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Implementation of Heterogeneous Hybrid Multi-Functional Topology in Cisco Packet Tracer

Manoj Sindhwani*, Pritesh Kumar Jain, Shippu Sachdeva
Asst. Professor, Department of ECE
Lovely Professional University
Punjab, India

Abstract— Now a days we can't imagine the world without e-mails, online banking, chats and other important services provided by the internet. We all know that today is the era of technology & communication in which Computer Network plays a very important role. One of the attractive features of Computer Network is to access a file without having to physically go to the other computer. In order to achieve reliability and efficiency, we have to consider the best way of connecting end user devices together, also known as topology design which create a significant impact. So in this paper, we are designing a network using a network simulator tool i.e. Cisco packet tracer, while keeping focus on a heterogeneous hybrid topology to understand various concepts such as topology design, create dynamic host configuration protocol, domain name system and perform distance vector routing within a single network.

Keywords— Cisco Packet Tracer (CPT); Dynamic Host Configuration Protocol (DHCP); Domain name System (DNS); Route Information Protocol (RIP); Personal Computer (PC); Internet Assigned Number Authorities (IANA)

I. INTRODUCTION

Cisco Packet Tracer

Cisco Packet Tracer (CPT) [1] [2] is multi-tasking network simulation software to perform and analyse various network activities such as implementation of different topologies, select optimum path based on various routing algorithms, create DNS and DHCP server, subnetting, analyse various network configuration and troubleshooting commands. In order to start communication between end user devices and to design a network, we need to select appropriate networking devices [3] like routers, switches, hubs etc. from the component list of packet tracer. Networking devices are costly so it is better to perform first on packet tracer to understand the concept and behaviour of networking.

Routing Information Protocol

Routing Information Protocol (RIP) [4] [5] is an intra-domain dynamic routing protocol which is used to provide optimum path based on Bellman-Ford Distance Vector Algorithm [6] [7].RIP is commonly used protocol for managing router information within a network like Local Area Network (LAN). The special characteristics of RIP which uses hop count as a way to determine network distance, also prevents routing loops, as maximum number of hops allowed for RIP is 15.RIP is generally used in small networks because of this hop limit. With the help of RIP, a router transmits full updates (in its knowledge) to its nearest neighbouring nodes every 30 seconds which may generate heavy amount of extra traffic in the network. In case of topology change the routing table must be updated.

Dynamic Host Configuration Protocol

Dynamic Host Configuration Protocol(DHCP) [8][9] is a networking protocol that assigns unique IP addresses to IP based hosts for a specific time period generally known as lease period. DHCP provides static and dynamic address [10] allocation that can be automatic or manual. Static addresses are created manually and dynamic addresses are created automatically. So when a DHCP client request to its respective server, the servers first find its static database, and if the entry is matched then the IP address of the client is returned. But if the entry is not matched then it uses the concept of Dynamic Address Allocation where DHCP has a pool of available IP addresses, assigns an address from pool to DHCP client, and adds the entry to dynamic database. The addresses assigned from pool are temporary addresses and on expiry of lease period, the client needs to either stop using that IP address or renew that IP address, as per instruction of server.

Domain name System

Domain name System (DNS) [11] [12] is basically a large database with hierarchal structure, which provides a critical service for mapping of fully qualified domain names to their respective IP addresses. DNS acts as phone directory, with additional feature of updation, for the internet by translating user-friendly domain names into unique IP addresses. We generally use a domain name e.g. www.xyz.com which might translate to 192.168.20.2, with the help of DNS. In some cases if DNS Server does not find the correct mapping, it will in turn forward the request to a different DNS server at next higher level in the hierarchy until it gets an answer to that query (or an error message is returned if it's not possible

to get answer). DNS names are assigned through internet registries by Internet Assigned Number Authorities (IANA). An important query of DNS named as reverse lookup, is used when client provides the IP address and ask for name.

II. SYSTEM MODEL

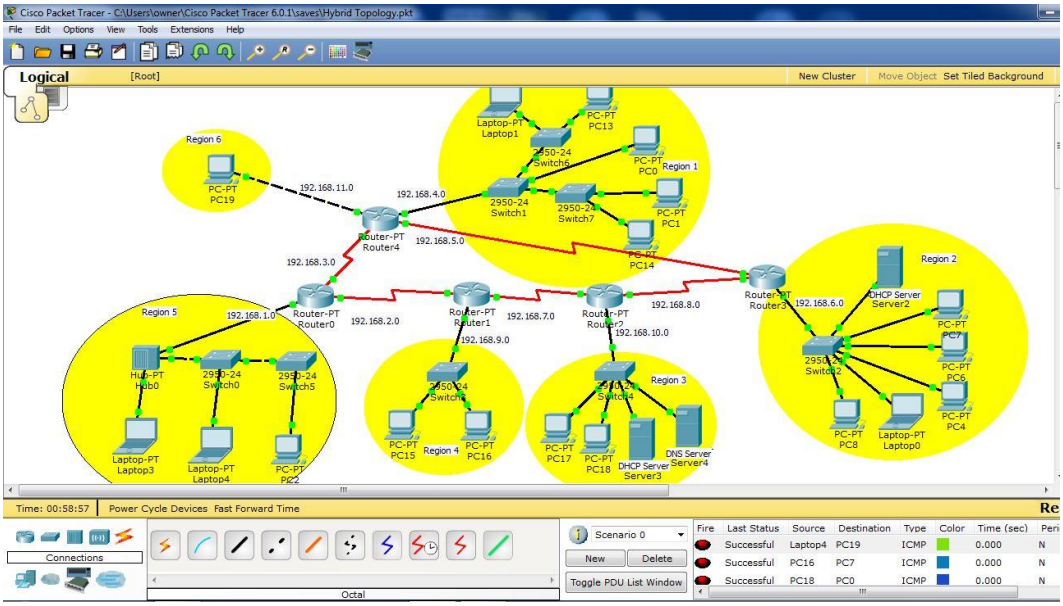

Fig.1. Implementation of Hybrid Topology

In order to implement such a network we are using a network simulator named as CPT. The steps involved in given system model are as follows:-

1. First to create particular topology we need to take networking devices like routers, switches, end-devices and connections from component list in CPT, as mentioned in the Table I.

Table I. Specification list

Name of Device	**Specification**
Generic Router	4 Fast-Ethernet Ports and 2 Serial Ports
Switch(2950-24)	24 Fast-Ethernet Ports
Generic Hub	6 Ports
End Devices	PC, Laptop, Server
Connections	Serial DCE, Copper Straight-Through and Copper Cross-Over Cable

2. The connections between routers are serial DCE, between routers to switches or hubs, are Copper Straight-Through, and between routers to PC, Hub to switch and switch to switch is Copper Cross-Over.
3. To configure the routers there can be two possible ways, either to execute commands in command line interface(CLI) or direct selecting the Configure tab after clicking on that particular router(here we used both approaches). In the configuration process we created 11 networks, all from Class C i.e.192.168.1.0 to 192.168.11.0.
4. All the routers in designed system model are connected in ring topology and entire system model have been distributed among various Regions i.e. Region1 to Region 6. These regions are explored in the following Table II.

Table II. Region wise Specification

Region	**Specifications**
Region 1	Illustrates the concept of Tree Topology
Region 2	Shows the concept of DHCP
Region 3	Shows the Concept of DNS
Region 4	Static addressing with Star Topology
Region 5	Illustrate the concept of Bus Topology
Region 6	Direct Connection of PC with Router

5. Finally to implement RIP [4][5] in this system design model we have used following syntax-
   Router(config)#router rip
   Router(config-router)#network 192.168.1.0
   Similarly we can configure all routers using rip.

6. To implement DHCP [8] (here implemented in Region 2) the syntax is as follows:-
   Router(config)#ip dhcp pool abc
   Router(dhcp-config)#network 192.168.6.0 255.255.255.0
   Router(dhcp-config)#default-router 192.168.6.1
   Router(dhcp-config)#exit
   Using DHCP we can also exclude address range, which will not be dynamically allotted by DHCP server but can be used later with the help of static addressing.
7. To implement DNS, Figure 2 illustrates the concept.

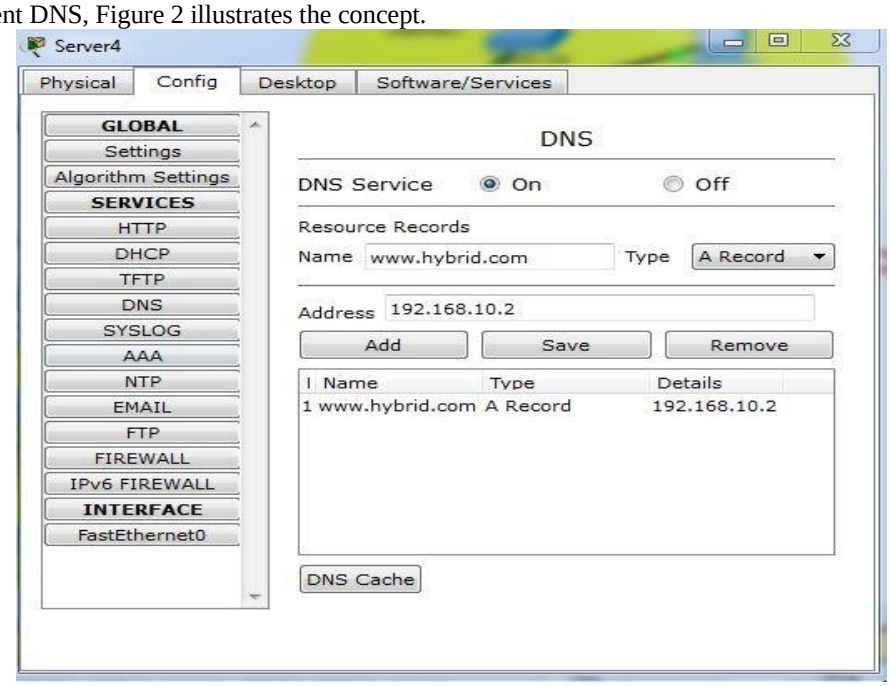

Fig.2.Setting DNS on Server 4

Here we have taken a unique IP address 192.168.10.2 and the name given is www.hybrid.com (in this example).DNS Service must be ON to apply the concept of DNS.
To implement this service we have configured a DNS Server (Server 4), and then from PC we will use DNS service by entering IP address of Server 3(DHCP implemented in this server) in Web Browser. Figure 3 illustrates the concept.

Fig.3.Acessing with IP Address

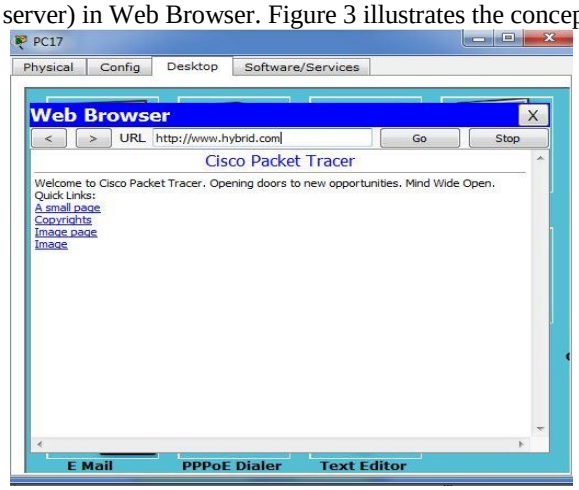

Fig.4. Accessing with Name

Similarly we can access server with the help of name (mentioned in DNS) instead of IP Address. Figure 4 illustrates the concept.

III. CONCLUSION

In this paper, we have implemented various topologies with some important concepts like DHCP, DNS and routing protocol RIP in a single network using Cisco Packet Tracer. We have used a simple protocol RIP which uses a hop count mechanism to find the optimal path for packet routing. Routing protocols are used to transmit packet across the internet and specify how routers communicate with each other. RIP is very popular protocol while considering simplicity and easy configurability, so perform best for small-scaled network. Also we have implemented DHCP and DNS in the same network, as DHCP is used to assign IP addresses dynamically and DNS is used to map fully qualified domain name to unique IP address.

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