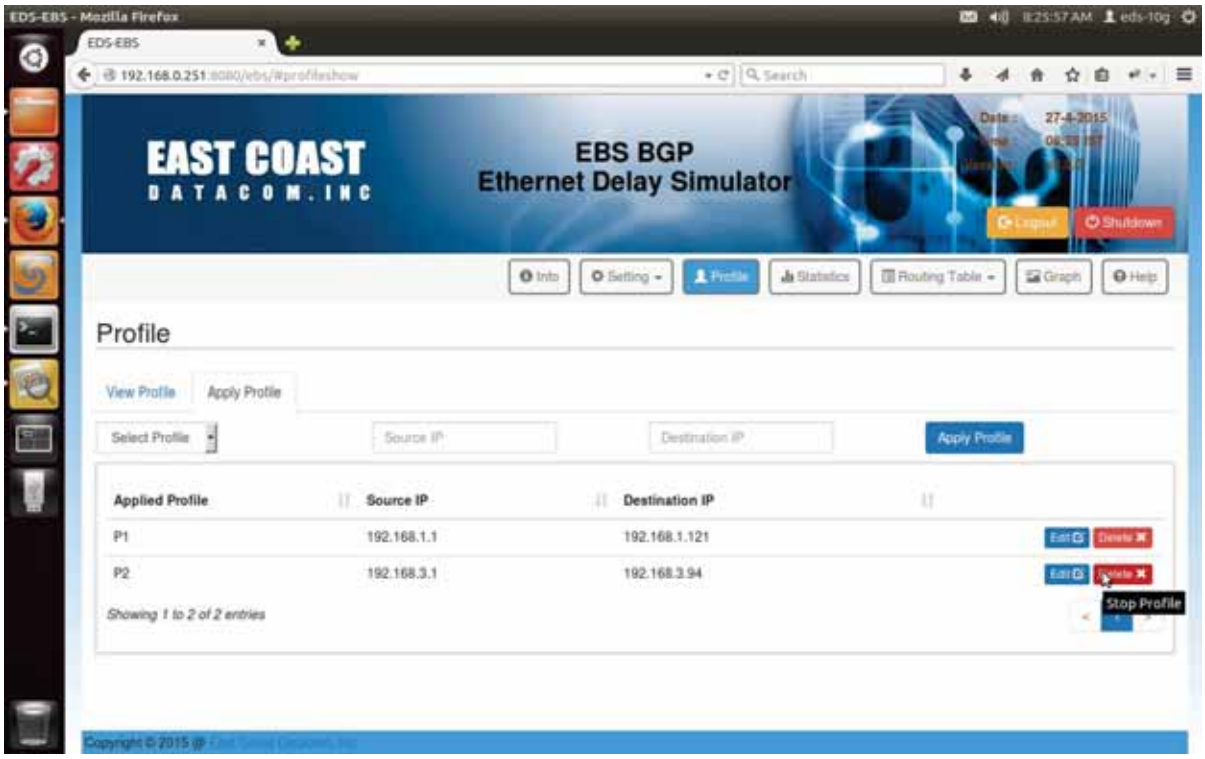


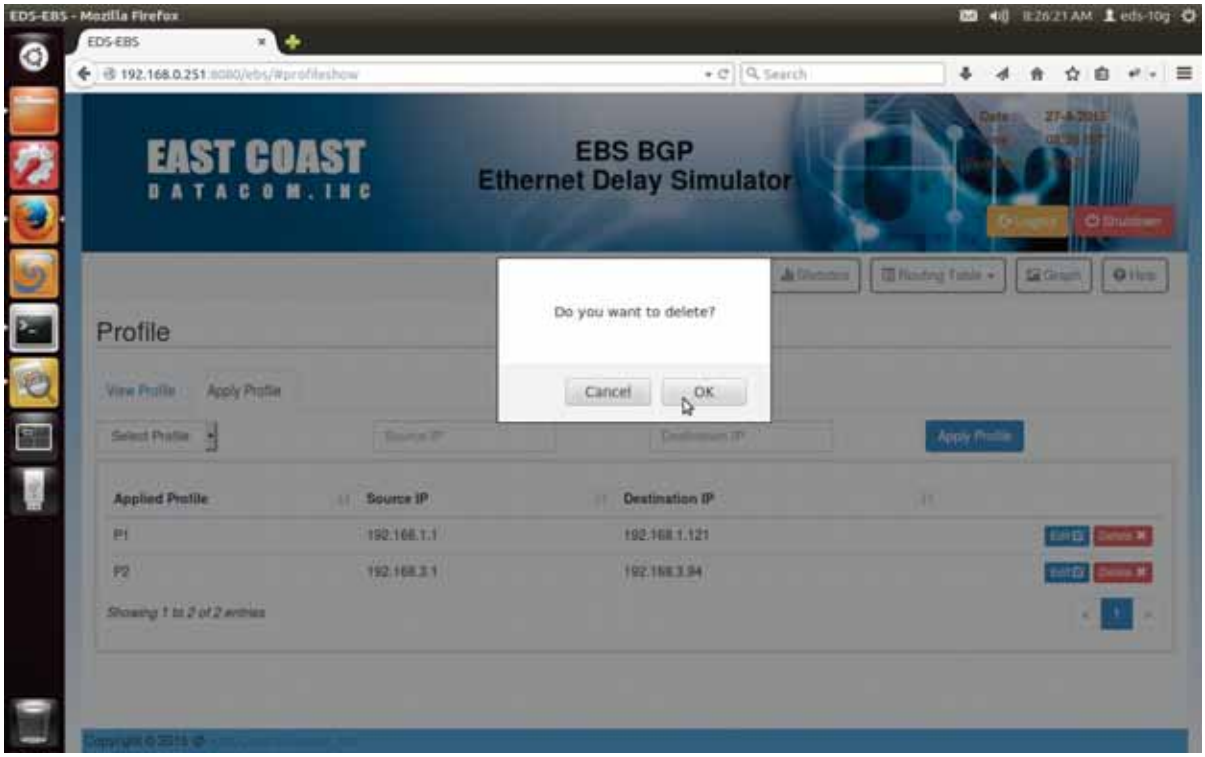
Table 3-5 .Edit Applied Profile

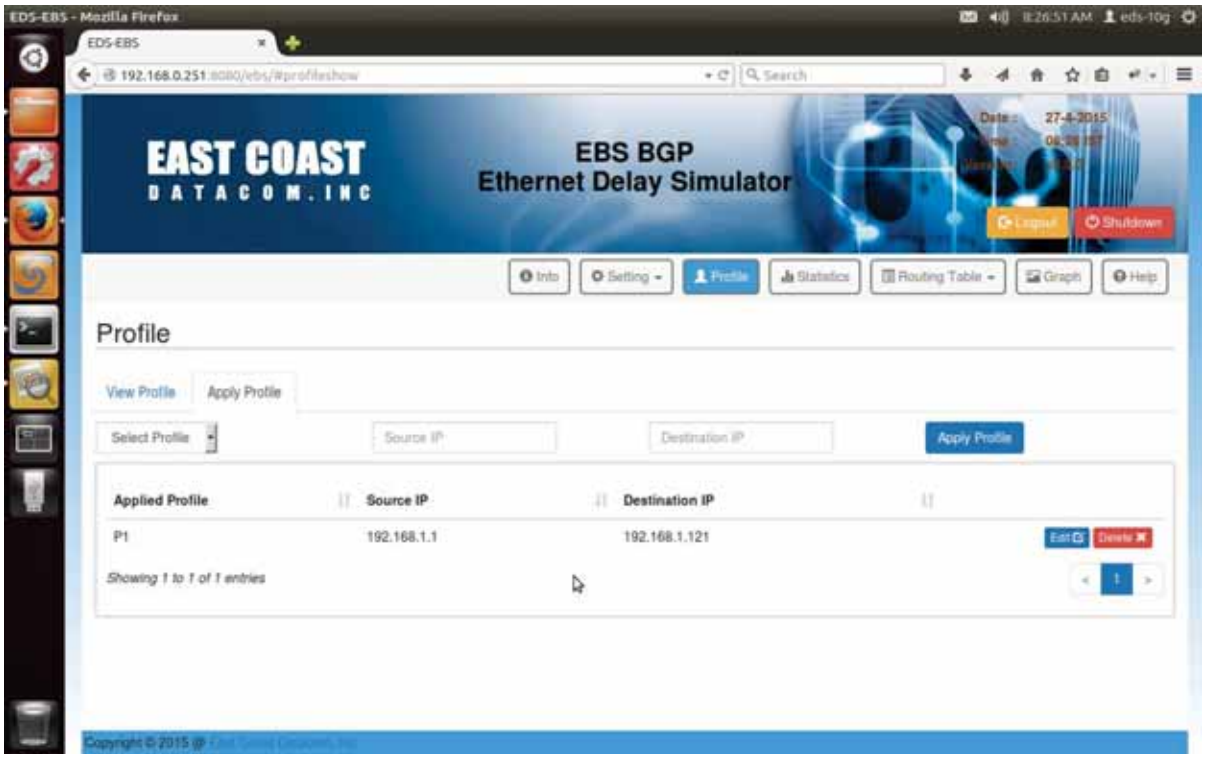
3.2.3 Stop Profile (Simulation)

Press Button "Delete" adjacent to Source-Destination IP pair from Apply Profile Menu to stop an existing Simulation for the same pair.Deleting the IP pairs will decrement the Multiple count for the Profile Applied to IP pair.If there are no other IP pairs sharing the same Profile , then Status of the Profile will revert back to inactive state in View Profile Menu.

The Deleted IP pair will get removed from Statistics Menu also.







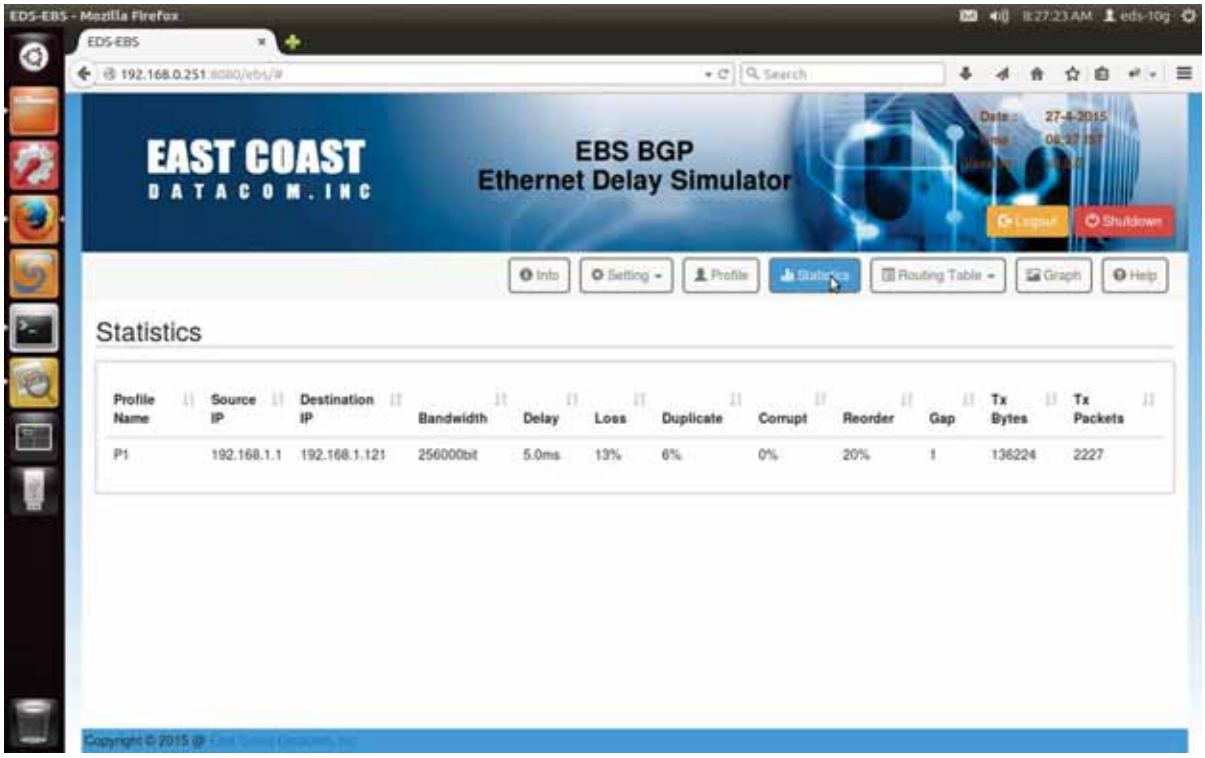
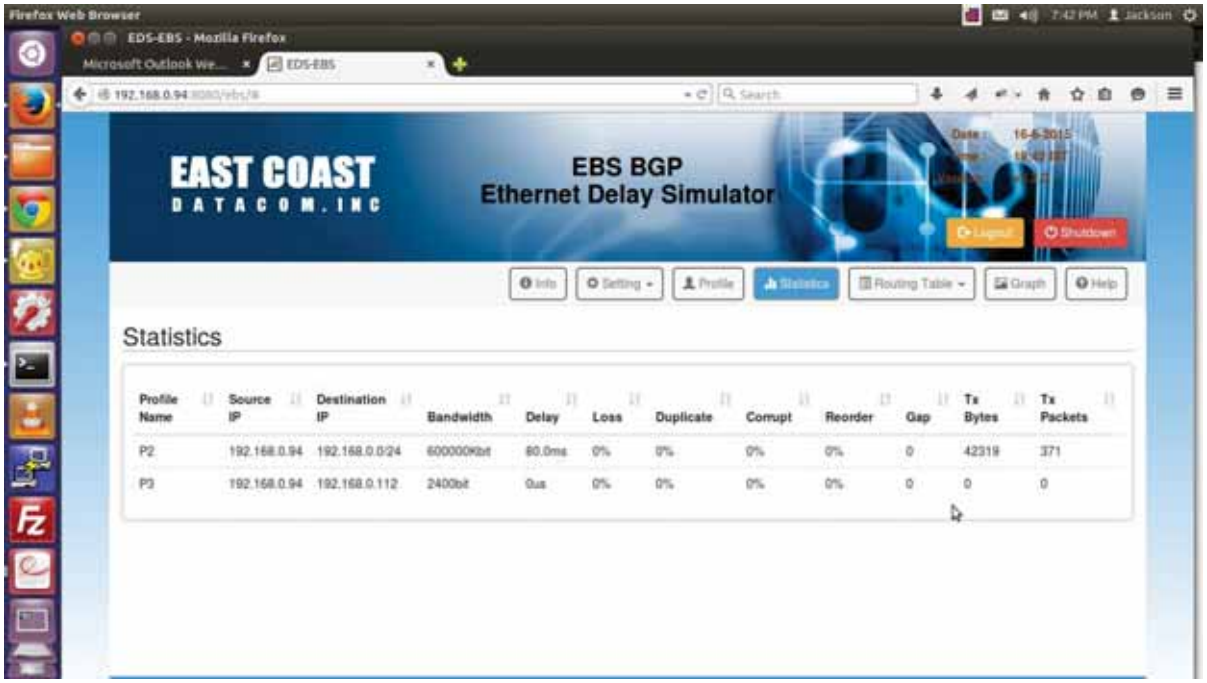
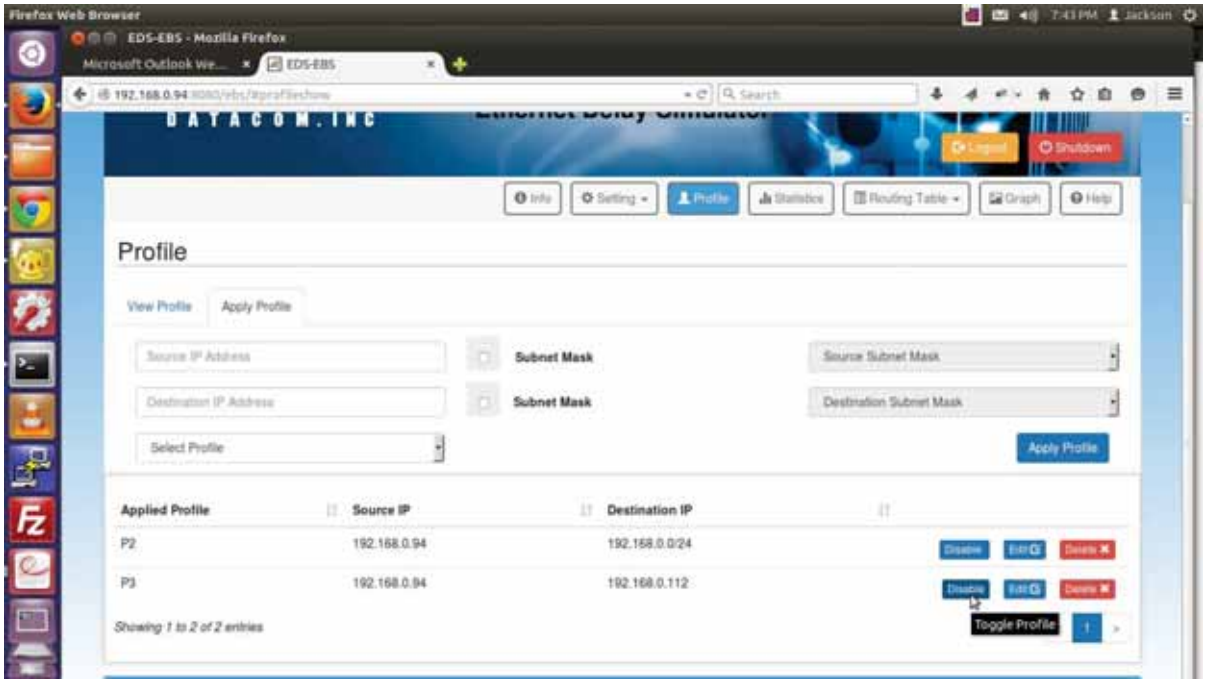


Table 3-5. Stop Profile Simulation

3.2.4 Toggle Profile

We can enable/disable an already applied profile as per our interest by Clicking the Toggle Profile Button .To verify our action we can check Statistics menu before and after toggling the Profile.





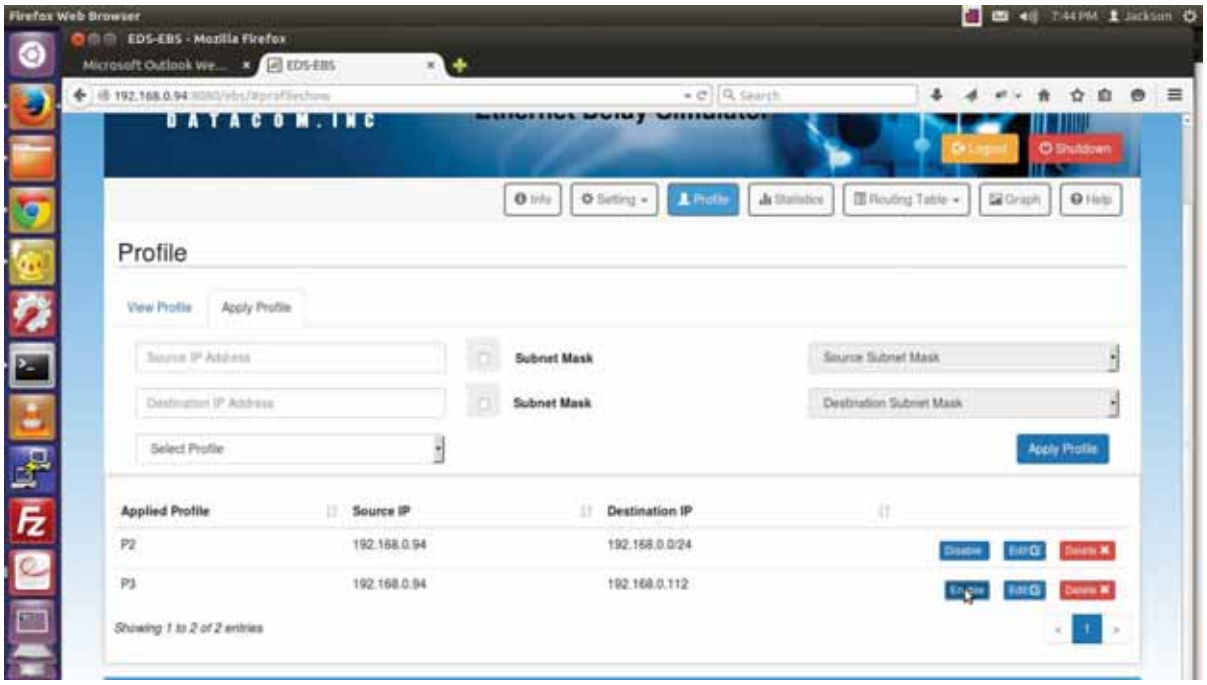


Table 3-6. Toggle Profile

How to Test Bandwidth parameters?

1. Bandwidth
2. Delay
3. Loss
4. Reorder
5. Duplication
6. Bit Error(Corrupt)

1.Bandwidth

This parameter is mandatory to simulate traffic of any behaviour ,hence it can't be kept zero .Apply the bandwidth parameters e.g (256kbps) using **Profiles** Menu. Run Iperf on some Server (192.168.0.105)System in UDP mode as

```
$ iperf -s -u -i 1
```

On EBS system run iperf client in udp mode thereby specifying Bandwidth as 1Mbps

```
$ iperf -c 192.168.0.105 -b 1mb
```

On Client side the bandwidth will show 1mbps but on Server system band width will get reduced to 256 kbps(approximately).

2.Delay

Apply some delay of 200ms on any active port in ping to the connected system.
If the reply time becomes equal to 200ms (or nearly)then Delay is happening.Due to ARP request the first packet may have somewhat greater delay value.

```
ping 192.168.0.105

PING 192.168.0.105 (192.168.0.105) 56(84) bytes of data.

64 bytes from 192.168.0.105: icmp_req=1 ttl=64 time=310 ms

64 bytes from 192.168.0.105: icmp_req=2 ttl=64 time=200 ms

64 bytes from 192.168.0.105: icmp_req=4 ttl=64 time=200 ms

^C

--- 192.168.0.105 ping statistics ---

5 packets transmitted, 3 received, 40% packet loss, time 4010ms

rtt min/avg/max/mdev = 200.204/200.215/200.237/0.516 ms
```

2.1 **Jitter**

Values of jitter will limit the delay in range (**Delay ± Jitter**)

3.Loss

Apply Loss Parameters without specifying Bit Errors (corrupt) parameters and ping from other systems to Supermicro (EDS-10G) for a calculated no of attempts e.g. 40% loss of 10000 packets

```
$ sudo ping -i 0.0001 -c 10000 -q 192.168.0.1
PING 192.168.0.1 (192.168.0.1) 56(84) bytes of data.


--- 192.168.0.1 ping statistics ---


10000 packets transmitted, 6032 received, 39% packet loss, time 48107ms


rtt min/avg/max/mdev = 0.168/0.222/1.334/0.033 ms, ipg/ewma 4.811/0.228 ms
```

If the loss percentage observed becomes nearly equal to the loss percentage stored on Profile then Packet Loss is being simulated by traffic shaping subsystem..
Loss percentage is clearly visible on ping statistics under Delay parameter.

4.Reorder

Reordering requires delay value to be non -zero so before setting reorder percentage set delay time first to some known value e.g. 200ms and give some value of Reorder gap e.g. 5

Now ping to some connected system

```
$ ping 20.0.0.1
64 bytes from 20.0.0.1: icmp_req=3 ttl=64 time=193 ms

64 bytes from 20.0.0.1: icmp_req=4 ttl=64 time=193 ms

64 bytes from 20.0.0.1: icmp_req=5 ttl=64 time=193 ms

64 bytes from 20.0.0.1: icmp_req=6 ttl=64 time=0.089 ms

64 bytes from 20.0.0.1: icmp_req=7 ttl=64 time=193 ms

64 bytes from 20.0.0.1: icmp_req=8 ttl=64 time=193 ms

64 bytes from 20.0.0.1: icmp_req=9 ttl=64 time=193 ms

64 bytes from 20.0.0.1: icmp_req=10 ttl=64 time=193 ms

64 bytes from 20.0.0.1: icmp_req=11 ttl=64 time=0.099 ms

64 bytes from 20.0.0.1: icmp_req=12 ttl=64 time=193 ms

64 bytes from 20.0.0.1: icmp_req=13 ttl=64 time=193 ms

64 bytes from 20.0.0.1: icmp_req=14 ttl=64 time=193 ms
```

Leaving the highlighted ones ,other packets are reordered with a delay .
If after every 5 packets the response time is relatively lower then the other delayed values(such as 0.045ms) that means some packets are being sent quicker then other remaining packets.
It implies Packet Reordering is happening

Packet reordering messages can easily be seen on iperf servers' output when it displays message “Out of Order Packets Recieved”.

5 Duplication

Set the Duplication Parameters and apply them via **Apply Profile[3.4}** .Ping to a known system which can be connected to any of EBS system.

```
$ ping 192.168.0.105

Watch the ping reply packets which has would look like

64 bytes from 20.0.0.1: icmp_req=1 ttl=64 time=187 ms

64 bytes from 20.0.0.1: icmp_req=1 ttl=64 time=187 ms (DUP!)

64 bytes from 20.0.0.1: icmp_req=2 ttl=64 time=187 ms
```

```
64 bytes from 20.0.0.1: icmp_req=2 ttl=64 time=187 ms (DUP!)

64 bytes from 20.0.0.1: icmp_req=3 ttl=64 time=187 ms

64 bytes from 20.0.0.1: icmp_req=3 ttl=64 time=187 ms (DUP!)

64 bytes from 20.0.0.1: icmp_req=4 ttl=64 time=187 ms
```

The word **(DUP!)** specifies duplication is happening . Also we can check **icmp_req** has identical values due to duplicated packets.

6.Bit errors (corrupt) :
Set Loss Percentage value to 0 and set Bit Errors to some value. e.g. 50%.
As bit errors will be observed at the destination system so set this parameters into EDS10-G (supermicro) System and from other remote system ping to EDS-10G ethernet port to which you have applied Traffic Simulation scripts . The bitwise error packets will get dumped onto your Console.

```
ping 192.168.0.94 -c 10

PING 192.168.0.94 (192.168.0.94) 56(84) bytes of data.

64 bytes from 192.168.0.94: icmp_req=1 ttl=64 time=0.202 ms

64 bytes from 192.168.0.94: icmp_req=2 ttl=64 time=0.225 ms

wrong data byte #47 should be 0x2f but was 0x2e

#8    8 9 a b c d e f 10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22
23 24 25 26 27

#40   28 29 2a 2b 2c 2d 2e 2e 30 31 32 33 34 35 36 37

64 bytes from 192.168.0.94: icmp_req=4 ttl=64 time=0.232 ms

wrong data byte #41 should be 0x29 but was 0x39

#8    8 9 a b c d e f 10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22
23 24 25 26 27

#40   28 39 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 36 37

64 bytes from 192.168.0.94: icmp_req=5 ttl=64 time=0.206 ms

wrong data byte #15 should be 0xf but was 0xe

#8    8 9 a b c d e e 10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f 20 21 22
23 24 25 26 27

#40   28 29 2a 2b 2c 2d 2e 2f 30 31 32 33 34 35 36 37

64 bytes from 192.168.0.94: icmp_req=7 ttl=64 time=17.5 ms

64 bytes from 192.168.0.94: icmp_req=8 ttl=64 time=0.207 ms

64 bytes from 192.168.0.94: icmp_req=9 ttl=64 time=0.944 ms

--- 192.168.0.94 ping statistics ---

10 packets transmitted, 7 received, 30% packet loss, time 8998ms
```

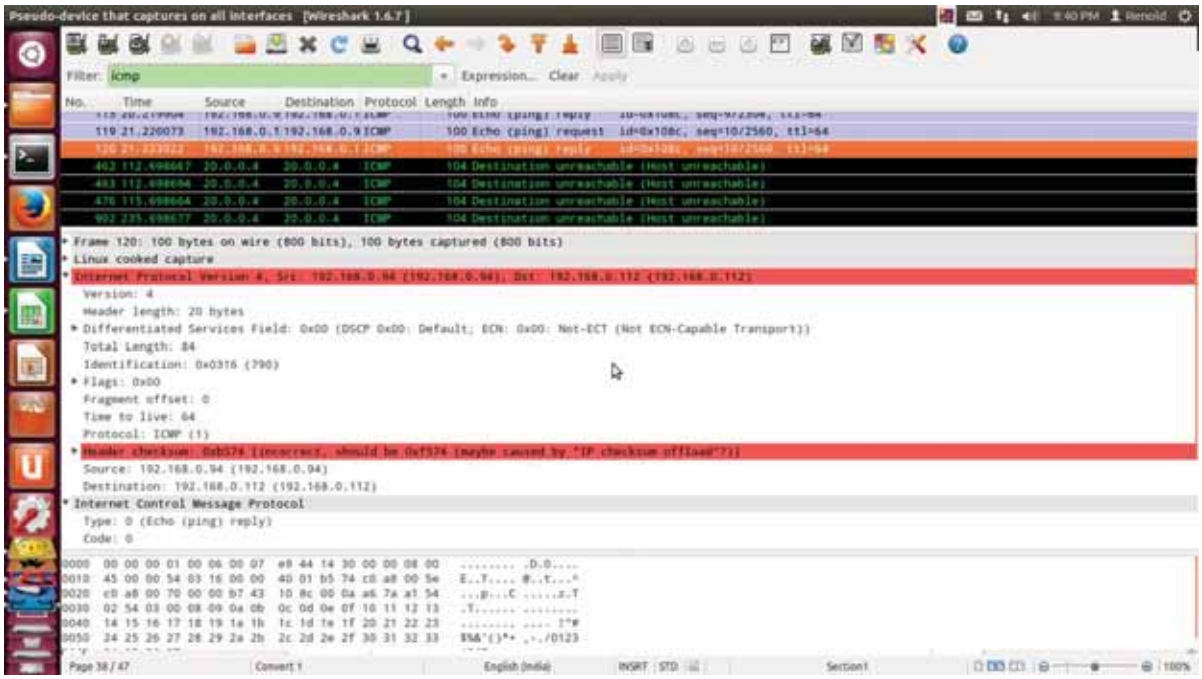


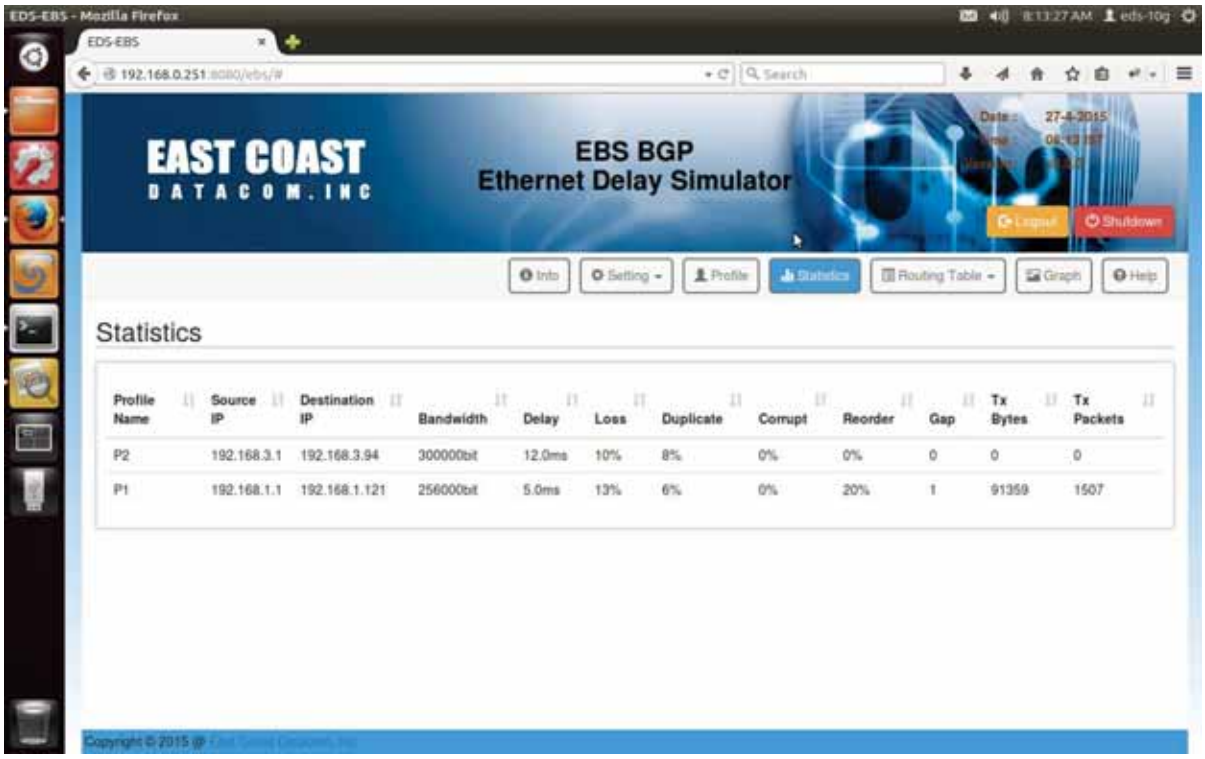
Figure 3-6 Bit Errors (Packet corruption) Check

As it is clearly visible that 38% of packet loss is observed which can be taken as just near value to Corruption errors percentage. To further verify you can check bit-wise errors into packets captured by wireshark on Remote system.

4 Statistics

From the Main Menu set option “Statistics” to view network statistics. If we apply the profile to a pair of Source and Destination IP Addresses from **Profile** Menu,then **Statistics** option will display the statistics of Source-to-Destination IP Address corresponding to the Profile applied on All Ethernet Interfaces.Even if same profile is applied to two pairs of Source-to-Destination IP Addresses , it will show Tx Bytes and Packets separately for each such pair

As Traffic Shaping works best when applied for Egress Traffic , so here also only Transmission Bytes and packets are shown.



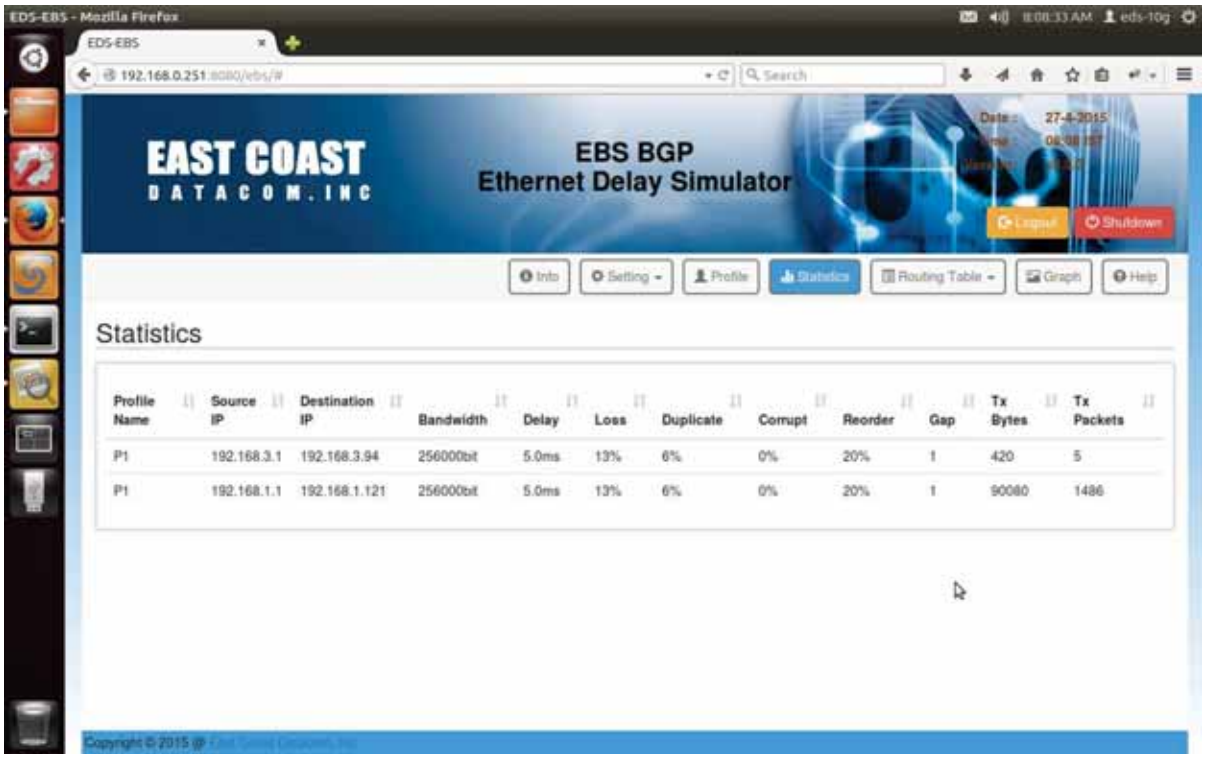


Table 4-0. Statistics

5 Show Routing Tables

In the Main menu select option Routing Table to view the routing table.This option will display the BGP and Kernel routing Table for every network. BGP routing table may have multiple paths to reach a network.But the best selected path will be shown on Kernel Routing table.

1.Kernel Routing Table
2.BGP Routing Table

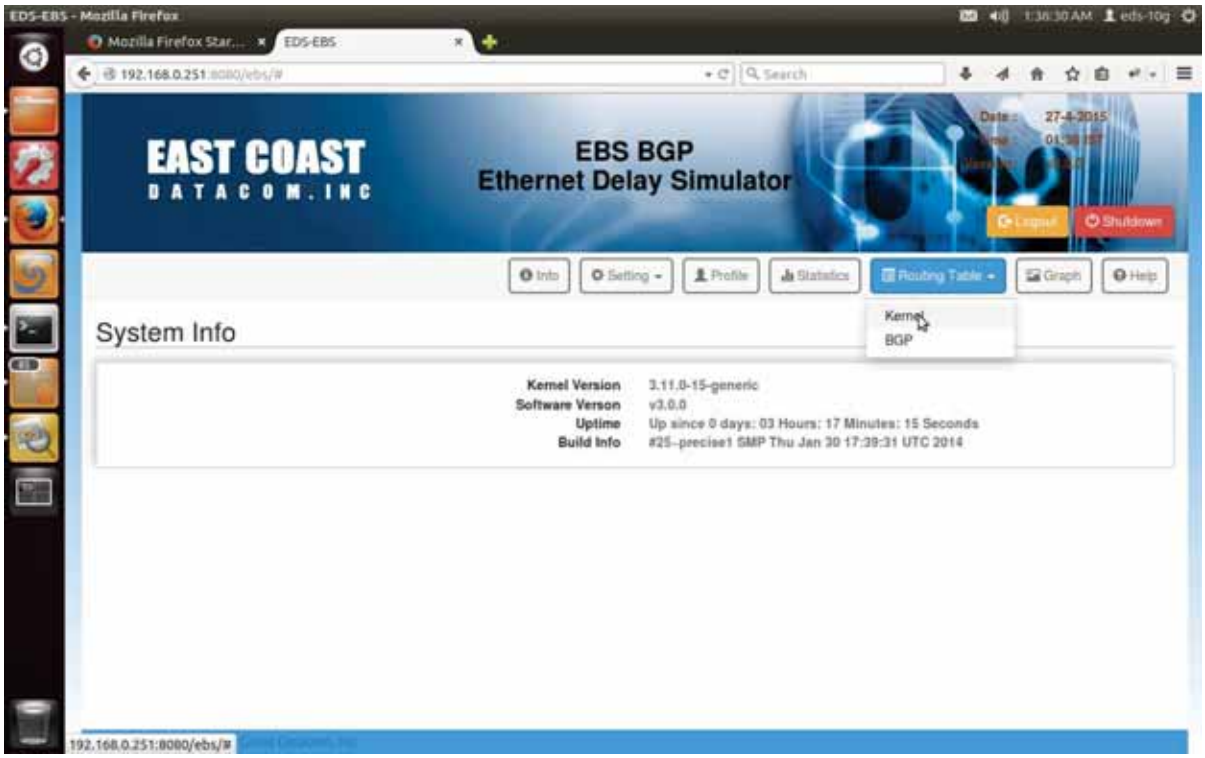


Table 5-0 Routing Tables

5.1 Kernel Routing Table

Select option “Kernel” to display Kernel Routing Table . It displays Kernel routing table with Gateways as best selected neighbors by BGP protocol along with that it will show Ethernet interface selected as per neighbors network address .

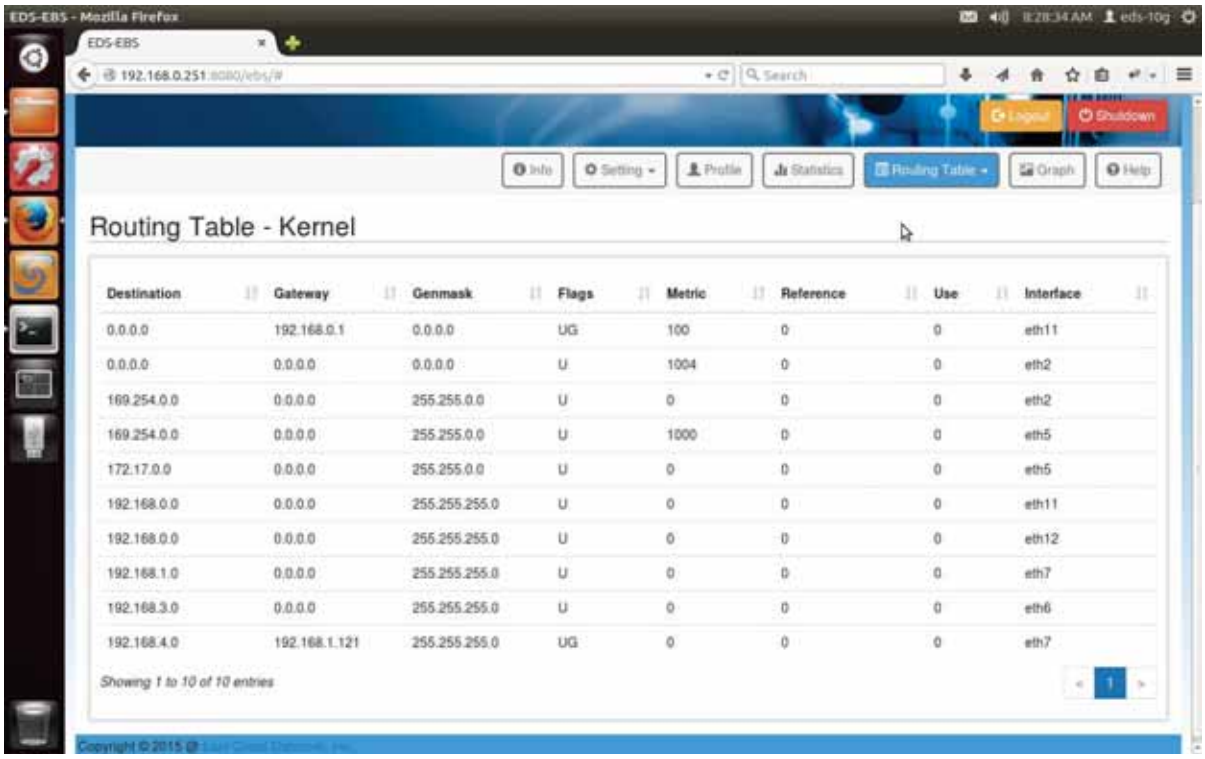
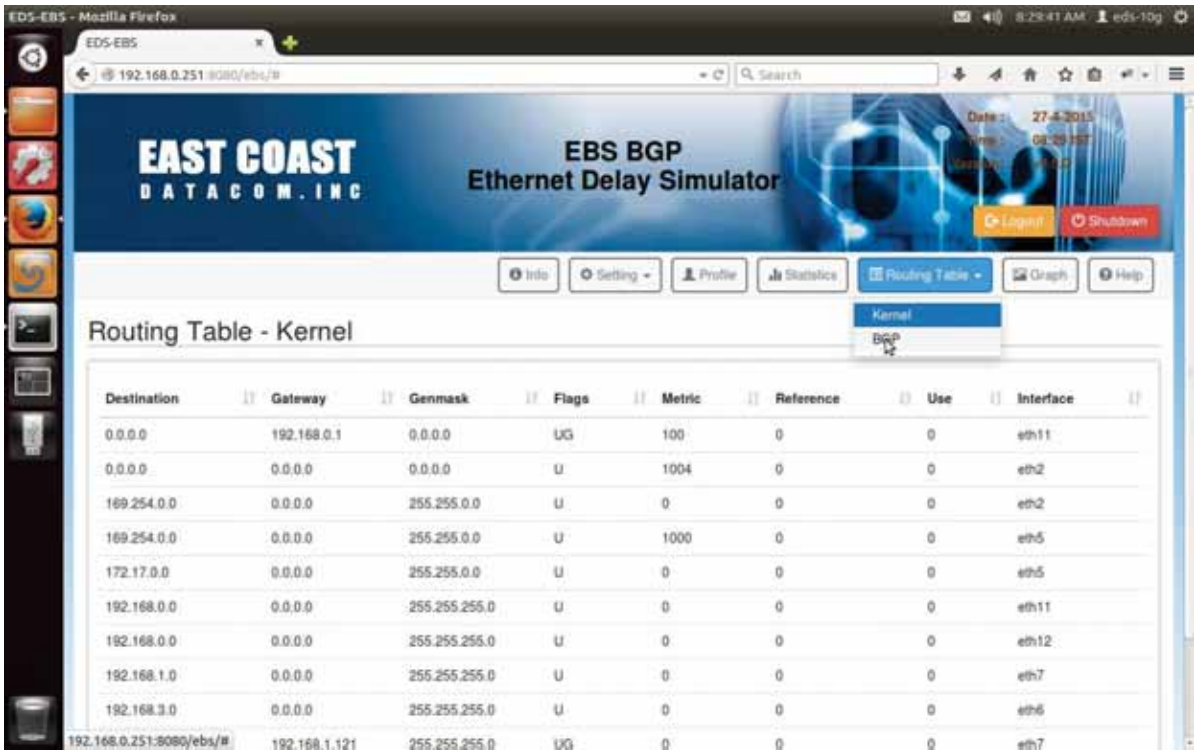


Table 5-1 Kernel Routing Table

The Flags Field with value **UG** specifies the Gateway IP as Default Gateway to reach a network.

5.2 BGP Routing Table

Select option “BGP” to display BGP routing Table.It displays all possible paths to reach the network along with corresponding Neighbors.Out of them the Best Selected Path and Neighbor will be marked by {Default } Status .That special Neighbor's IP address will be selected as the default gateway by Kernel Routing Table.



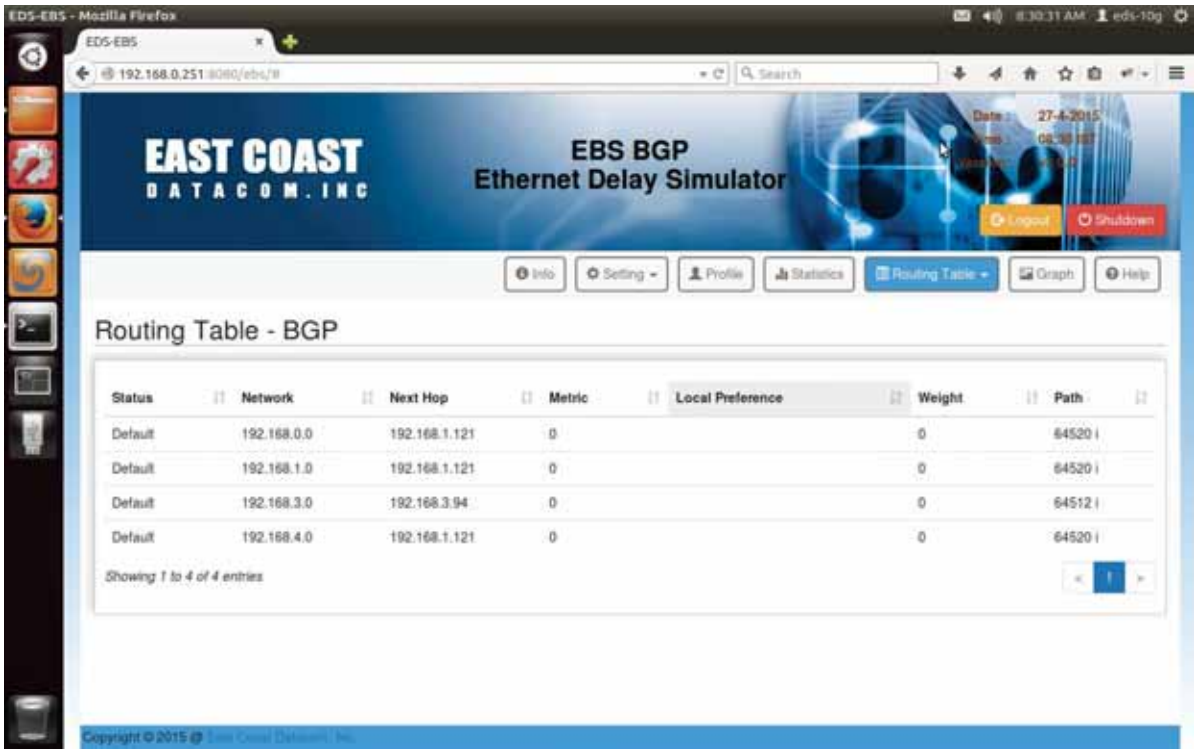


Table 5-2 BGP Routing Table

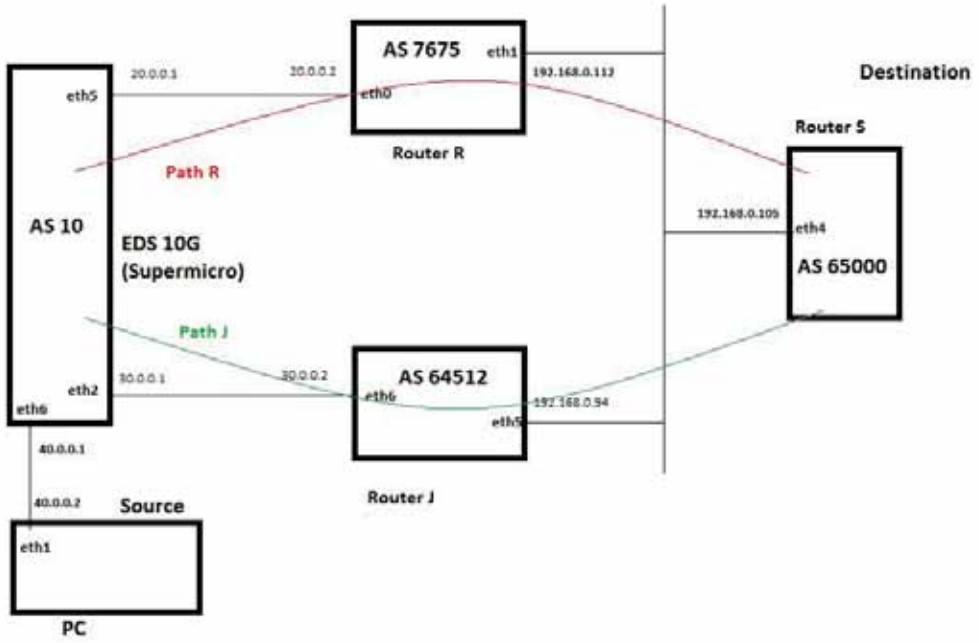


Figure 5-1.BGP Multi-path Testing Topology

We need five Systems to test dynamic routing decision of BGP

1. EDS 10G system:Dynamic routing decision will be made.
2. Router R: One of the node for Path R.
3. Router J: Another node for Path J.
4. Router S: Destination where EBS System wants to connect to.
5. PC: Source who uses EBS System to connect with Destination Router S.

Router R,J and S are any PCs with two set of network cards available . BGP Should be present in all the three routers.For Testing Purposes we can install our software on Desktop Systems that will act as router R,J and S with 2 network cards installed on each systems.

PC is an easy Linux system with only one Ethernet Card installed .It will be used only to check the network connections and path followed.Make sure that software as **traceroute** or **tracepath** are installed on them.

PC will forward the request to EDS 10G(Supermicro).EDS-10G will take dynamic routing decisions to connect to Router S through any one between two paths provided by Router R as Path R or by Router J as Path J.

To understand the Dynamic Routing Procedure we will disconnect the link going through the default path to break the traffic flow. After the link break EDS-10g will wait till **3 minute** for the link to go UP .Failing which it will declare that link as dead and select the alternate path for the traffic flow.If out of the failed and alternate path.Traffic Shaping is applied then behavior of traffic shaping will be determined by the nature of alternate path taken.

Note: To see dynamic Routing taking place, please be patient till 3 minutes for the BGP Routing Table to update.You can check the updated entry in BGP Routing Table when the Next Hop Column will show

update for network 192.168.0.0.
In case the destination network is available directly from EDS System, then the setup will fail to contact destination IP address due to ambiguity.

The following four Systems must have EBS-2.1.0 installed and running to set/get neighbors and networks.Or Routers with BGP must have a mechanism to check neighbors and networks
Please Provide a unique Autonomous System Number to track each nodes of connection.
In our case the AS numbers are

1. EDS-10G----10
2. Router R-----7675
3. Router J------64512
4. Router S------65000

Check-list of Setup

1. Enable IPv4 forwarding in All the 4 systems or more .Use this command in root user mode to get/set.

```
$ cat /proc/sys/net/ipv4/ip_forward

$ echo 1 > /proc/sys/net/ipv4/ip_forward
```

2. Separately check link state of each of the nodes in Supermicro System to fetch interface name using LAN Status [**2.2**] option of EDS software.
3. Set the IP Address of each of the Ethernet ports thus found from Step 2 according to the Given Topology in Figure 5-4.

Note: You can set ip address for Supermicro (EDS-10G)via EDS application.
For PC you can set ip address on linux terminal via command line as :

```
$ sudo ifconfig eth1 40.0.0.2 up
```

4. Ensure to ping the other end of connections successfully.
5. Router J and Router R should be connected via different network to Source.(EDS-10G).
6. Router J and Router R can be connected via different network to Destination.(Router S) also but in our case we have connected the three into same LAN Network.
7. Add your respected neighbor AS number and its IP address onto your BGP routing Table.
8. Add the network of your neighbor IP onto BGP routing table.

For AS 10(EDS 10G)
Neighbor:20.0.0.2(AS 7675)
Neighbor:30.0.0.2(AS 64512)
Network : 20.0.0.0
Network : 30.0.0.0
Network : 40.0.0.0(For PC)

For AS 7675(Router R)
Neighbor:20.0.0.1(AS 10)
Neighbor:192.168.0.105(AS 65000)
Network : 20.0.0.0
Network : 192.168.0.0

For AS 64512(Router J)
Neighbor:30.0.0.1(AS 10)
Neighbor:192.168.0.105(AS 65000)
Network : 30.0.0.0
Network : 192.168.0.0

For AS 65000(Router S)
Neighbor:192.168.0.94(AS 64512)
Neighbor:192.168.0.112(AS 7675)

Network : 192.168.0.0

9. Ping to that LAN ip of Source which is active at that moment.

At AS 10(EDS 10G)
```
ping 20.0.0.2
```
At AS 7675(Router R)
```
ping 20.0.0.1
```

At AS 10(EDS 10G)
```
ping 30.0.0.2
```
At AS 64512(Router J)
```
ping 30.0.0.1
```

At AS 65000(Router S)
```
ping 192.168.0.112
ping 192.168.0.94
```
At AS 64512(Router J)
```
ping 192.168.0.105
```
At AS 7675(Router R)
```
ping 192.168.0.105
```

AT PC
```
ping 40.0.0.1
```

10. Now Ping to IP address of Destination

At AS 10(EDS 10G)
```
ping 192.168.0.105
```
At PC
```
Ping 192.168.0.105
```

11. Use Traceroute to inquire about the path followed.Note down the IP Addresss and AS number of neighbor which is selected to reach the destination

At AS 10(EDS 10G)
```
traceroute 192.168.0.105
```
At PC
```
traceroute 192.168.0.105
```

13. Verify from Destination

At AS 65000(Router S)
```
ping 20.0.0.1
traceroute 20.0.0.1
ping 30.0.0.1
traceroute 30.0.0.1
ping 40.0.0.1
traceroute 40.0.0.1

ping 40.0.0.2
traceroute 40.0.0.2
```

14. Now disconnect the router who is best selected to reach destination. Wait for 3 minutes and check whether the the destination is able to reply Ping requests from EDS-10g System as source and vice-versa

At AS 10(EDS 10G)
```
traceroute 192.168.0.105
```
At AS 65000(Router S)
```
ping 20.0.0.1
traceroute 20.0.0.1
```
OR
```
ping 30.0.0.1
traceroute 30.0.0.1
```
AND

```
ping 40.0.0.1
traceroute 40.0.0.1
ping 40.0.0.2
traceroute 40.0.0.2
```

At PC

```
ping 192.168.0.105
traceroute 192.168.0.105
```

15. If we get Reply from Step 14 that means Dynamically Route Selection is being made by EDS 10G.

6 Graphical Visualization

This option will help to get a IP to IP wise overview of network traffic. At a time only one set of Source and Destination IP throughput graph will be visualized .

User can select pair of Source and Destination IP address from List of Applied pairs accessed from first drop-down menu.

Second Drop down menu will show list of different Bandwidth units they are listed as :

1. bps (Byte per second)
2. Kbps (kilobytes per second)
3. Mbps(Megabytes per second)
4. kbit/s (kilobits per second)
5. mbit/s (megabits per second)
6. packets/s(Packets per second)

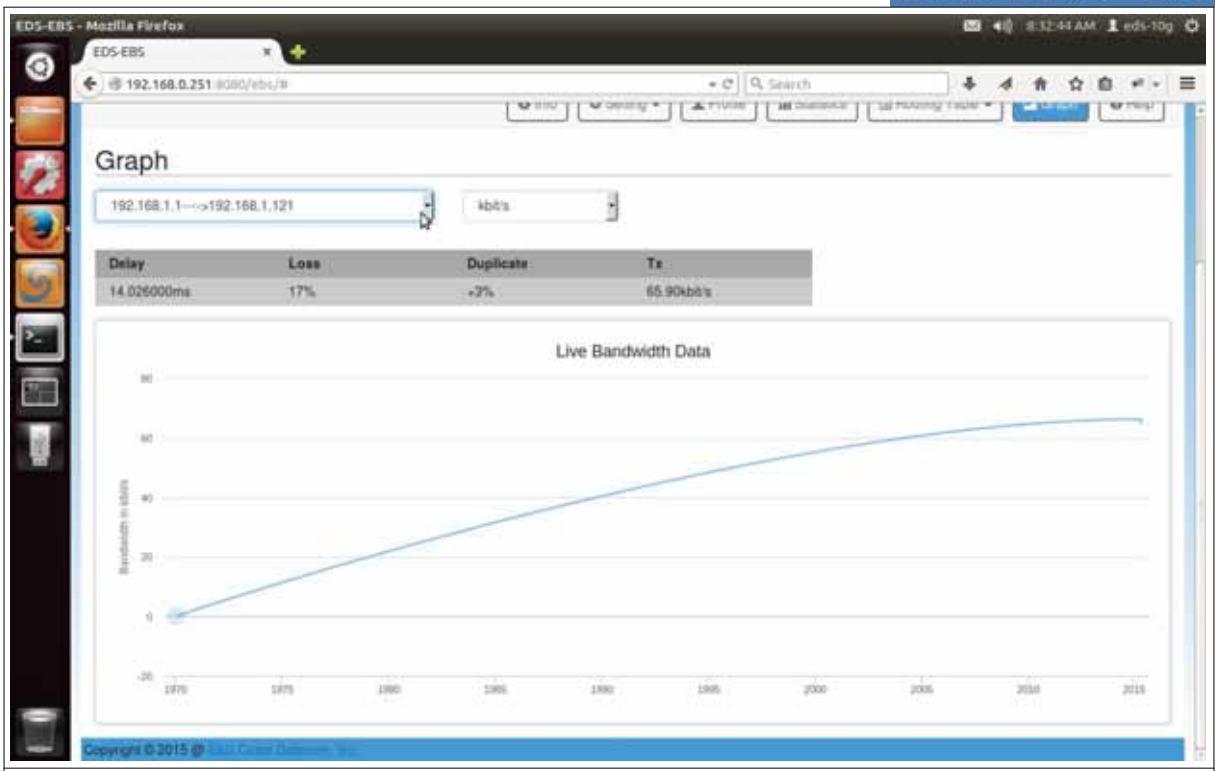
As traffic Shaping is applied for Egress traffic only, so only Transmitted data is fetched for plotting Graph.

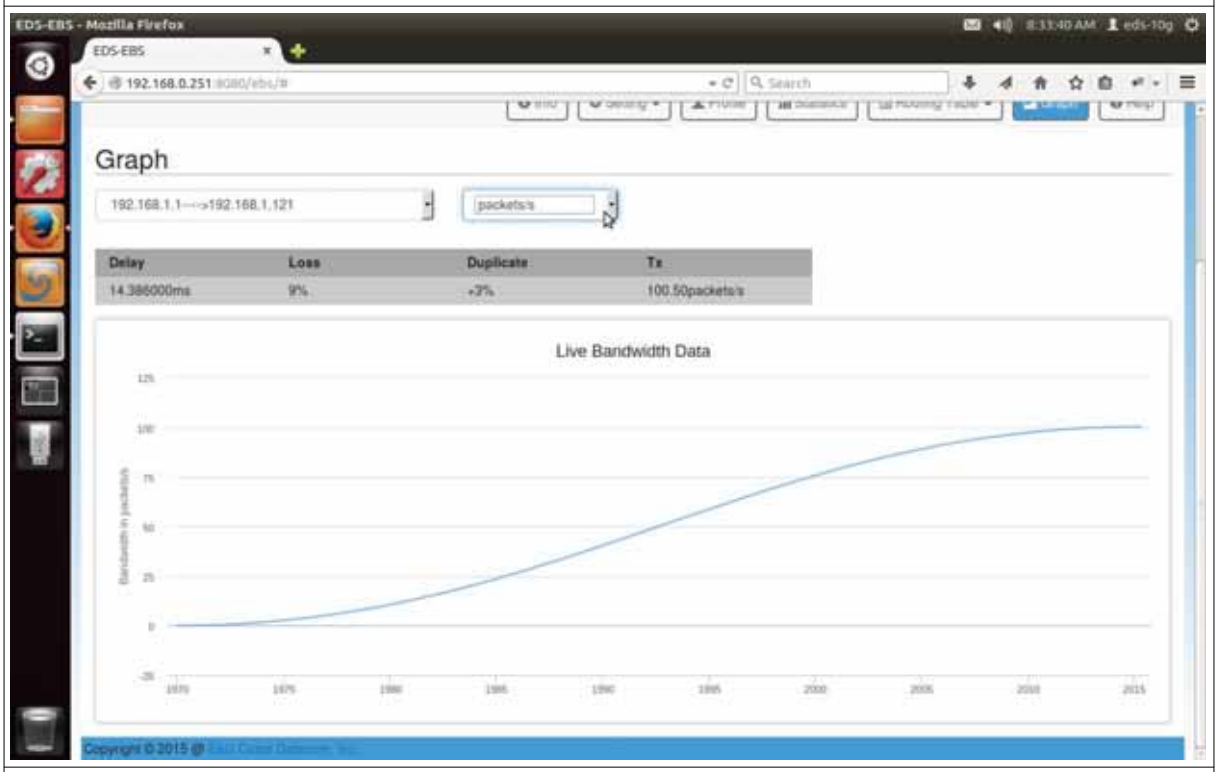
Also traffic specific information is shown as :

1) Delay
2) Loss percentage
3) Duplication percentage
4) Transmitted Bandwidth.

Note:

1. As the data shown is extracted from ping protocol reply, hence you can not be able to run ping protocol while Graphical visualization is running.
2. A delay may be encountered when a destination IP is not reachable . In that case switch to some other pair of Source and Destination IP addresses.

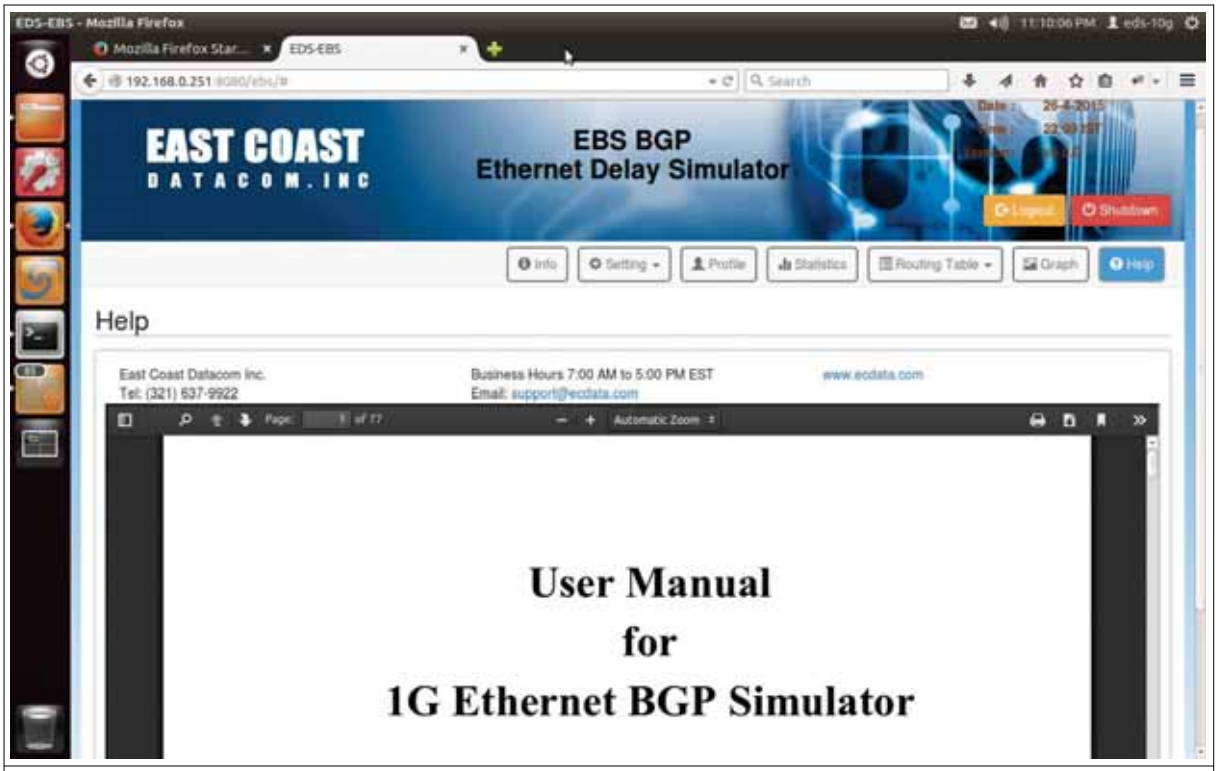




Graph

7 Help

Pressing Help Menu will open a page with user manual in PDF Format .The top of Help menu has contact details of East Coast Datacom. Inc. For any queries please contact at the phone number or email address. If the User Manual is not visible in Web-browser, please install all pdf viewer in your Web browser.



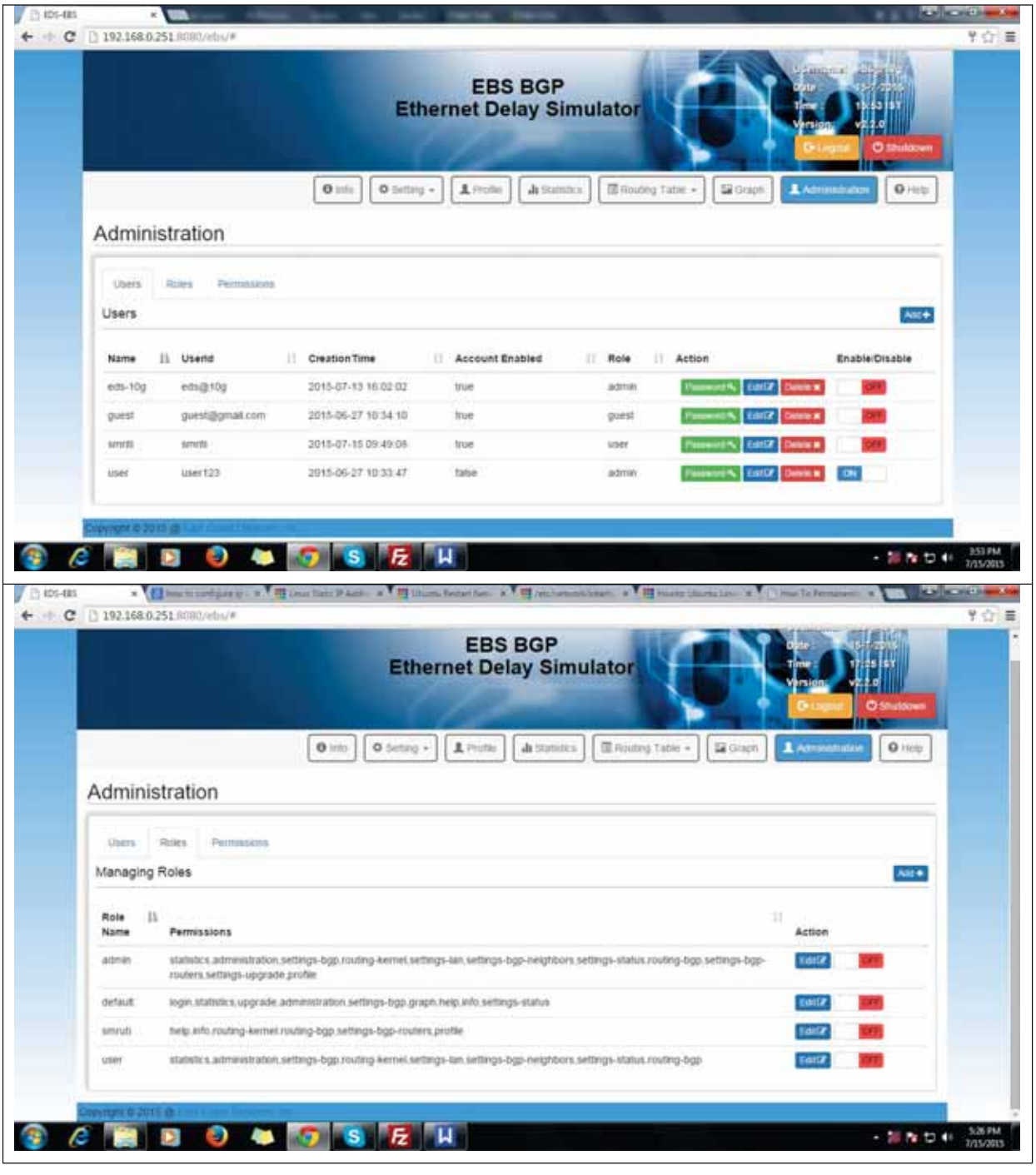
Help

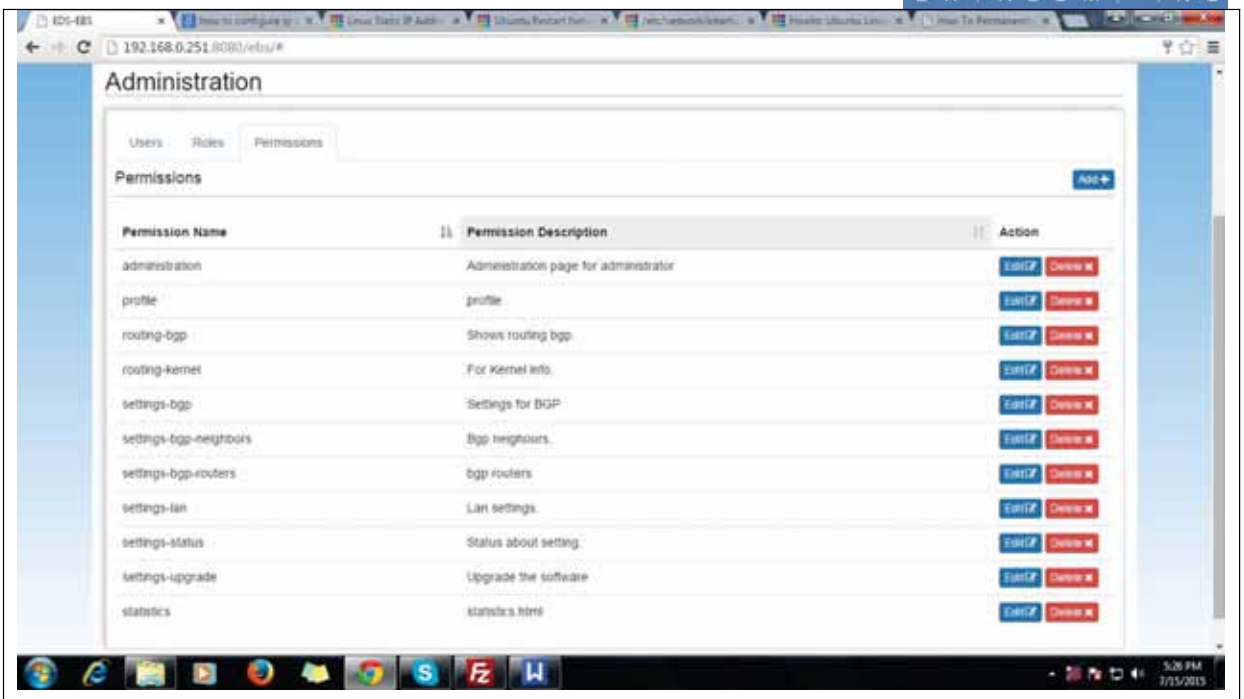
8 Administration

User Access rights can be managed via Administration menu. With this menu , different kind of users can be created .Each user can have his/her own set of Password,Roles and Permissions.Roles and Permissions can be shared among many users.

It has 3 tabs:

1. Users
2. Roles
3. Permissions , as shown in the diagrams given below.





Administration

8.1 Users

Users tab will show the list of users along with their information like user Id, user creation time, user role,user is enabled/disabled etc.

Only an administrator with Role as “admin” can create new users. User’s Role can be classified into three subcategories (by default 3 roles will be present in the fresh system, new roles can be added in the roles tab).

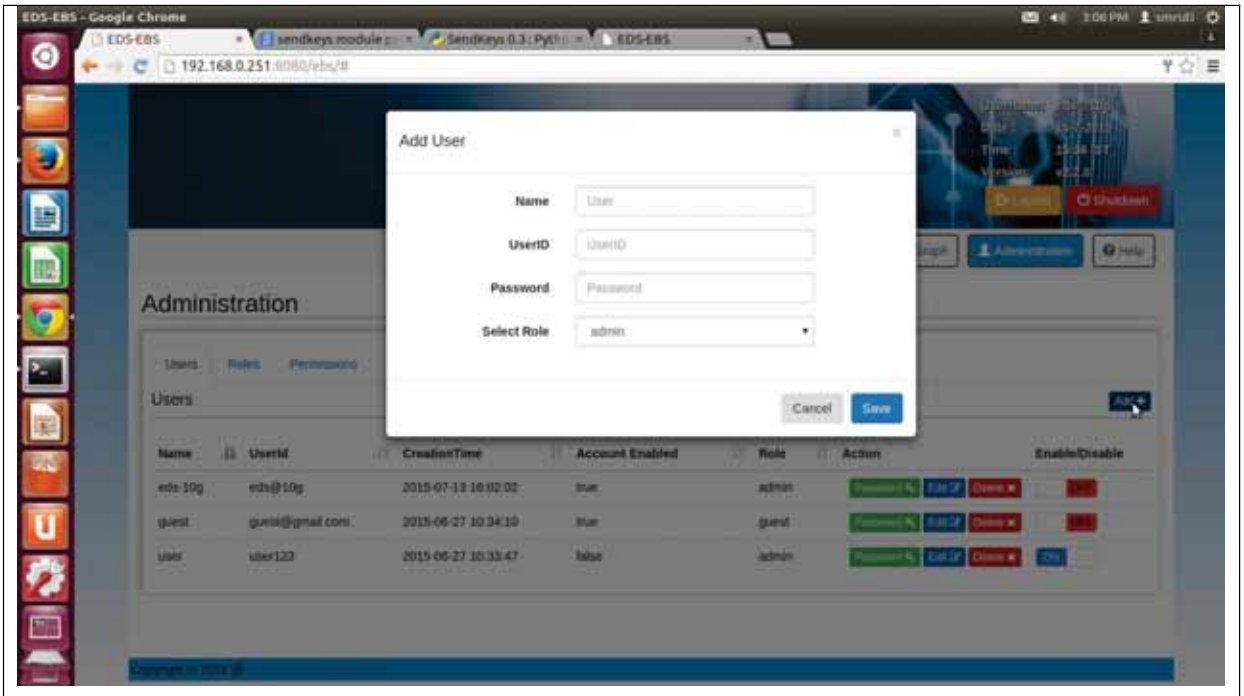
- Admin
- Normal User
- Guest

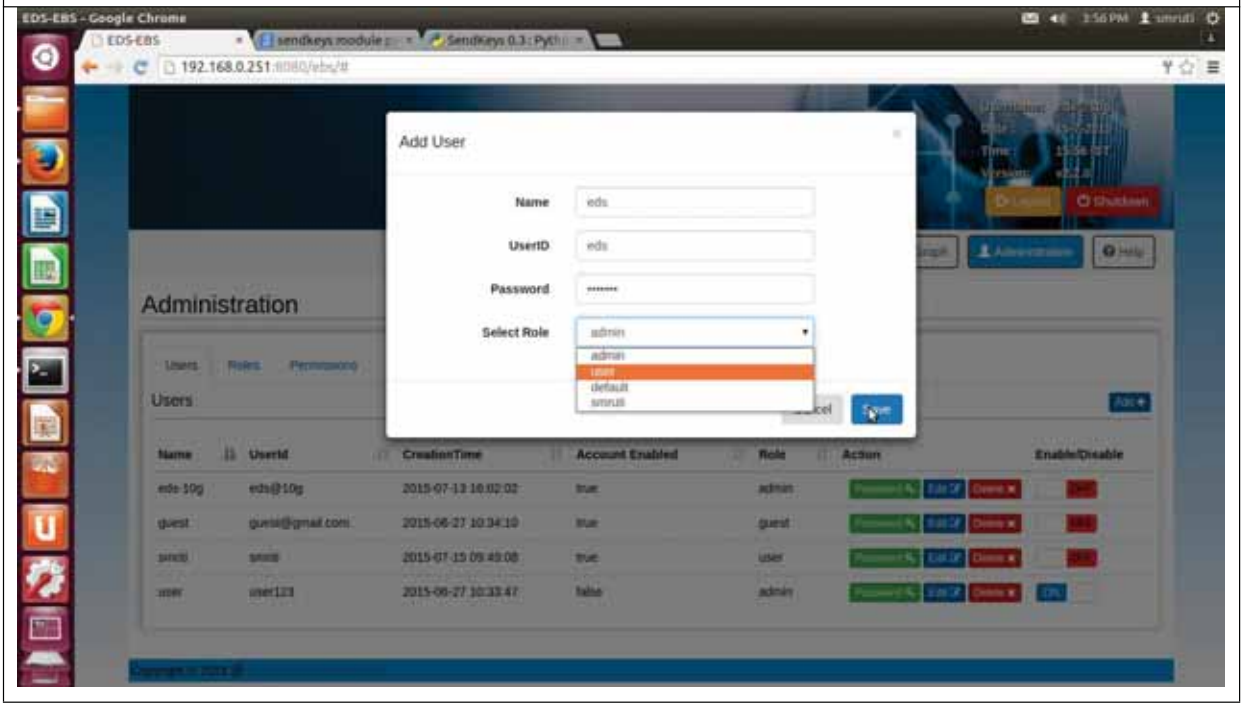
Once we enter into Users tab , we can perform following operations:

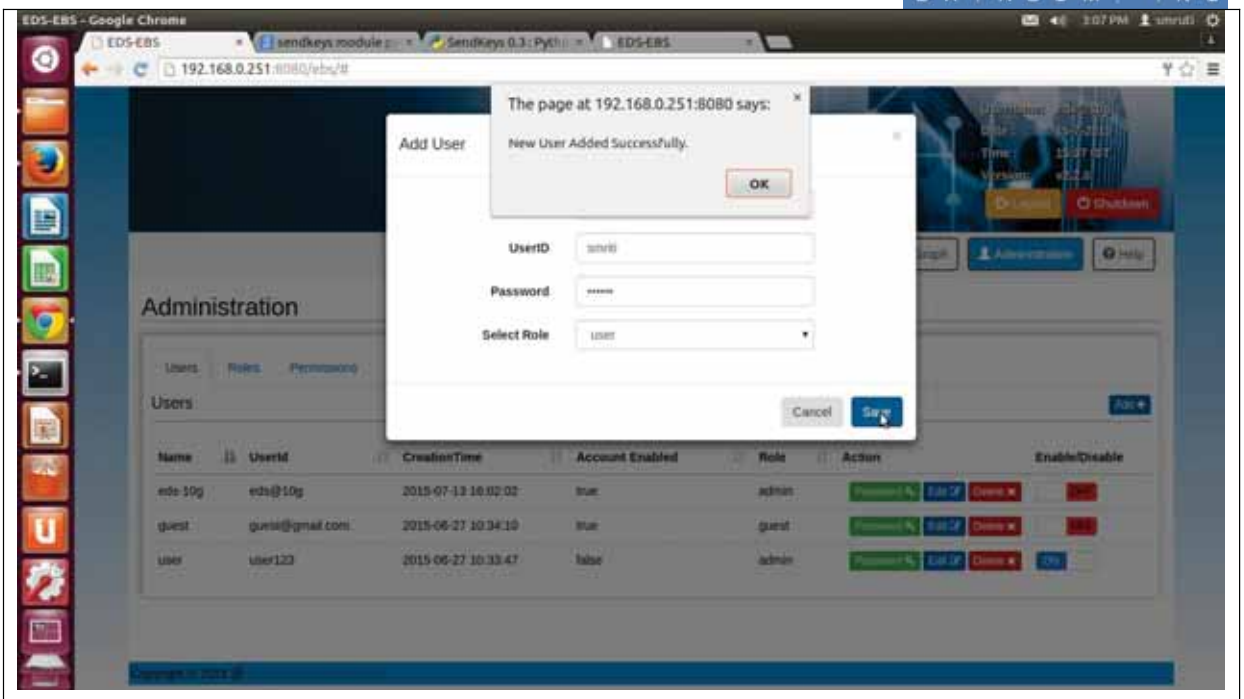
1. Add User
2. Edit User
3. Delete User
4. Enable/Disable User
5. Change User Password

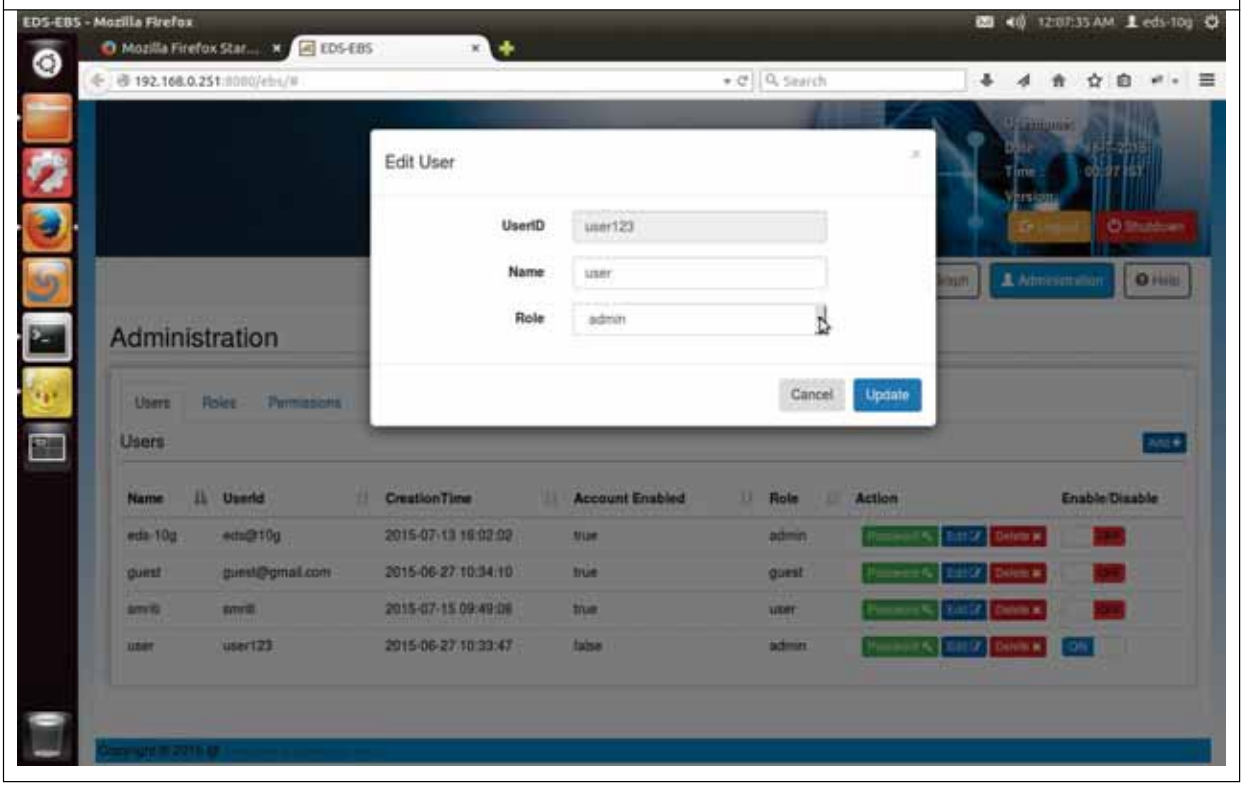
While adding the user, system will ask for User Name,User ID,password and role. In role drop-down box all the existing roles will be shown. For each user, edit,change password,delete,enable/disable option will be present. In edit option user’s name and role can be updated. For changing the password of any user, password button present on the corresponding row of that particular user will be used. Once any user is disabled, he/she can’t be able to log-in for the next time unless and until he/she is enabled again.

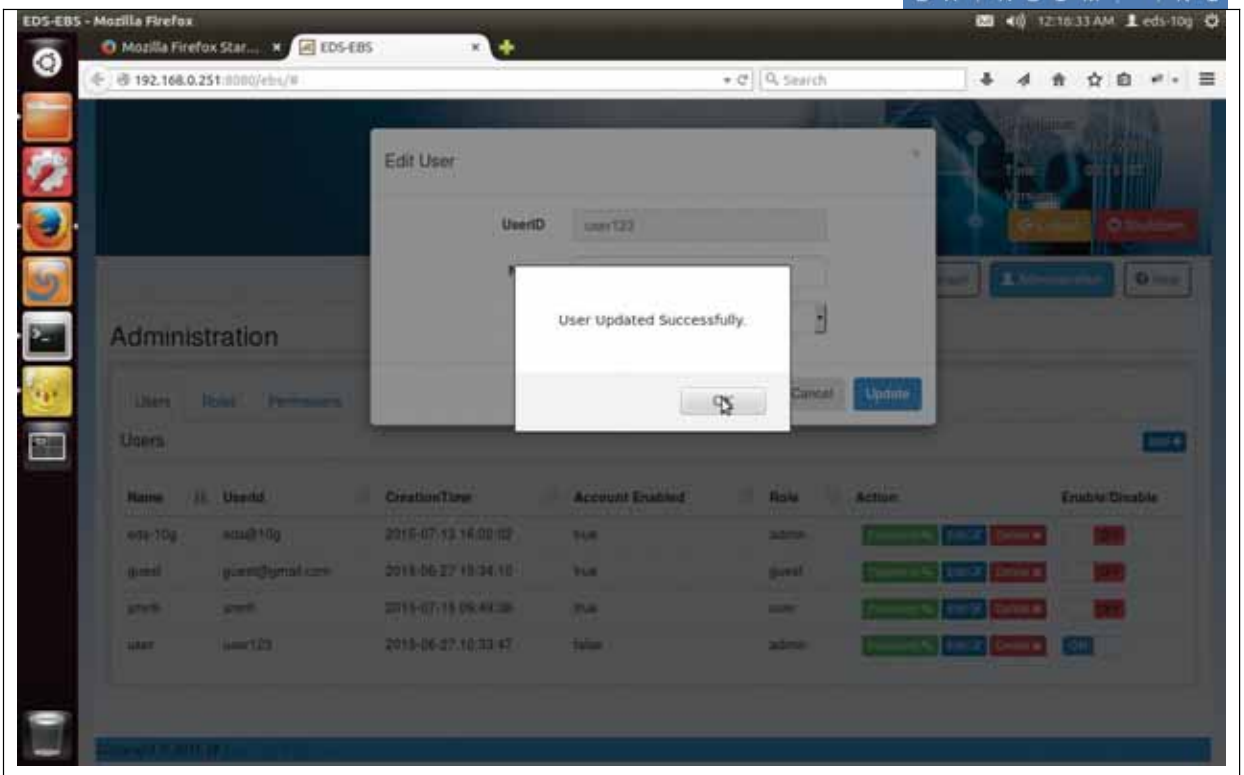
Some of the screen shots of the user operations shown below.

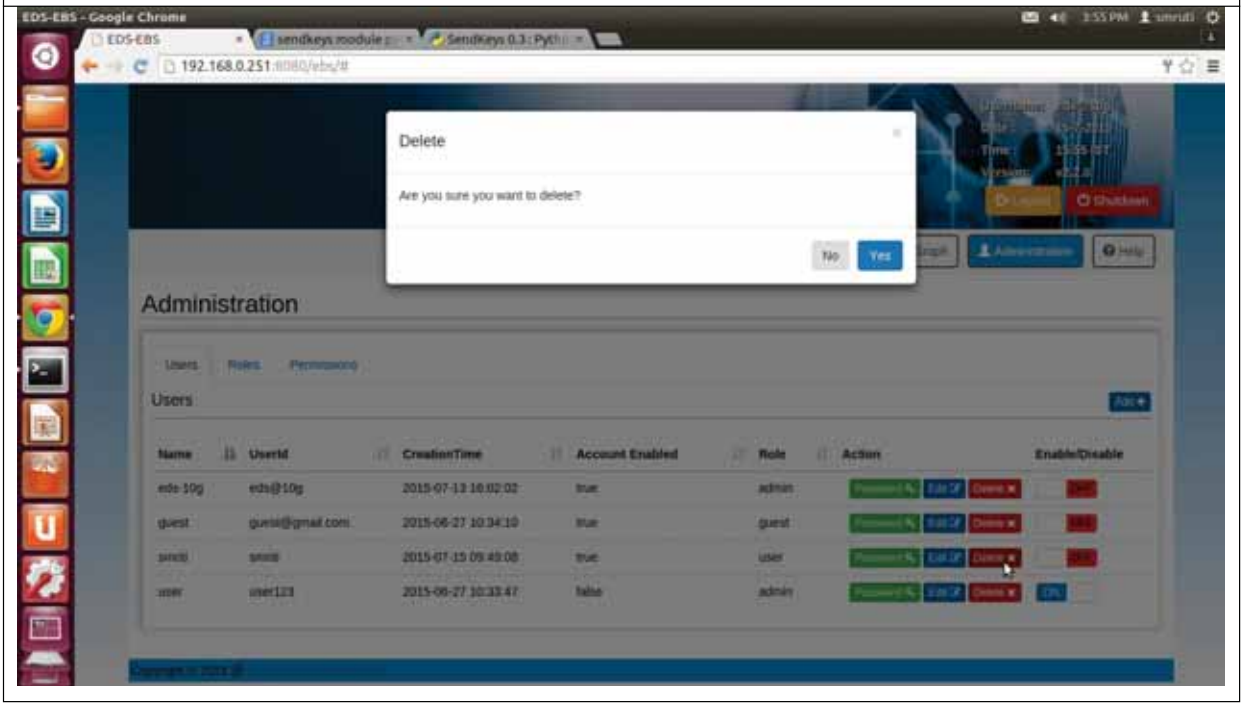


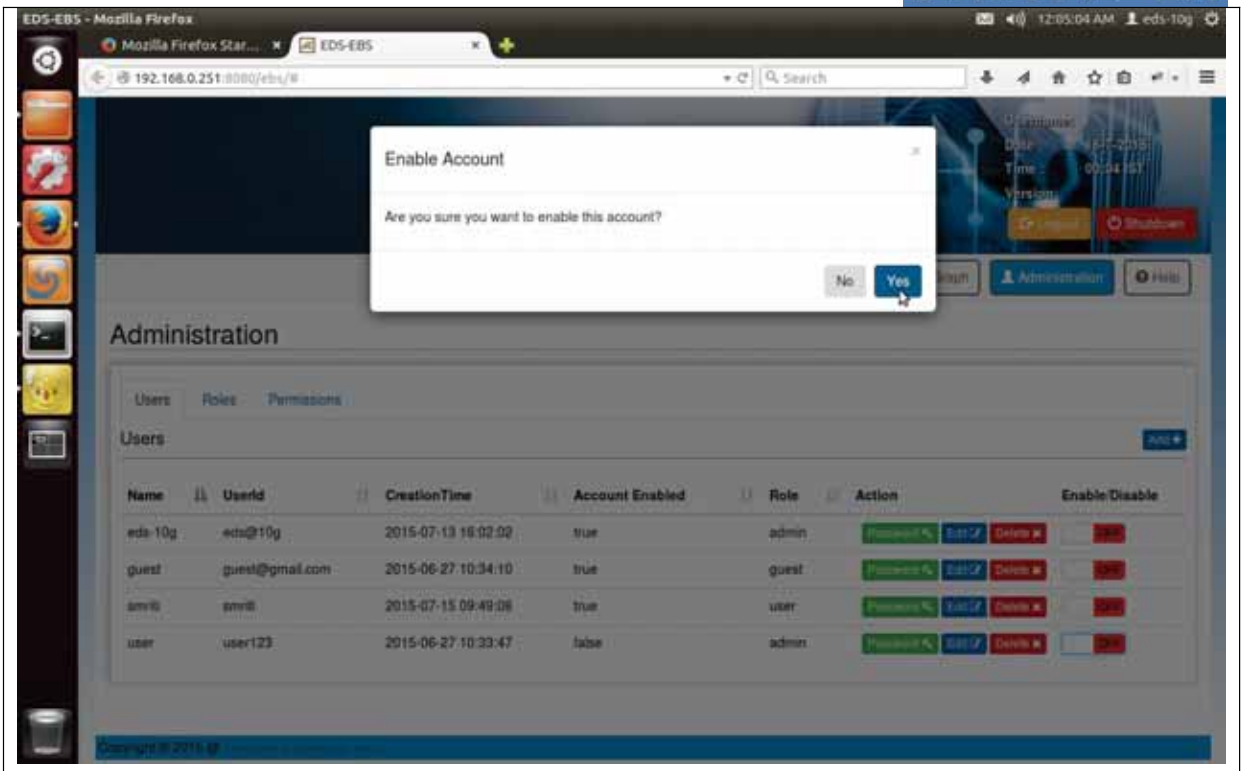


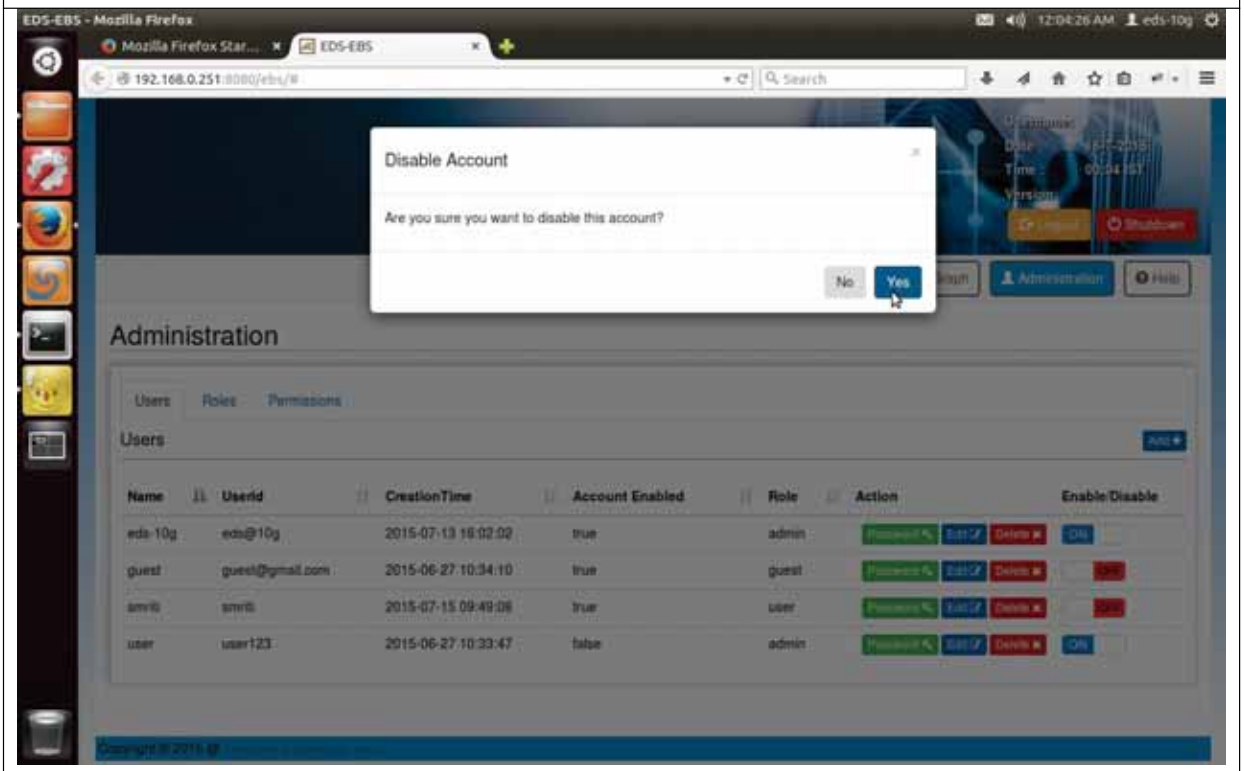


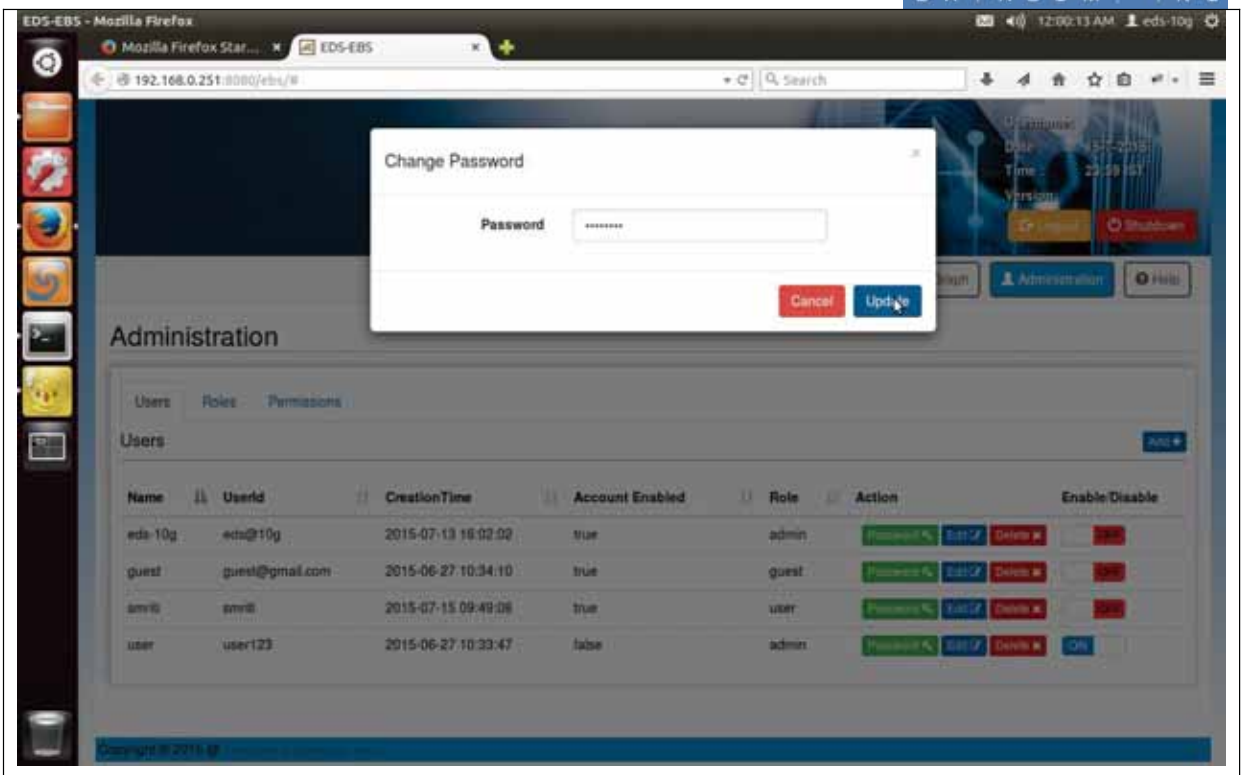












Users

8.2 Roles

Roles are the set of permissions which are common for a class of users.We can customize the set of pages that are visible to all the Users with a same Role.Remember , in order to assign a unique set of access to each user , you have to create a unique Role for each User.

Once we create a role, then those roles will be visible as a drop-down menu option for Adding /Editing user Roles in User tab.

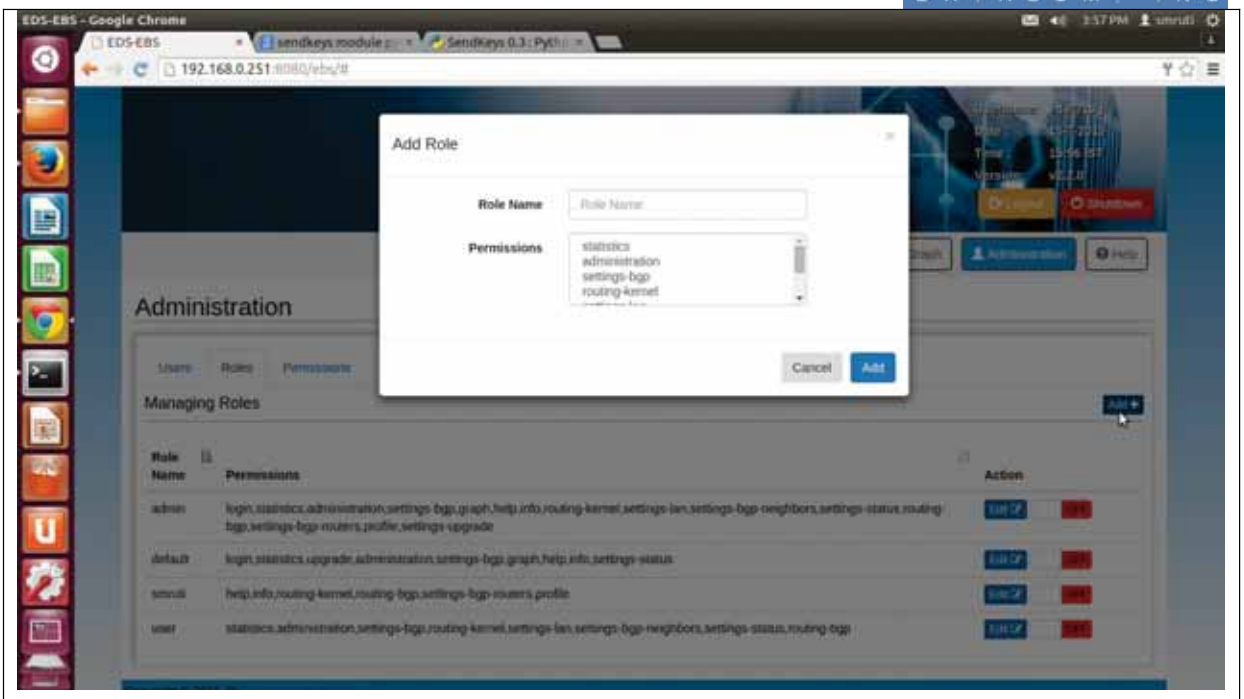
The Table in Roles tab specifies the list of roles with their corresponding accessible pages(permissions).

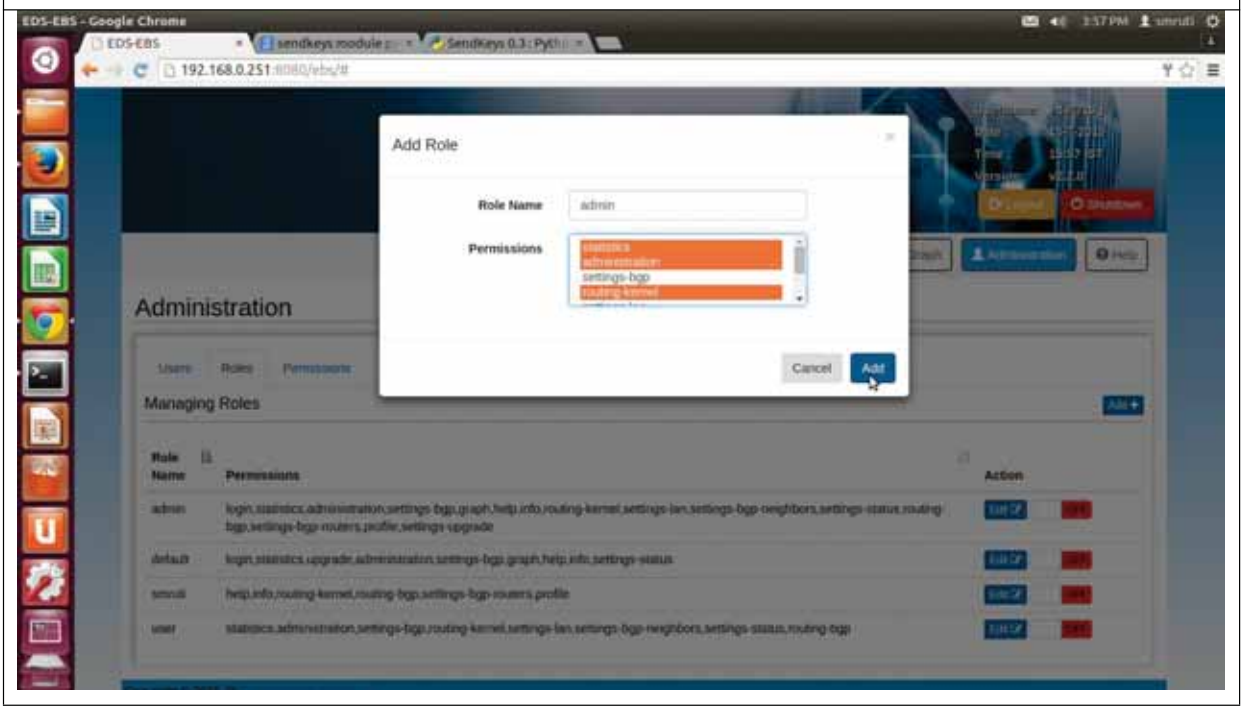
Following options will be present on roles tab:

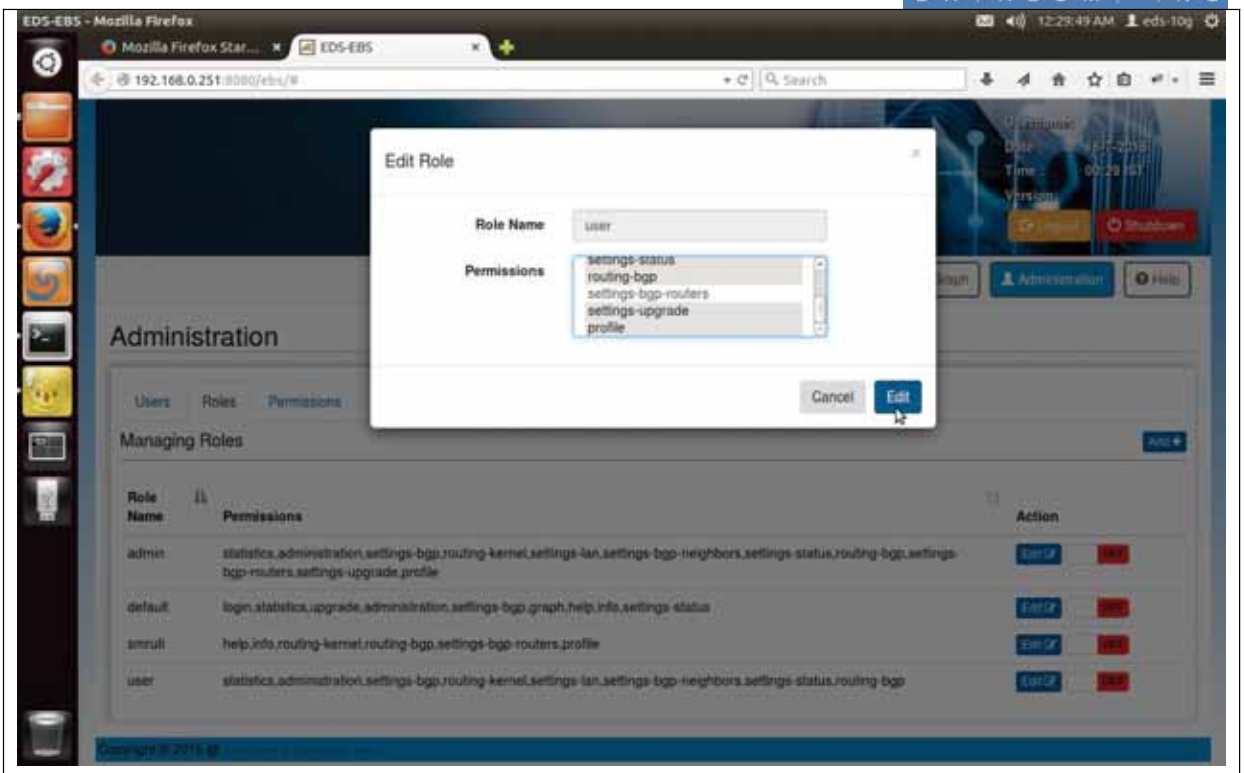
1. Add role
2. Edit role
3. Enable/Disable role.

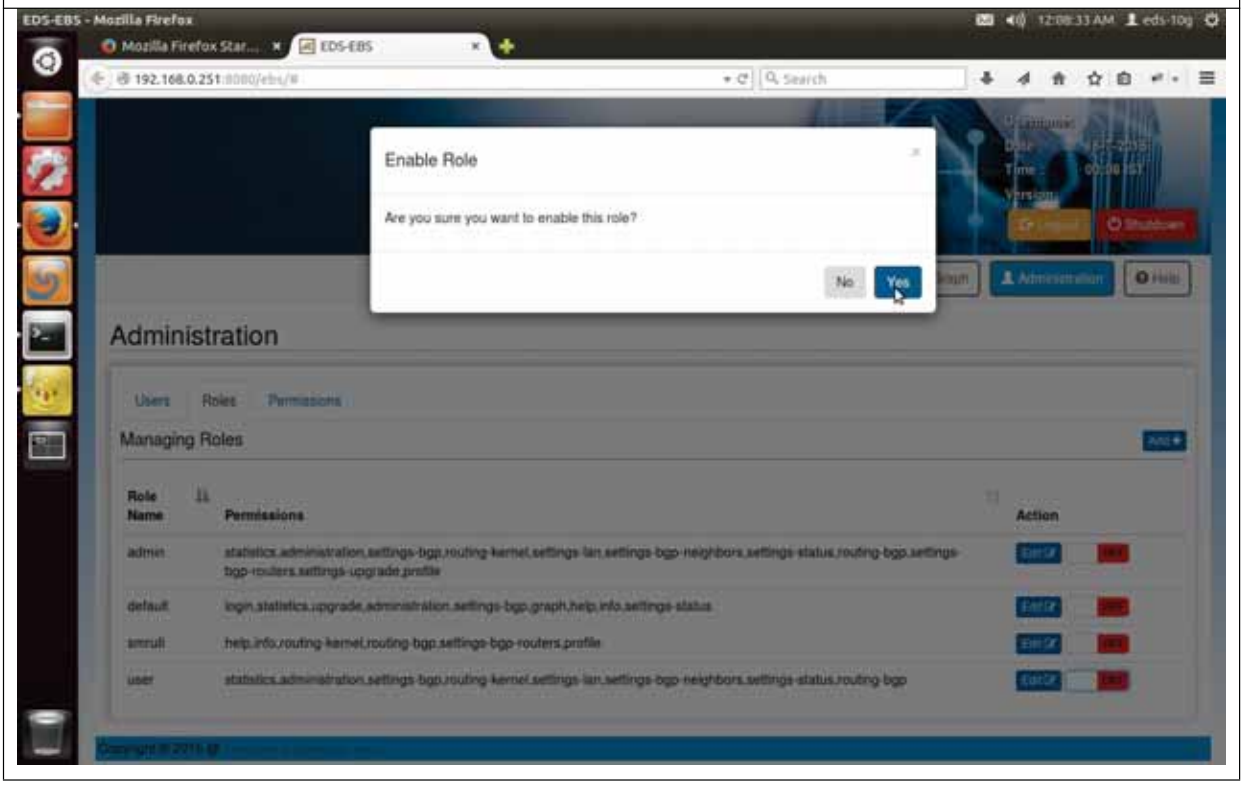
While adding the role, page will ask for role name and permissions. One or more number of permissions can be selected at a time in add/edit role. In edit role, only permissions can be updated for the selected role and permissions drop-down menu will show previously existing entries, user have to append/select/deselect the permissions while updating the role. Any role which is disabled will not appear in drop down menu of the add/edit option in User Tab.

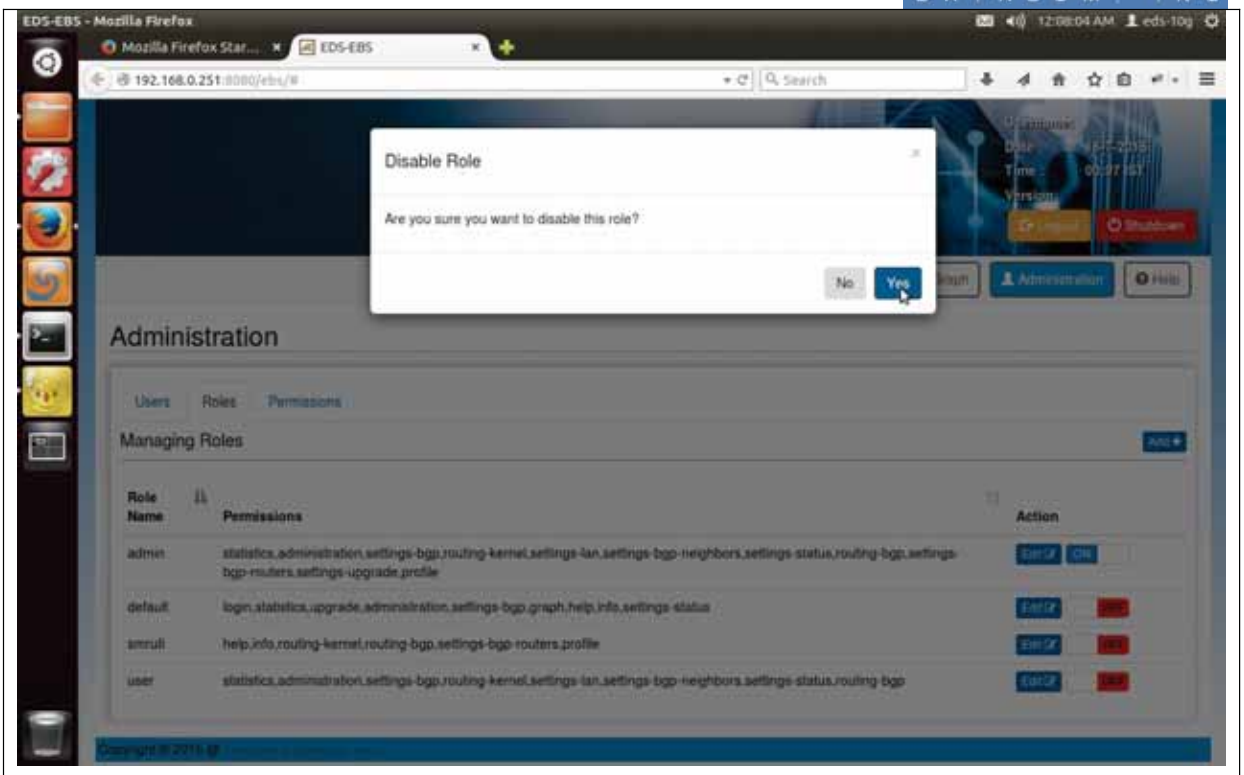
Some of the screen shots of the role operations shown below.











Roles

8.3 Permissions

Permissions tab will be listing the permissions with the brief description of them. Following options will be present under permissions:

1. Add permission
2. Edit permission
3. Delete permission

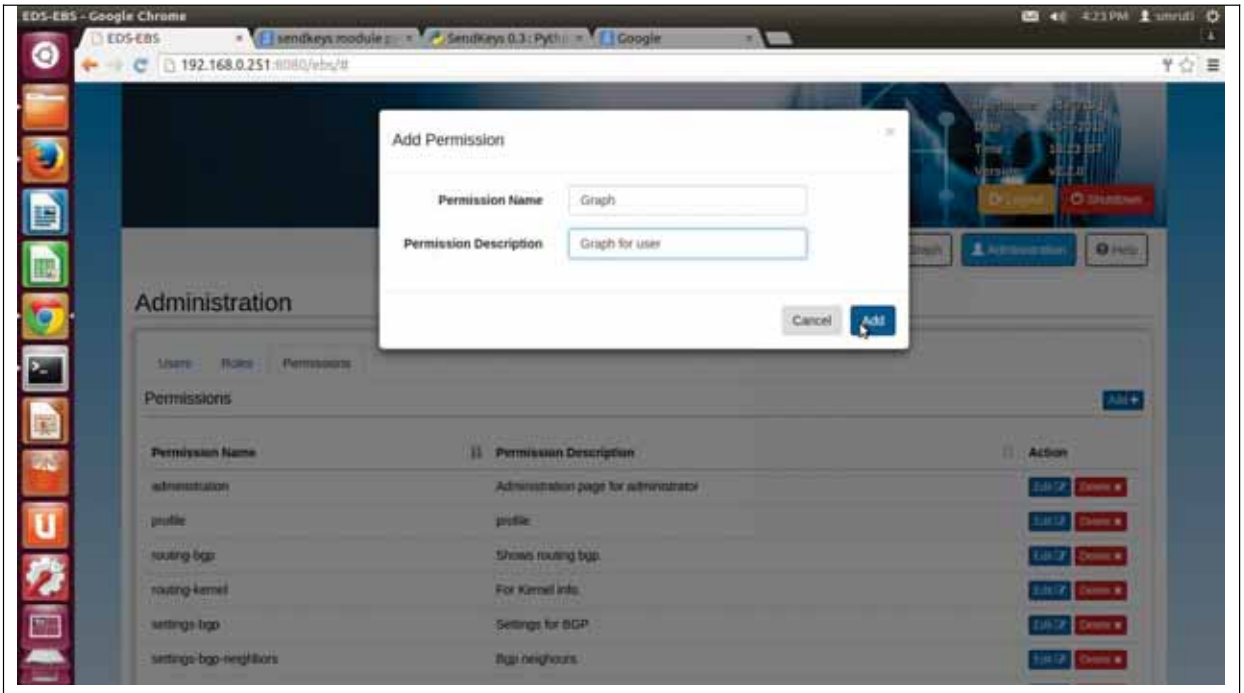
While adding the permission, name and description should be given. Permission name should be known by the user because it's predefined by the system. Following permission names are used for the different pages.

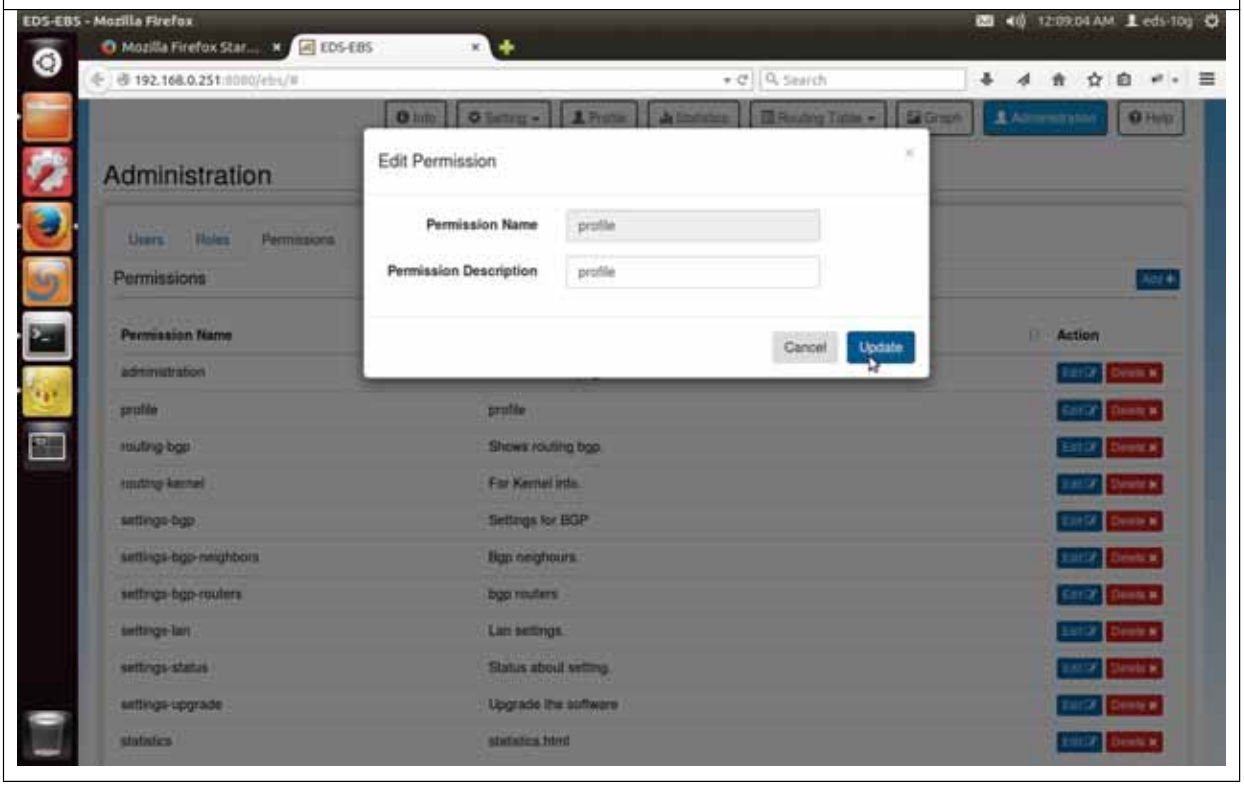
Page Name	Permission Name
Login	login
System Info	info
Lan settings	settings-lan
Lan Status	settings-status
BGP Settings	settings-bgp
BGP neighbor List	settings-bgp-neighbors
BGP routes	settings-bgp-routers
Upgrade System	settings-upgrade
Profiles	profile
Profile Statistics	statistics
Kernel Routing Table	routing-kernel
BGP Routing Table	routing-bgp
Graph	graph

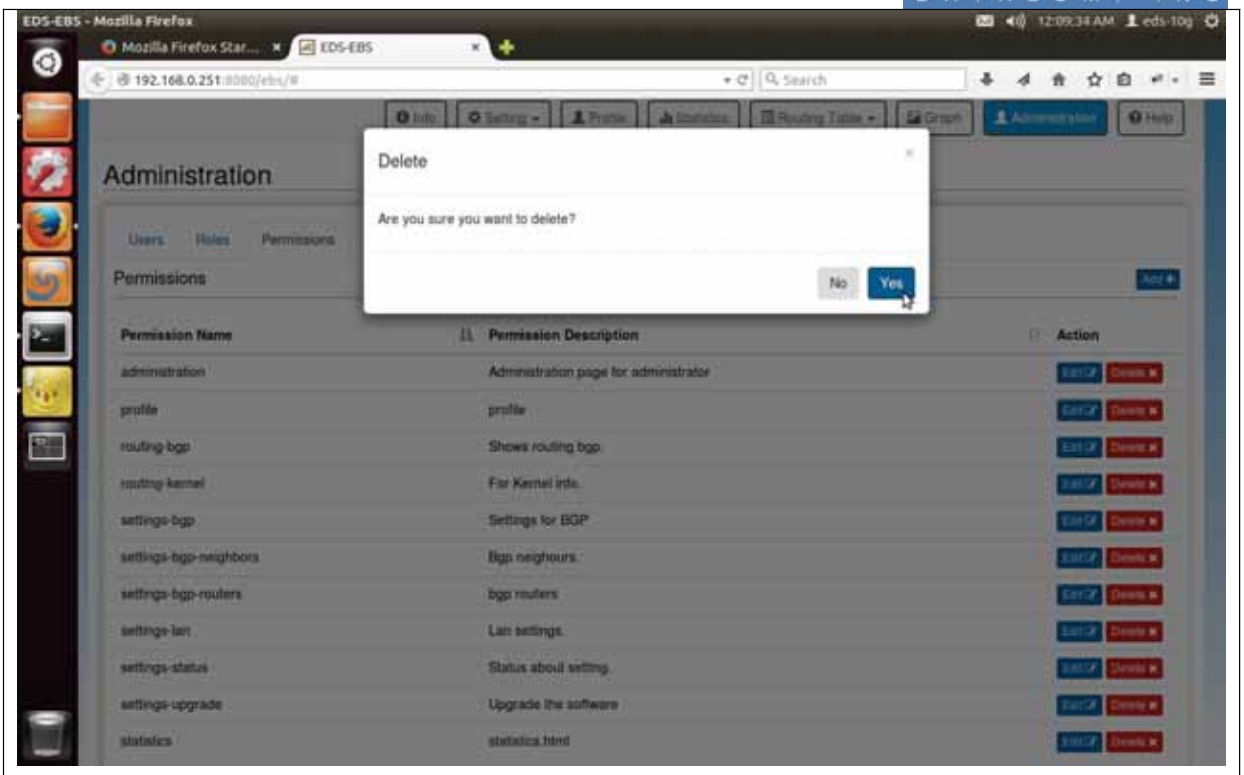
Administration	administration
Help	help

User can change only the permission description in edit permission option. Once the permission is deleted from the permission list it will not longer be available for the roles/users. Screen shot of add permission is given below.

NOTE: Once any permission is deleted , you can re-insert them based on the above table.



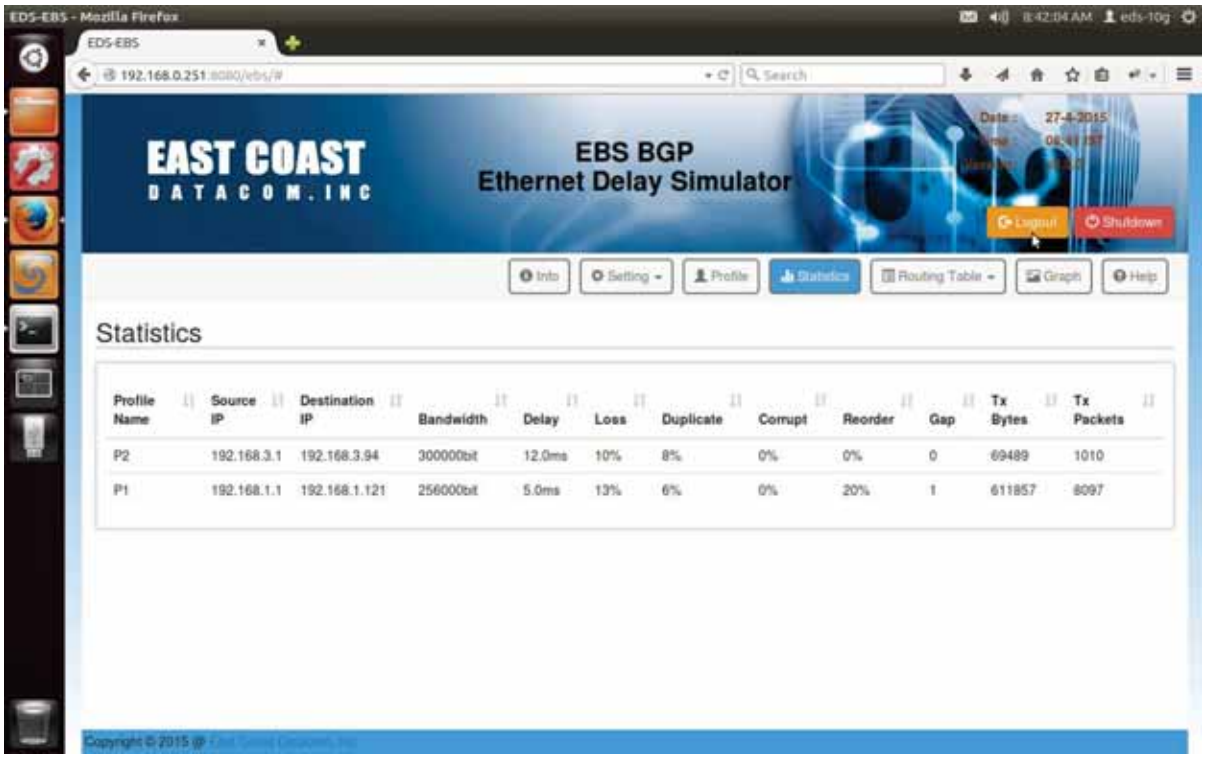




Permissions

9 Logout:

Upon pressing Logout, user will be signed out of EDS System . This option is needed when more then two users are trying to access the same EDS System.



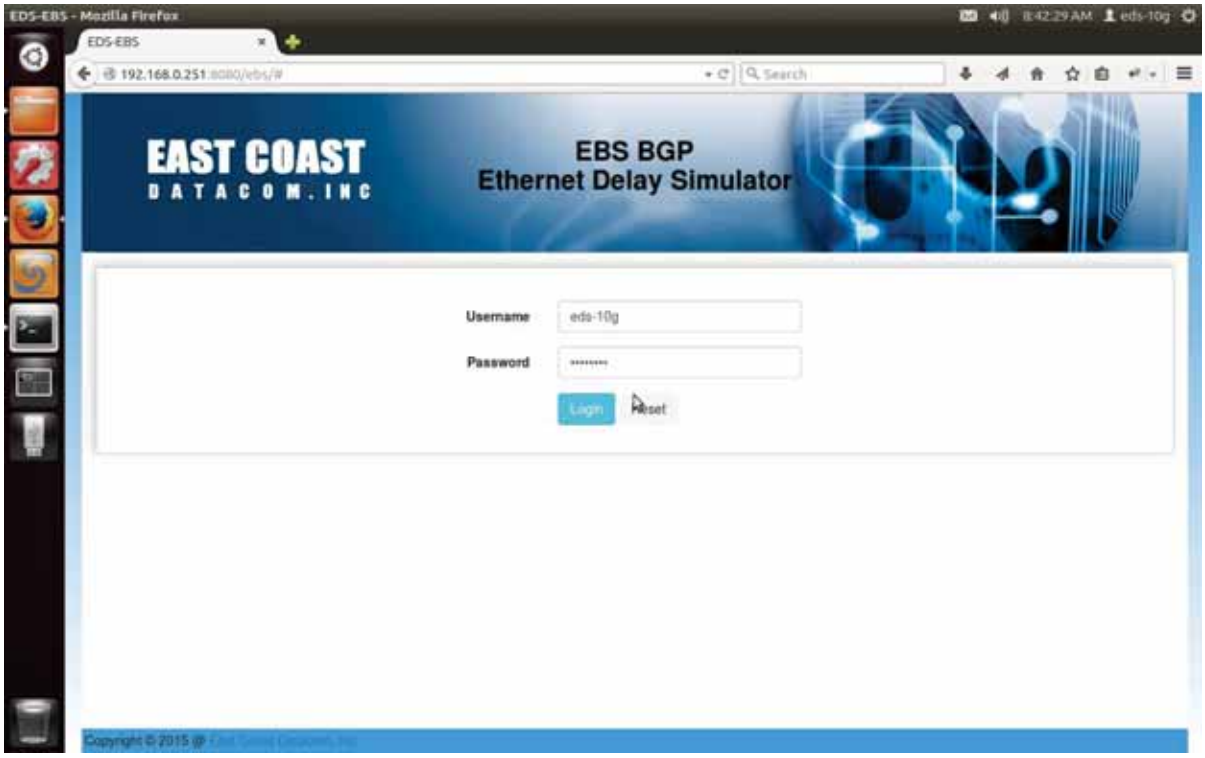


Table 6-0 Log-out

10 Shutdown

There can be two cases of Shutdown:

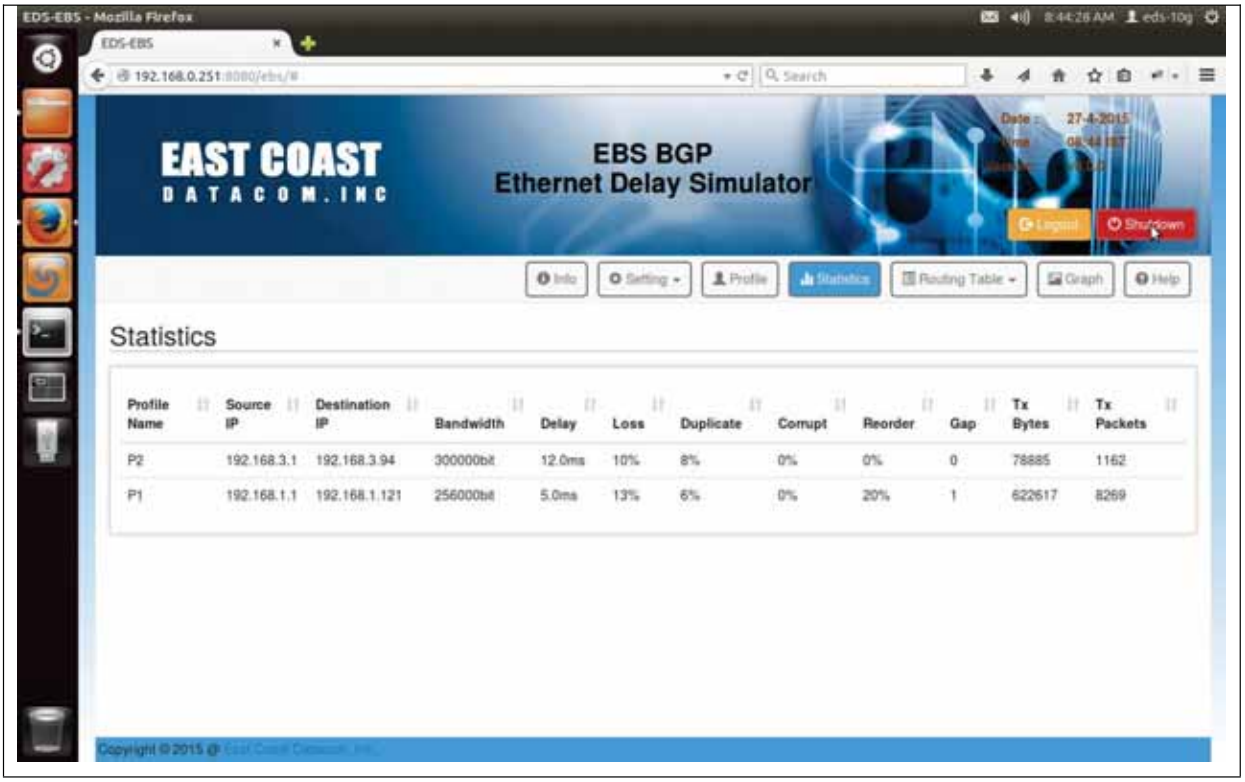
1) The user is remotely accessing EDS System.

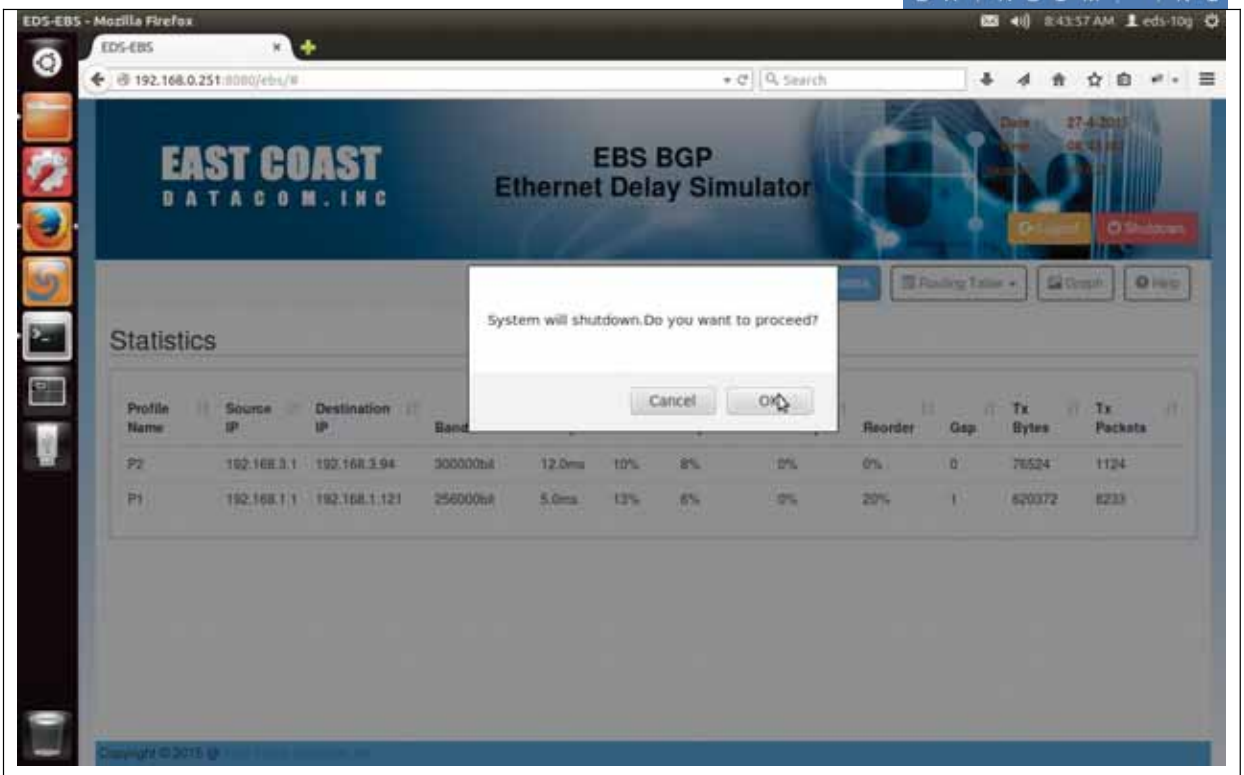
2) The user is directly using EDS System.

In case of remote access, the user will get logged-off from web-gui. Thereby causing EDS System to get shutdown remotely.

In case of local access , it will directly Shutdown the EDS System.

Before Shutting down , a warning message will prompt for confirmation from user to shutdown .





Shutdown

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