Role of Packet Tracer in learning Computer Networks

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Abstract: This paper relates the role of a packet tracer in learning computer networks. As computer networks have increased in number and size, moreover computer networks are used almost everywhere because of various benefits of computer networks, like file sharing, printer sharing, internet connection sharing, multi-player gaming, internet telephone services, entertainment etc, thus it is important to understand the basic concepts of computer networks. This paper begins with an introduction to packet tracer, and its advantages to learn various concepts of computer networks effectively and efficiently. Further various features of packet tracer are discussed in brief along with the experience of a student and a teacher while working with a packet tracer.

Keywords: Packet Tracer, Work Space, Modes, Networking Devices, Connections, CLI.

I. INTRODUCTION

Packet Tracer is virtual networking simulation software developed by Cisco, to learn and understand various concepts in computer networks. Networking devices appear in packet tracer as they look in reality and a student can interact with various networking devices, by customizing the configurations, by turning them on and off etc. Packet Tracer is teaching and learning software and a tool, easy to work with, thus after working with virtual environment, a student gains lot of confidence, when it comes to working in real-time environment. We can track the path of a packet, when it moves from source to destination, and also learn and understand, how to troubleshoot a network, when a packet doesn't reach the destination. Packet Tracer can be used to learn concepts more clearly by creating different scenarios. Since Networking is all about imagination and it's difficult to track movement of packets in a real-time environment, thus various networking concepts can be explained by creating a virtual environment, showing the moment of packets, exactly as it would happen in real-time. Packet tracer can be used to understand the working of various networking devices, their use, what makes them different and their appropriate use in a designing a network. Packet tracer is a user friendly tool, with various options, where a user can customize and design a network. Various tests can be run, to understand various network failures and how to troubleshoot them in real-time.

This paper is divided in to 5 sections; Section 1 begins with an introduction to packet tracer. Features of packet tracer are covered in Section 2, Section 3 discusses various benefits of using a packet tracer, teaching and students experience are briefly covered in Section 5 and Section 6 concludes the various benefits and advantages of using packet tracer to learn various concepts of computer networks.

II. FEATURES OF PACKET TRACER

Packet creates a simulation environment where a student gets visualization experience. An instructor can set up an activity wizard to assess the students by giving them different grades. There is also a multi-user feature, where students at different physical locations can work together on the same project, assignment or lab. Packet tracer has both Logical and physical workspace to create customized scenario based labs and it has got both Real-time and simulation Modes to understand various networking concepts, the same way as it would have happened in real-time. Packet trace also has got user friendly GUI and CLI interfaces, which are easy to work with and doesn't need any experience or expertise.

Another most important feature of packet tracer is that it can support multiple languages and it is platform independent.

It is an open-source software which can be downloaded free of cost from the internet. Packet tracer also helps to understand the concept of logical troubleshooting and it can also be used for case studies. There are integrated tutorials along with the software to understand use of various features of packet tracer. It also supports group and individual labs, homework, exams, games, problem solving etc.

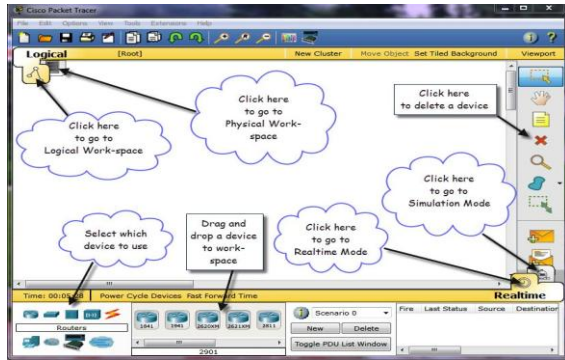**Workspaces:** There are two types of work space

Logical Work-space: It allows users to build logical network topologies and various devices can be dragged and dropped to logical workspace.

Physical work-space: It allows a user to create a network, the way as it would look in real world, and has the capability of geographical representation, where different networking devices can be shown as connected at different locations of the city.

Modes: There are two types Modes

Real-time Mode: The devices in a network behave as real devices do and look similar to real devices.

Simulation Mode: In this mode, a student can see and control time intervals, to learn how to troubleshoot network failures

Packet Tracer Workspace

Networking Devices: There are various networking devices which can be used to create different networking lab scenarios. E.g. Routers, Switches, Hubs, Wireless Devices, Connections, End Devices, WAN Emulation, Custom Made Devices, Multi-user Connection, Personal Computer, Laptops, Servers, Printers, IP Phones, VOIP Devices, Analog-Phones, TVs, Wireless-Tablets, PDAs, Wireless End Devices, Wired End Devices etc.

Connections: Various types of cables which can be used to connect various networking devices in a packet tracer are Console cable, Copper straight-through cable, Copper Cross-over Cable, Fibre Cable, Phone Cable, Coaxial Cable, Serial DTE, Serial DCE, and Octal Cable.
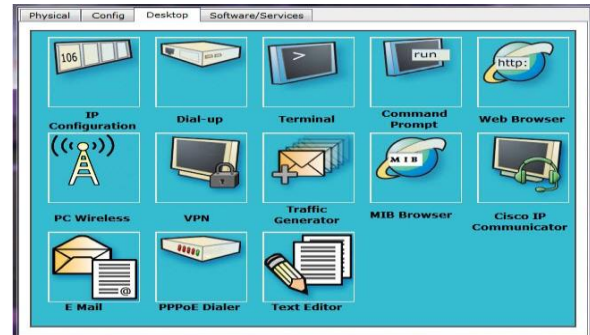
While connecting various cables to connect various networking devices, it is important to know which type of cable to use and to which port the cable should be connected to a particular networking device. Most of the times we deal with a pc, switch and a router, thus it's important to know what type of cable can be used to connect these devices On a PC, we can add a module based on the requirement, enable firewall rules, assign IPV4 and IPV6 address, default-gateway and subnet mask to an interface. We can also create a dial-up connection and use the terminal software to access the CLI of a router using console cable. We can run various diagnostics tests using Command Prompt; also we can use Web Browser, Wireless connection, VPN, Traffic Generator, MIB Browser, Cisco Ip Communicator, Email, PPPoE Dialler, Text Editor.

DEVICES	CABLE
Pc to Pc	Cross-Over Cable
Pc to Router	Cross-Over Cable
Pc to Switch	Straight Cable
Switch to Router	Straight Cable
Router to Router	Serial Cable

Types of cables to connect PC, Switch & Router

We can also use the following services on a server HTTP, DHCP, TFTP, DNS, SYSLOG, AAA, NTP, EMAIL, FTP, FIREWALL, IPV6 FIREWALL, and test these services
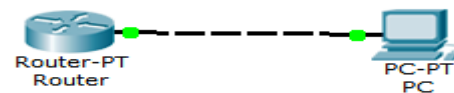
from the client machine. Packet tracer has a user friendly CLI mode, where a user can type different commands to configure various network devices. It is important to know which mode a student is using, what are the commands, which can be used in that mode and how to navigate between different modes of a networking device.

Various services available on a PC

Simple Scenario:
Let's take a simple scenario by connecting a PC to a Router using a cross-over cable. If it is a brand new router then it needs to be connected using a console cable and configured using terminal software.

PC connected to a Router

These are the basic modes of a router, which are recognized by the symbols shown in the table below. A user needs to know which mode he is in, what are the various commands that he can type in that mode and how to navigate between different modes of a router. If a user is not sure of what are the commands to be typed in any mode, then he can type the "?" Symbol to get help, or the list of commands to be typed in that mode.

MODE	SYMBOL
User Mode	Router>
Privilege Mode	Router#
Global Configuration Mode	Router(config)#
Interface Configuration Mode	Router(config-if)#
Line Configuration Mode	Router(config-line)#

Basic Modes of a Router

A user can access the CLI-Mode of a router either by using a terminal software, for first time configuration, when a PC is connected to a Router, using a console cable or by using telnet/ssh/putty etc, when it is connected using a cross-over cable.

Following basic commands can be typed on any router to assign an IP address on an Ethernet and serial interface.

Router Commands:
Router>enable
Router# configure terminal

Router(config)# interface FastEthernet0/0
Router(config)# ip address 192.168.1.0 255.255.255.0
Router(config)# no shutdown
Router(config)# interface serial0/1/0
Router(config)# ip address 172.115.1.0 255.255.0.0
Router(config)# no shutdown

III.   BENEFITS OF USING A PACKET TRACER

Packet tracer provides network simulation and visualization. It can be used to enhance and improve the practical knowledge of computer networking principles among students. Moreover, students can design mini-projects with solutions with more innovation and creativity. As with other tools, students are able to understand the use of different networking protocols but they are not able to understand the application of these protocols in the real networks, thus packet tracer can be used to design and configure a network, and understand the application of various protocols. As students can't access different networking devices, because of the cost, also devices may be damaged and further, movement of packets from source to destination can't be seen in a real-time, thus by using packet tracer, students can access the virtual network devices any time and no damage can be caused to devices, moreover the movement of packets can be shown by simulations.

Packet Tracer can further be used, to understand the difference between different networking devices like hubs, switches, routers etc and their appropriate use while connecting various Computers to design a network. How to assign logical address to various networking devices like computers, routers etc appropriately. While moving from source to destination, which route is selected by a packet depending on various routing protocols? Type of cable to be used while connecting different networking devices. Checking connectivity between different networking devices by running various networking tests. Basic networking concepts like DNS, DHCP, NAT, routing etc can be easily explained by using packet tracer and students can build, configure and troubleshoot networks using packet tracer. It also makes teaching easier, students can create their own scenario based labs and provides real simulated and visualization environment

IV.   TEACHING AND STUDENTS EXPERIENCE

Teaching Experience:

Packet tracer provides multiple opportunities for instructors to create different networking scenarios to explain different networking concepts. Since packet tracer is not a replacement of real equipment but it helps a student to do lot of practice and gain lot of confidence so that it's easy to work on a real network. Packet tracer is user friendly and easy to use tool, which doesn't need any expertise or training to use this tool. As a teacher, I have been using packet tracer for almost 3 years to teach Computer Networks Lab, Computer Network security Lab and Advanced Computer Networks Lab to teach various concepts of networking by creating different scenarios in a packet tracer. There are various basic concepts of networking like DNS, DHCP, NAT, IP addressing,

Firewalls etc which can be explained by network simulation and visualization using packet tracer. Packet tracer can also be used to gain experience and confidence which is very useful in designing real networks.

Students Experience:

Students, who spend more time, doing practice on a packet tracer, become more confident to work with real equipment. Students are very much interested in learning various concepts of networking using packet tracer. They are very much interested in creating their own scenarios and always keep on asking what if questions. There is better understanding of connecting proper devices, using appropriate cables and assigning proper IP address to various networking devices. There is also clear understanding about the difference in working of various networking devices and their appropriate use in connecting various hosts together. The multi-user functionality of a packet tracer helps the students to collaborate and compete with each other to increase and enhance the learning of different concepts.

V.   CONCLUSIONS

The findings of this study conclude that there are various benefits and advantages of using a packet tracer in learning basic and important concepts of computer networks which can be difficult and challenging to understand theoretically. Packet tracer has lot of features to create various scenario based labs. Students are very much interested to learn computer networks and after doing more practice on a packet tracer, they gain lot of confidence to work on real-time networking devices. As a matter of fact, a student can't afford to buy real equipment, because of the cost and the chances of causing damage to the real equipment, thus packet tracer is cost-effective tool, which gives a feeling, as if a student is working on a real-time project. It is an easy and user friendly tool to understand various concepts of computer networks.

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BIOGRAPHY

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