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IP Routing In Computer Networks

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Abstract: The term routing is used for taking a packet from one device and sending it through the network to another device on a different network. The logical network address of the destination host is used to get packets to a network through a routed network and then the hardware address of the host is used to deliver the packet from a router to the correct destination host.
To be able to route packets, a router must know at minimum the following: Destination Address, Neighbor routers from which it can learn remote networks, Possible routers to all remote networks, The best route to each remote network, How to maintain and verify routing information. After getting familiar with the neighboring routers, it builds a routing table(a map of the internetwork)that describes how to find the remote networks. If a network is directly connected, then the router already knows how to get it.

I. INTRODUCTION

Routing is often contrasted with bridging, which might seem to accomplish precisely the same thing to the casual observer. The primary difference between the two is that bridging occurs at Layer 2 (the link layer) of the OSI reference model, whereas routing occurs at Layer 3 (the network layer). This distinction provides routing and bridging with different information to use in the process of moving information from source to destination, so the two functions accomplish their tasks in different ways.
Mainly there are two types of routing namely: Static Routing, Dynamic Routing

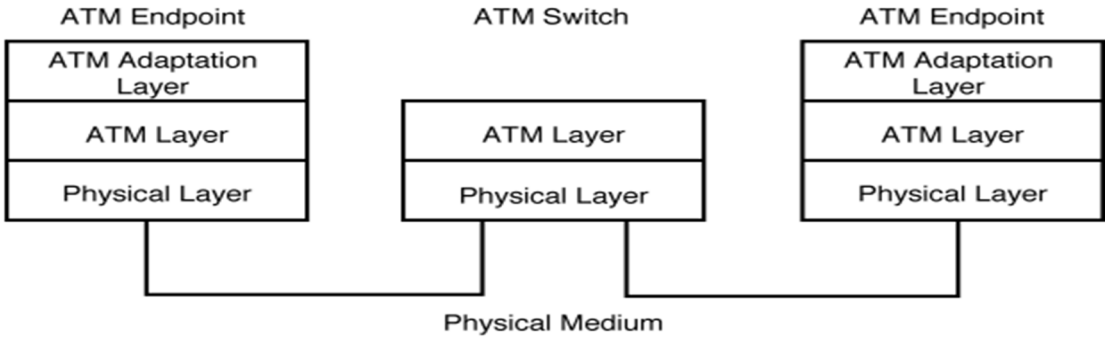
A. Network Management

Network management means different things to different people. In some cases, it involves a solitary network consultant monitoring network activity with an outdated protocol analyzer. In other cases, network management involves a distributed database, auto polling of network devices, and high-end workstations generating real-time graphical views of network topology changes and traffic. In general, network management is a service that employs a variety of tools, applications, and devices to assist human network managers in monitoring and maintaining networks.

The following articles provide information different network management technologies:

1) Virtual Private Networks
2) Directory-Enabled Networking
3) Remote Monitoring
4) Simple Network Management Protocol

Various technologies are used under this like involving of the Eighteen major types of wireless technologies exist, containing a large number of subset technologies that range from ATM-protocol based (which sells at approximately $200,000 per data link, to wireless local-area network (WLAN, which sells at less than $500,000 per data link). Frequencies of the different technologies travel between several hundred feet (wireless LAN) and 25 miles (MMDS).

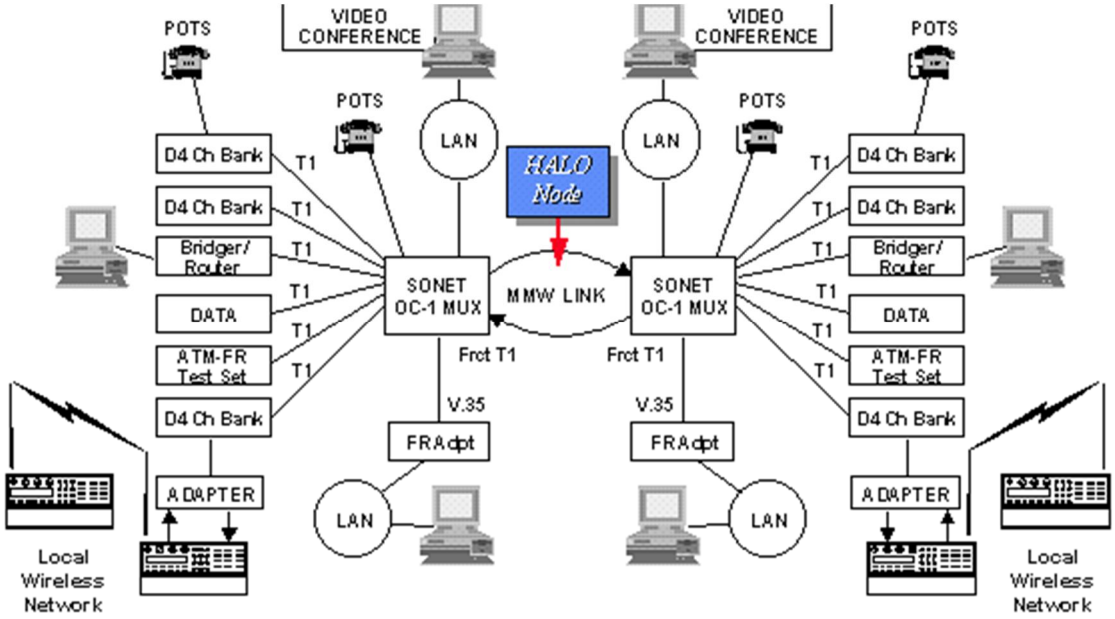


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The process by which radio waves are propagated through the air, the amount of data carried, immunity to interference from internal and external sources, and a host of other characteristics varies from technology to technology.

Wireless technologies are differentiated by the following:

Protocol - ATM or IP
Connection type - Point-to-Point (P2P) or multipoint (P2MP) connections
Spectrum - Licensed or unlicensed
The Base Station Used
The base station (also referred to as the hub or the cell site) is the central location that collects all traffic to and from subscribers within a cell. The indoor base station equipment consists of channel groups. The channel groups each connect to the existing network, typically with a DS-3 with ATM signaling. The function of the channel group is to effectively act as a high-speed radio modem for the DS-3 traffic. The outdoor base station equipment (Tx/Rx node) modules are located on a tower or a rooftop mount and consist of frequency translation hardware and transmitters/receivers. The Tx/Rx node delivers and collects all the traffic to and from subscribers within a cell or a sector. Additionally, the Tx/Rx node equipment translates the channel group output into the appropriate frequency for over-the-air transmission. Multiple channel groups are used in each sector to meet the traffic demands, thus providing a highly scalable architecture.



B. Access Networks

The access networks are the transport and distribution networks that bridge the premises network and the core network demarcation points. For purposes of this discussion, the primary means of providing the transport from an access network point-of-presence (POP) to the premises is radio and the distribution between access network POPs is either fiber or radio.

C. IP Point-to-MultiPoint Architecture

The point-to-multipoint (P2MP) system consists of a hub, or head end (HE), or a base station (BS), which serves several sectors in the cell. Each sector consists of one radio communicating with many customers.

The head end is an outdoor unit, or transverter, connected to a wireless modem card inside a Cisco UBR7246 or 7223 router.

At the customers' premises is another transverter, which is connected to a wireless network module in a router.

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Cisco P2MP objectives are these:

1) Integrated end-to-end solution (one box, one management and provisioning platform)
2) Complete multiservice offering (Voice over IP, data, Video over IP)
3) Scalability and flexibility (scalable head end and CPE offerings)
4) Enabled for non-line-of-sight (substantially better coverage)
5) Native IP packet transport
6) Part of an overall standards-based strategy to provide many Cisco hosts and many frequency bands on a global basis

The shared-bandwidth, or multipoint, product delivers 1 to 22 Mbps aggregate full-duplex, shared-bandwidth, P2MP fixed-site data in the MMDS band for both residential and small business applications.

Routing is Like a Postal System

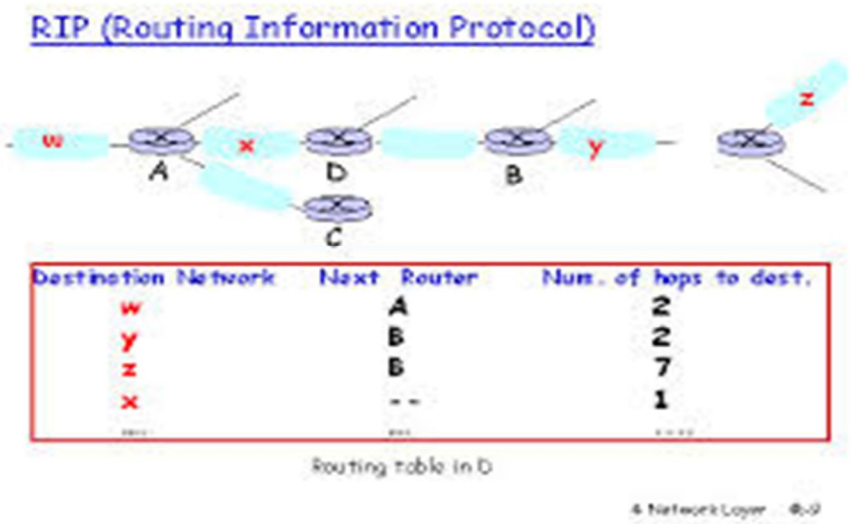
Routing between a LAN and a WAN is similar to a postal or courier . A packet travelling from Germany to Mexico travel through various other places before heading to its final destination. In such a case the router chooses shortest possible path.

Of all the possible routers it is aware of the information that which connections lead to particular groups of addresses.

Priorities for connections to be used Rules for handling both routine and special cases of traffic.

Routing tables are dynamic , they are updated by routing protocols such as Routing Information Protocol (RIP)

Or Open Shortest Path First (OSPF) that constantly passes the messages between the routers.

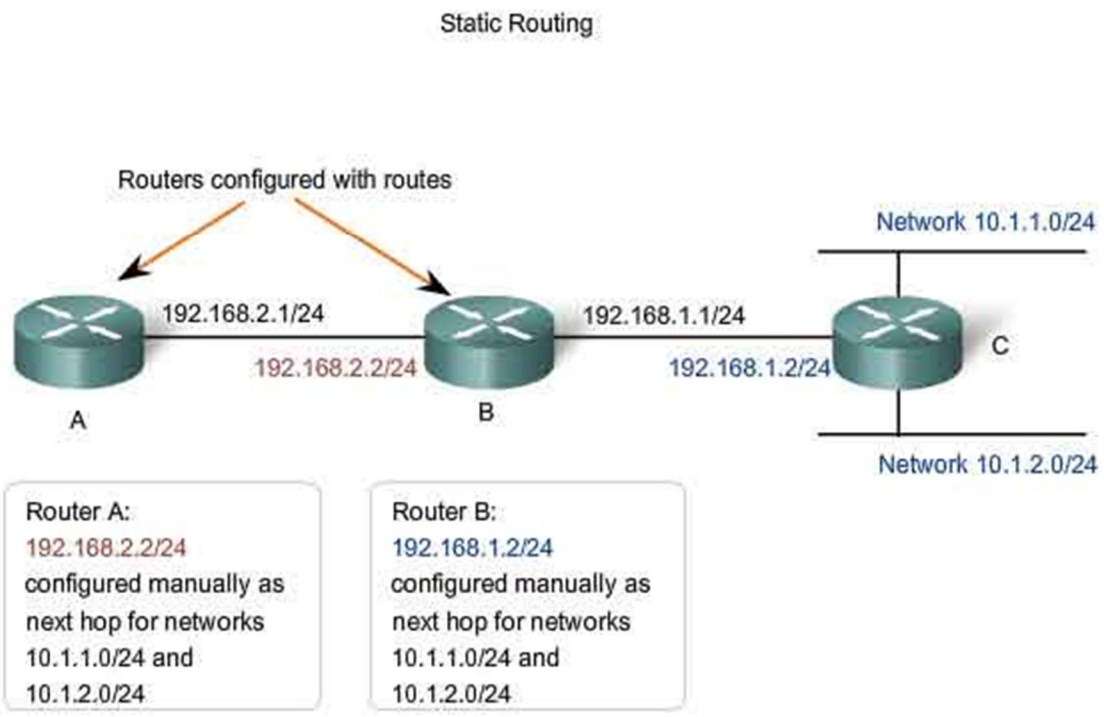


Further the above two ways of maintaining routing table entries on IP routers works as follows:

Manually—Static IP routers have routing tables that do not change unless manually changed by a network administrator. *Static routing* relies on the manual administration of the routing table. Remote network IDs are not discovered by static routers and must be manually configured. Static routers are not fault tolerant. If a static router goes down, neighboring routers do not sense the fault and inform other routers.

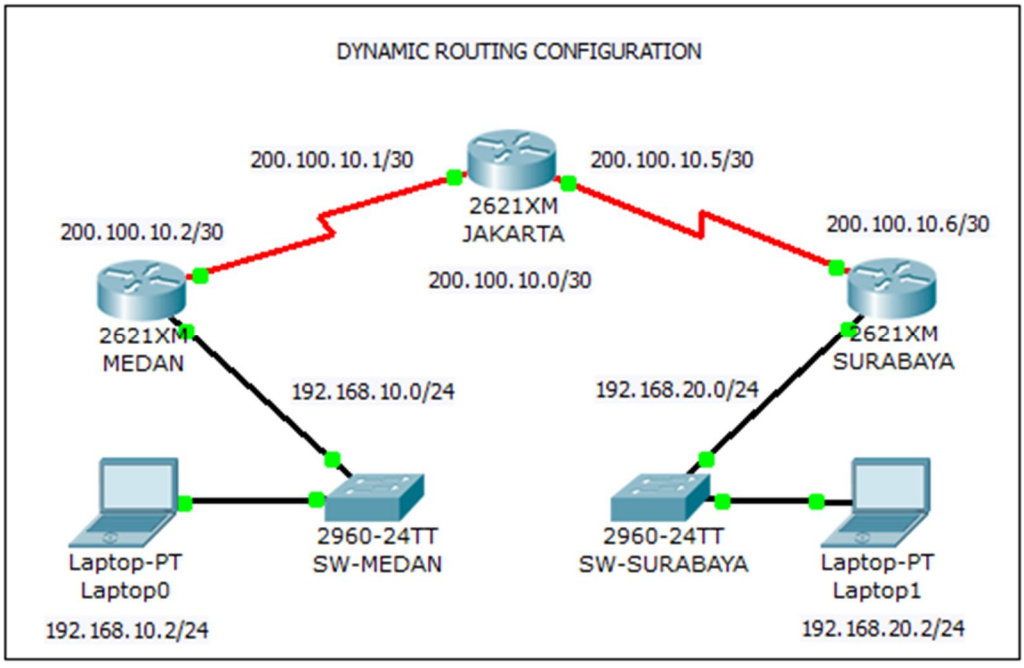
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Automatically—Dynamic IP routers have routing tables that change automatically based on the communication of routing information with other routers.

Dynamic routing employs the use of routing protocols, such as Routing Information Protocol (RIP) and Open Shortest Path First (OSPF), to dynamically update the routing table through the exchange of routing information between routers. Remote network IDs are discovered by dynamic routers and automatically entered into the routing table. Dynamic routers are fault tolerant. If a dynamic router goes down, the fault is sensed by neighboring routers who propagate the changed routing information to the other routers in the internetwork.



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D. The Need for Dynamic Routing

Residential Internet connections, whether broadband or dialup usually use dynamic IP addresses, while commercial leased lines and servers have static IPs, so they can always be reached at the same address.

The need for dynamic IP addresses arises from the limited number of IP addresses available in IPv4 (Internet Protocol version 4). Theoretically, there can be about four billion IPs in the Internet, however, the actual number is much lower for various reasons. Something had to be done to ensure supply of address space, at least until IPv6 is widely implemented on the Internet, allowing for 128bit IP addresses. The limited IP address space is one of the reasons for the wide use of NAT routers, as well as DHCP and leasing of dynamic IP addresses.

E. Ways to Convert from Dynamic to Static IP Addresses

Here are three different approaches you can use to move from using dynamic IPs, handed out by DHCP, to configuring static or permanent addresses:

1) *Reserve DHCP addresses on the router for select clients:* If your router has a DHCP reservation feature, this is a great way to quickly solve your IP dilemma. You don't have to physically configure each computer. You simply tell the router to always give a client a certain IP. Thus when the client polls the DHCP server when it connects to the network, it will automatically receive its reserved IP. Clients without a reservation will simply receive a random IP like normal. You might even think about doing this for all your computers and devices; it's quick and easy.
2) *Manually configure select clients with static IP addresses:* Do this only if select devices and computers need a static IP and the other ones can use DHCP. You'd have to take a minute or two and input the IP details into the desired computer(s). It's not as quick to go this route with multiple computers; however, you don't have to access the router. Even regular network users have the ability to do this, given that they have administrative rights on their Windows account or at least the ability to edit network settings.
3) *Manually configure all clients and disable DHCP on the router:* This is similar to the above approach but requires you or the users to manually configure any device that connects to the network. This is great if you find it beneficial that all the computers and devices have a permanent IP address. Just keep in mind that you'll need to manage these addresses.

F. Uses Of Static IP Routing

1) Providing ease of routing table maintenance in smaller networks that are not expected to grow significantly.
2) Routing to and from a stub network, which is a network with only one default route out and no knowledge of any remote networks.
3) Accessing a single default route (which is used to represent a path to any network that does not have a more specific match with another route in the routing table).

1) Easy to implement in a small network.
2) Very secure. No advertisements are sent, unlike with dynamic routing protocols.
3) It is very predictable, as the route to the destination is always the same.
4) No routing algorithm or update mechanisms are required. Therefore, extra resources (CPU and memory) are not required.

G. Benefits of Dynamic IP Routing Over Static IP Routing

1) A dynamically routed network can grow more quickly and larger, and is able to adapt to changes in the network topology brought about by this growth or by the failure of one or more network components.
2) Routing tables can contain directly connected, manually configured static routes and routes learned dynamically using a routing protocol. Network professionals must understand when to use static or dynamic routing. This section compares static routing and dynamic routing.
3) Dynamic routing protocols help the network administrator manage the time-consuming and exacting process of configuring and maintaining static routes.
4) Dynamic routing protocols work well in any type of network consisting of several routers. They are scalable and automatically

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determine better routes if there is a change in the topology.

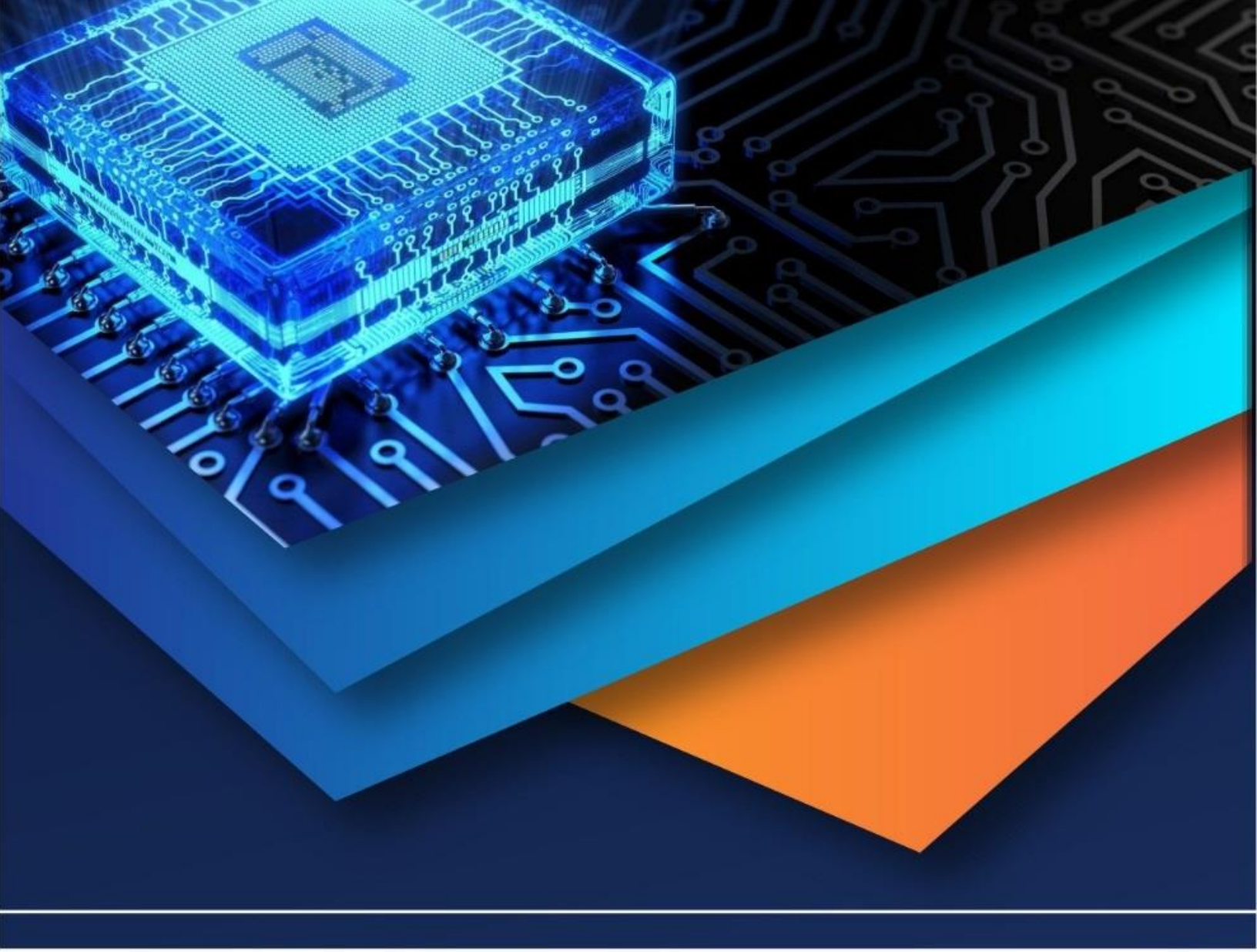
5) Generally independent of the network size.

The ability to learn about changes to the network's configuration has implications beyond adding new segments or moving old ones. It also means that the network can adjust to failures. If a network has redundant paths, then a partial network failure appears to the routers as if some segments got moved (they are now reached via alternate paths), and some segments have been removed from the network (they are now unreachable). In short, there's no real difference between a network failure and a configuration change. Dynamic routing allows the network to continue functioning, perhaps in a degraded fashion, when partial failure occurs.

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