Computer Network Laboratory

- Notes from the first 8 Experiments -

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اللّهم علّمنا ما ينفعنا، وانفعنا بما علّمتنا، وزدنا علماً.

Exp #1

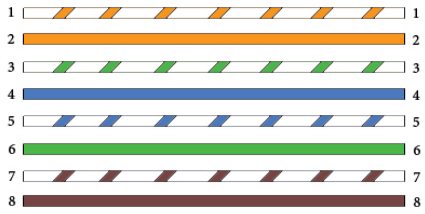
❖ Network cables

- Unshielded twisted pair
- Shielded twisted pair
- Coaxial cable
- Fiber optic.

Type	Max distance	Bandwidth	Noise effect	Cost
Twisted pair	100 m	Up to 1-100 MHz	High noise	Cheap
Coaxial	100 m	Up to 3 GHz	Medium noise	Moderate
Fiber Optics	100 km	Up to THz	Less Nosie	Expensive

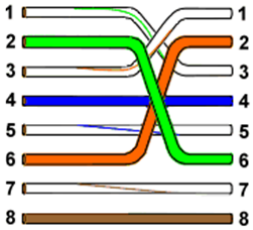
❖ Cable connections

❖ Straight through cable (for dissimilar devices e.g. switch-router, pc-switch …)
This would be an Ethernet- only cable and would not work with Voice, Token Ring, ISDN, etc.



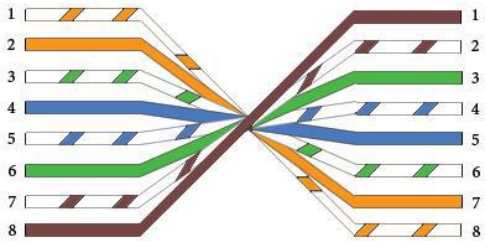
Note that only pins 1, 2, 3, and 6 are used. Just connect 1 to 1, 2 to 2, 3 to 3, and 6 to 6, and you will be up and networking.

❖ Cross-over cable (for similar devices and with some exceptions [switch and hub, Router and PC])



connect 1 with 3 and 2 with 6 in both sides.

❖ Roll-over cable (to connect the router/switch to the PC via console port for management purposes)



Notice that the left wire colors are the same as the Straight through cable.

This part is called an “RJ45” connecter.

- To check network interface card (NIC) in a pc → “Ping 127.0.0.1” This is the diagnostic or loopback address, or type “Ping localhost”.

- Note that newly Operating systems and computers nowadays detect the cable types, so now there is no need to care a lot about the cable type.

❖ Commands

❖ IPCONFIG Command

This command is used to get IP configurations present in your PC.

❖ PING Command

This command is used diagnostically to ensure that a host computer you are trying to reach is exist, can accept requests and is actually operating.

❖ Mention the difference between fragmenting and non-fragmenting packets.

Fragmentation: Breaks down large packets into smaller fragments that are transmitted separately and reassembled at the destination. It adds overhead and can degrade performance.

Non-Fragmentation: Ensures packets are sent as a whole without being split, relying on mechanisms like PMTUD to adjust packet size. It avoids fragmentation overhead but requires careful management of packet sizes.

❖ TRACERT Command

This command is used to determine which way does the data (packet) goes and through which devices.

In UNIX machines it is called **traceroute**, in Windows machines it is called **tracert**.

- Enhanced Ping

  TJPing is a fast, multithreaded ping/lookup/traceroute utility for Windows (95/98/Me/NT/2000/XP). It's fully configurable, remembers settings between sessions, and allows users to log results to a file of their choice.

- NETSTAT Command

  This command is used to get information about the open connections on your system (ports, protocols being used, etc.), incoming and outgoing data and also the ports of remote systems to which you are connected.

- How can two computers be connected without using hub or switch?

  Using cross-over cable.

Extra

- Subnetting

Subnet	1	2	4	8	16	32	64	128	256
Host	256	128	64	32	16	8	4	2	1
Subnet Mask	/24	/25	/26	/27	/28	/29	/30	/31	/32

Watch this video for a good understanding: https://www.youtube.com/watch?v=ecCuyq-Wprc&t=544s

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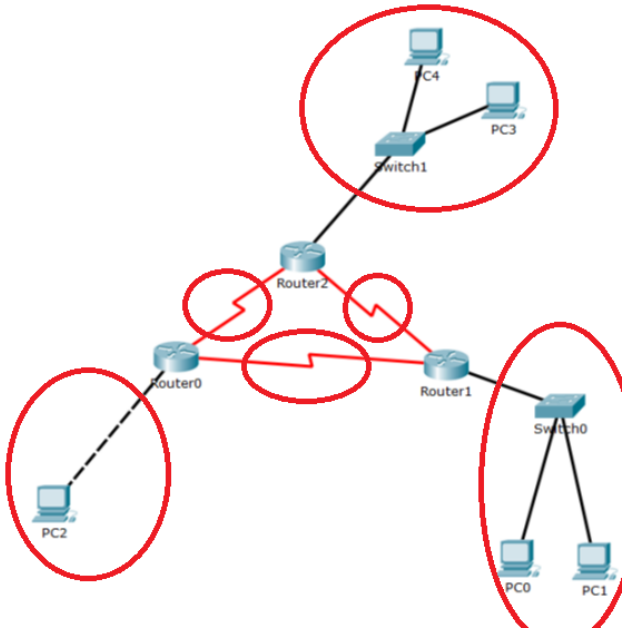
- Address classes

Address Class	IP Range	Bits for Subnet Mask	Subnet Mask
Class A	**1.0.0.1 – 126.255.255.254**	**Left most 8 bits**	**255.0.0.0**
Class B	**128.0.0.1 – 191.255.255.254**	**Left most 16 bits**	**255.255.0.0**
Class C	**192.0.0.1-223.255.255.254**	**Left most 24 bits**	**255.255.255.0**

127.0.0.0/8 is reserved for loopback addresses - it is used for testing purposes.



There are 6 subnets in this topology.

OSI model layers.

Layer	Examples	Functions	Data to be sent	
Application Layer 7	**FTP DNS SMTP HTTP**	**Services used with end users' applications**	**Data**	**Hosts Layers (between hosts)**
Presentation Layer 6	**JPG, GIF SSL (HTTPS)**	**Formats the data to be viewed Encryption/decryption (security)**	**Data**	
Session Layer 5	**H322 that used for VOIP**	**Manage end-to-end connection between hosts**	**Data**	
Transport Layer 4	**TCP UDP**	**Ensure delivery of entire message**	**Segments**	
Network Layer 3	**IP RIP**	**Routing→path Forwarding→interface**	**Packets**	**Media Layers (over Network)**
Data Link Layer 2	**Ethernet MAC ARP**	**Physical addressing (MAC) Flow control**	**Frames**	
Physical Layer 1	**(Transmission media) Ethernet DSL**	**Signal Transmission**	**Bits**	

Some examples of each layer should be known for exam.

- Why layering
  - Troubleshooting: easier.
  - Change: change in one-layer, other layers are not affected.
  - Design: division into layers makes the solution much simple.
  - Learning: understanding the network communication as layers is easier.

EXP #2 - Static Routing

When devices are connected through a switch (one network), packets are transferred without the need for routing protocols. However, if routers are used to connect networks to each other, routing protocols are required to transfer packets from one network to another.

❖ Router's main job

Router's main role is to route packets to the correct destination. Traditionally the router is called a layer-3 device, therefore it uses the IP address (layer-3 address. Each network is called a segment (subnet). May be the main reason for having subnets is to control the traffic. Based on routing information (routing table) a router can determine the next node toward the destination. The router uses the destination IP address of the packet to find the correct path.

❖ Cisco routers

The Cisco Internetwork Operating System (IOS) is the kernel of Cisco routers and most switches. IOS was created to deliver network services and enable networked applications.

The important things that the Cisco router IOS software is responsible for:

- Carrying network protocols and functions.
- Connecting high-speed traffic between devices.
- Adding security to control access and stop unauthorized network use.
- Providing scalability for ease of network growth and redundancy.
- Supplying network reliability for connecting to network resources.

❖ Connecting to a Cisco Router

There are different ways to connect to a Cisco router to configure it, verify its configuration, and check statistics.

- The console port

  The console port is usually an RJ-45 connection located at the back of the router -by default, there is no password set. A password can be set by "line console 0" command. The console port is utilized when in close physical range of the router.

- Auxiliary port

  A cisco router can be connected through an auxiliary port. it allows to configure modem commands so that a modem can be connected to the router. Aux port is often used for connecting a modem to provide remote access to the router.

- Telnet

  The third way to connect to a Cisco router is in-band, through the program. Telnet is a terminal emulation program that acts as though it is a dumb terminal. Telnet can be used to connect to any active interface on a router like an Ethernet or serial port.

❖ Routing

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. To be able to route packets, a router must know, at a minimum, the following:

- Destination address.
- Neighbor routers.
- Possible routes to all remote networks.
- The best route to each remote network.
- How to maintain and verify routing information.

❖ Types of routing

There are two main types of routing protocols, static and dynamic.

In static routing, it is the role of the administrator to update the router with new routing information (add segment or remove a segment).

- Pros of static routing:
  - There is no overhead on the router's CPU, meaning a cheaper router can perform the job effectively compared to using dynamic routing.
  - There is no bandwidth usage between routers, this means that money could potentially be saved on WAN links.
  - It adds security because the administrator can choose to allow routing access to certain networks only.

- Cons of static routing:
  - The administrator must really understand the internetwork and how each router is connected in order to configure routes correctly.
  - If a network is added to the internetwork, the administrator has to add a route to it on all routers -by hand.
  - It is not feasible for large networks because maintaining it would be a full-time job in itself.

In Dynamic routing the routing information will be updated automatically. A protocol on one router communicates with the same protocol running on neighbor routers.

❖ CLI modes

- User mode (Router>): is mostly used to view statistics, but it is also a stepping-stone to logging into privileged mode by typing “enable”.
- privileged mode (Router#): is used to view and change the configuration of a Cisco router.
- global configuration mode (Router (config)#): At this point, you make changes that affect the router as a whole.

❖ Telnet and passwords

As mentioned before, Telnet is a terminal emulation program that acts as though it is a dumb terminal. Telnet can be used to connect to any active interface on a router like an Ethernet or serial port.

Telnet is not enabled by default; to enable it with a password, the following commands must be typed in configuration mode

```
Router(config)# line vty 0 4
Router(config-line)# password (any password)
Router(config-line)# login
Router(config-line)# exit
Router(config)# enable secret (password 2)
```

After this, Telnet will be enabled on the router's interfaces, and the specified password will be required for access. Password 2 is required when typing "enable".

الجزء العملي

راح يكون الشرح في الأجزاء العملية بالعربي؛ عشان أسرع وأوضح.

الفكرة من هاي التجربة إنه نخلي الراوترز يتواصلوا مع بعض، طب كيف ممكن اعمل هيك؟ عن طريق الراوتنج برتوكولز. إذا كان عنا أكثر من شبكة، لابد من استخدام طريقة عشان نعرّف كل راوتر إنه إذا أجى الباكيت الفلاني من الراوتر الفلاني وجّهلي إياه إلى المكان الفلاني.

طبعاً عشان نبدأ في هاي التجربة، أول اشي لازم أعمله إنه أعطي (اي بي) لكل جهاز من الأجهزة، وكذلك لكل انترفيس بدي أستخدمه في الراوترز ولازم ما أنسى إنه أفعّل هذا الانترفيس.

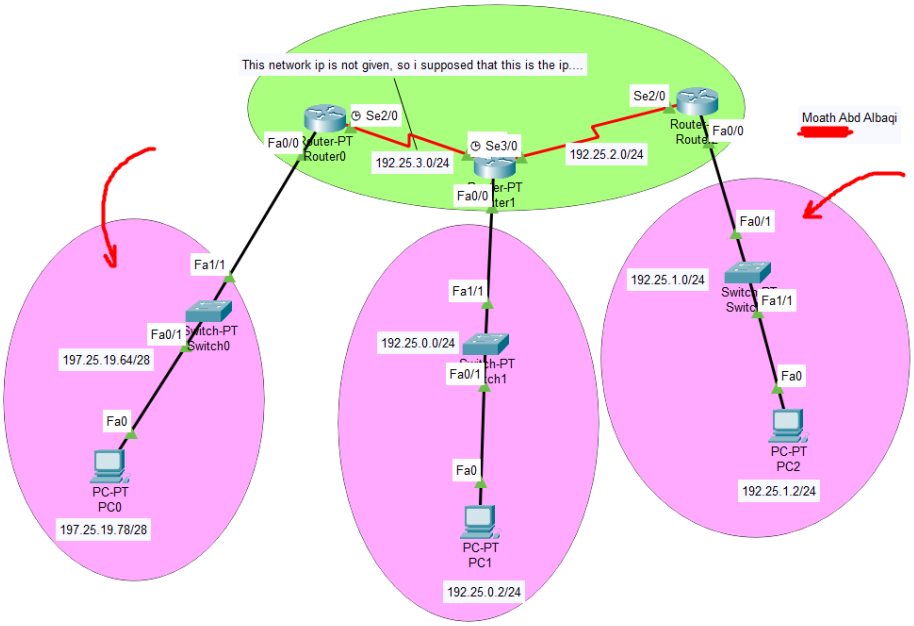
هسا بدي أعرّف ال(راوتنج بروتوكول) على كل الراوترز – في حالتنا هون (ستاتك راوتنج)، عن طريق هذا الكوماند.

```
Router(config)# ip route <destination_network> <mask> <next-hop_address>
```

معنى هذا الكوماند: إذا أجت أي باكيت على هذا الراوتر بدها تروح على الشبكة الي هي destination_network مع ال(سبنت) تبعها، ارسلها عن طريق next-hop_address إلّي هو بمثّل الانترفيس القادمة إلّي راح يتوجهلها.

موضوع تفعيل ال (telnet) ووضع باسوورد وما إلى ذلك، تمت تغطيته في الصفحة السابقة.

في ملاحظة مهمة حابب أنوّهلها، إذا طلب منكم إنّو تزبّطوا الroutingبحيث إنكم ترسلوا من اليمين للشمال



هسا هون فش طريق مباشر بين اليمين والشمال، فا بنضطر أنه نعمل ال Routing على أكثر من مرحلة أول إشي بحط إنه أي بكت من اليمين اذا بده يوصل الشمال، ارسله عن طريق الانترفيس القريبة على اليمين (الراوتر الي بالنص)، ومن ثم على الراوتر الي بالنص، بحط انه اي بكت بدها توصل إلى الشمال، تروح عن طريق الانترفيس الي على الشمال (الراوتر إلّي على الشمال)، وبهيك بصير اي بكت من اليمين بده يروح على الشمال يمر بالراوتر الي بالنص، وهذا الراوتر بوجّهه إلى الطريق الصحيح.

EXPs #3-4-5 - Dynamic Routing

❖ Dynamic routing classification

- Interior and exterior gateway routing protocols: Interior protocols include RIP, EIGRP and OSPF. Exterior protocols include BGP.
- Distance vector, path vector and link state routing protocols: RIP and EIGRP are distance vector. BGP is path vector. OSPF is link state.
- Classful and classless: RIP and EIGRP [1] are classful while OSPF is classless.

❖ Differences between Interior and exterior gateway routing protocols

Interior gateway routing protocols are used for routing inside the same autonomous system (AS), while exterior gateway routing protocols are used for routing between different ASs.

❖ Differences between Distance vector, path vector and link state routing protocols

In distance vector routing Protocols at the beginning each node (router) has only routing information about its direct neighbors. Each router broadcast periodically its routing information to its neighbors. This way, eventually, each node will get information about the entire network. This is called routing by rumor, because a router receiving an update from a neighbor router believes the information about remote networks without finding out for itself.

link-state routing protocol calls for sending of link-state advertisements (LSAs) to all other routers within the same area. As OSPF routers accumulate link-state information, they use the shortest path first algorithm (SPF) -Dijkstra's algorithm- to calculate the shortest path to each node. Then, they share this information with the entire area.

Path vector protocols determine the best path based on the sequence of autonomous systems (ASs) that data must pass through to reach a destination. The entire path (AS path) is considered when making routing decisions.

❖ Differences between classful and classless

In classful routing, all subnet masks must be the same across all devices in the network. In classless routing, the subnet masks can differ.

❖ Administrative distance (AD)

The administrative distance (AD) is used to rate the trustworthiness of routing information received on a router from a neighbor router. It is an integer from 0 to 255, where 0 is the most trusted and 255 means no traffic will be passed via this route. If a router receives two updates listing the same remote network, the first thing the router checks is the AD. If one of the advertised routes has a lower AD than the other, then the route with the lowest AD will be placed in the routing table. If both advertised routes to the same network have the same AD, then routing protocol metrics (such as hop count or bandwidth of the lines) will be used to find the best path to the remote network. The advertised route with the lowest metric will be placed in the routing table. But if both advertised routes have the same AD as well as the same metrics, then the routing protocol will load-balance to the remote network (which means that it sends packets down each link).

[1]: According to Wikipedia, IGRP is classful while EIGRP is classless. However, the manual indicates that EIGRP is classful.

Administrative Distance table

Route Source	**Administrative Distance (AD)**
Connected interface (directly)	0
Static route	1
External BGP	20
EIGRP	90
IGRP	100
OSPF	110
RIP	120
Internal BGP	200

The administrative distance of static routes can be changed.

- Routing Information Protocol (RIP)

  It uses only hop count to determine the best path to a network. If RIP finds more than one link to the same remote network with the same hop count, it will automatically perform round-robin load balancing. RIP can perform load balancing across up to six equal-cost links (four by default). It has a maximum hop count of 15 hops.

- Enhanced Interior Gateway Routing Protocol (EIGRP)

  EIGRP is a Cisco-proprietary distance-vector routing protocol. This means that all your routers must be Cisco routers to use EIGRP in your network.
  Cisco created this routing protocol to overcome the problems associated with RIP. EIGRP has a maximum hop count of 255 with a default of 100. This is helpful in larger networks and solves the problem of 15 hops being the maximum possible in a RIP network.
  EIGRP uses bandwidth and delay of the line by default as a metric for determining the best route to an internetwork. This is called a composite metric. Reliability, load, and maximum transmission unit (MTU) can also be used, although they are not used by default.
  The main difference between RIP and EIGRP configuration is that when configuring EIGRP, the autonomous system number is required. All routers must use the same number in order to share routing table information.
  Here is a list of EIGRP characteristics that you won't find in RIP:

  - EIGRP can be used in large Internetworks.
  - EIGRP uses an Autonomous System number for activation.
  - EIGRP gives a full route table update every 90 seconds.
  - EIGRP uses bandwidth and delay of the line as metric (lowest composite metric).

❖ Open shortest path first (OSPF)

OSPF allows packet authentication and uses IP multicast when sending/receiving packets. it has two primary characteristics, the first is that the protocol is open. The second is that it is based on SPF algorithm (Dijkstra algorithm).

OSPF is the routing protocol of choice when:

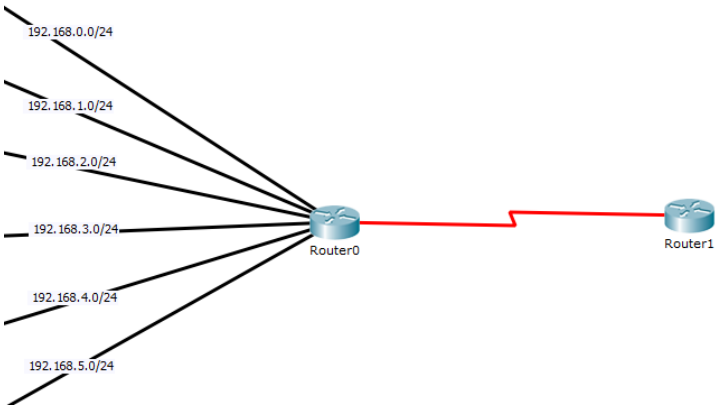
- There are routers from vendors other that Cisco in the network.
- The network requires segmentation into areas or zones.

OSPF uses bandwidth as metric (cost). It uses a reference bandwidth of **100 Mbps** for cost calculation (fixed). The formula to calculate the cost is reference bandwidth divided by interface bandwidth $cost = \frac{100Mbps}{BandWidth\ of\ the\ link}$. Thus, a 100Mbps link has a metric of 1; a 10Mbps link has a metric of 10; a 1Gbps (or faster) link also has a cost of 1 because the cost cannot be lower than 1. The cost for each link in the path is added together to form a metric for the route.

➢ Route Summarization

Route summarization is the process of replacing a series of routes with a summary route and a mask. This lessens the size of routing update packet itself and makes the routing table smaller, yet still allow for complete IP connectivity when done correctly. In, the 6 more specific routes in router 0 as shown in the Figure bellow (i.e. 192.168.0.0/24, 192.168.1.0/24, 192.168.2.0 …. and 192.168.5.0/24) can be replaced by two summary routes which are 192.168.0.0/22 and 192.168.4.0/23.

Not that we cannot replace the 6 networks using 21 subnet mask and id 192.168.0.0/21 with one subnet because this network includes smaller subnets that are not connected to router 1 as 192.168.6.0/24 and 192.168.7.0/24.



- Routing Hierarchy

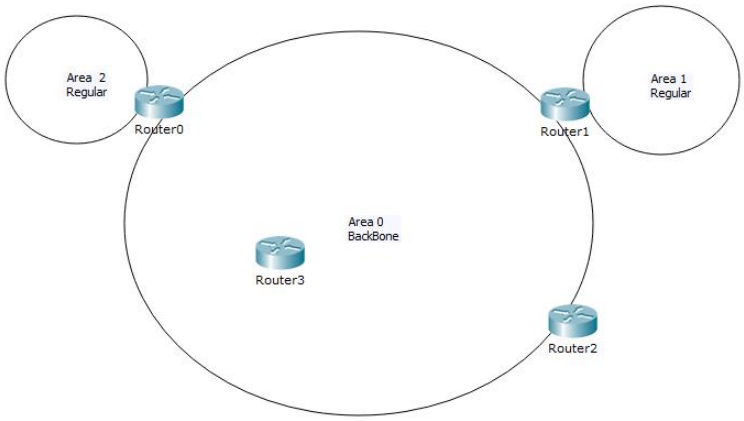
  Unlike RIP, OSPF can operate within a hierarchy. The largest entity within the hierarchy is the autonomous system (AS), which is a collection of networks under a common administration that share a common routing strategy.

  An AS can be divided into a number of areas, which are groups of contiguous networks and attached hosts. Routers with multiple interfaces can participate in multiple areas. These routers, which are called Area Border Routers (ABRs), maintain separate topological databases for each area.

  An area's topology is hidden from entities outside it, reducing OSPF routing traffic. OSPF uses intra-area routing when the source and destination are within the same area, and inter-area routing when they are in different areas.

  An OSPF backbone which is called **area 0** is responsible for distributing routing information between areas. It consists of all area border routers, networks not wholly contained in any area, and their attached routers shows an area design diagram.

  The backbone area forms the central hub of an OSPF network. All other areas are connected to it, and inter-area routing happens via routers connected to the backbone area and to their own non-backbone areas. The backbone must be adjacent to all other areas, but does not need to be physically contiguous. All OSPF areas must connect to the backbone area. This connection, however, can be through a virtual link.



- OSPF Neighbor Relationships

  Hello messages are sent on chosen interfaces once every 10 seconds on broadcast/point to point networks.

- Router ID

  If there are no loopback IPs on the router, the router ID will be the highest IP address of any active interface. However, if the router has loopback IPs, the router ID will be the highest loopback IP address.

❖ Border Gateway Protocol (BGP)

BGP Version 4 (BGPv4) is the current standard deployment. it is the routing protocol of choice on the Internet. Essentially, the Internet is a collection of interconnected Autonomous Systems. Its Autonomous Systems are assigned an Autonomous System Number (ASN), which is a 16-bit number ranging from 1 – 65535. A specific subset of this range, 64512 – 65535, has been reserved for private (or internal) use.
BGP's true benefit is in controlling how traffic enters the local AS, rather than how traffic exits it.

For BGP to function, BGP routers (called speakers) must form neighbor relationships (called peers).
There are two types of BGP neighbor relationships:

- **iBGP** Peers – BGP neighbors within the same autonomous system.
- **eBGP** Peers – BGP neighbors connecting separate autonomous systems.

Once BGP peers form a neighbor relationship, they share their full routing table. A Cisco router running BGP can belong to only one AS. The IOS will only allow one BGP process to run on a router.

➢ BGP Peers Messages

BGP forms its peer relationships through a series of messages listed below:

- **OPEN message**: it is sent between peers to initiate the session. The OPEN message contains several parameters:
  - BGP Version – must be the same between BGP peers.
  - Local AS Number.
  - BGP Router ID.

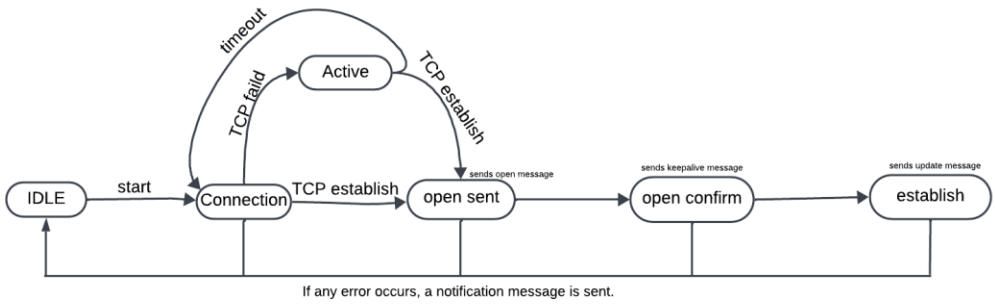
- **KEEPALIVE messages:** these are sent periodically (every 60 seconds by default) to ensure that the remote peer is still available. If a router does not receive a KEEPALIVE from a peer for a Hold-time period (by default, 180 seconds), the router declares that peer dead. To globally adjust the KEEPALIVE and Hold-time timers for all neighbors:

```
Router(config-router)# timers bgp <KEEP-ALIVE> <HOLD-TIME>
```

- **UPDATE messages:** these are used to exchange routes between peers.

- **NOTIFICATION messages:** are sent when there is a fatal error condition. If a notification message is sent, the BGP peer session is torn down and reset.

➢ BGP Finite-State Machine (FSM)



If a peer session is stuck in an Active state, potential problems can include: no IP connectivity, an incorrect neighbor statement, or an access-list filtering TCP port 179.

الجزء العملي

الفكرة من التجارب هذول انه عنا Dynamic Routing Protocols يعني فش داعي نعمل كلشي مانيوال.

RIP and EIGRP -1

اذا بدنا نعمل Dynamic routingباستخدام هذول الProtocols أول اشي لازم احط هذا الكوماند حسب اي نوع بدي استخدمه

```
Router(config)# router rip
```

```
Router(config)#  router EIGRP <AS>
```

بعدين بضيف كل ال Networksالي مشبوكات على هذا الراوتر حتى الاسلاك إلّي بين الراوترز عن طريق هذا الكوماند

```
Router(config-router)# network <ID-OF-CONNECTED-NETWORKS>
```

OSPF -2

بدنا نعرف هون إنه في اشي اسمه Backbone areaهاي إلها ID = 0، هاي هي المنطقة إلّي كل الباكتس بترجعلها عشان تنتقل من شبكة إلى شبكة أخرى، فا هي بتكون الشبكة الي بتربط كل الشبكات ببعض، والشبكات الثانية بكونلها ID مختلف عن الصفر أو ممكن نحط الشكل كامل في ال Area 0 وخلص (هيك اللاب مانيوال عامل في التجارب القادمة).

عشان أطبّق الOSPF على الرواترز بستخدم هذا الكوماند

```
Router(config)#router ospf <PROCESS-ID>
```

بعدين ببلّش أضيف الشبكات المجاورة زي التجربة إلّي قبل ولكن مع إضافة بعض المعلومات، عن طريق هذا الكوماند

```
Router(config-router)#network <NETWORK-ID> <OSPF-WILDCARD-BITS> area <AREA-ID>
```

طبعاً زي ما بتعرفوا إنه الWILDCARDبِنكَتَب عكس الSubnet mask

إذا كان في loopback لازم نضيفهم على الOSPF في نفس الراوتر فقط.

لتغيير ال Cost تبع Linkمعيّن، عن طريق أحسب ال Cost عن طريق المعادلة التي تم ذكرها سابقاً ومن ثم تطبيق هذا الأمر على ال Interface المراد التعديل عليه

```
Router(config-if)#bandwidth <BANDWIDTH-IN-KILOBITS>
```

بالنسبة لموضوع ال Summarization شوفوه من اللاب مانيوال، بسيط ان شاء الله.

BGP -3

هون النظام مختلف شوي، أول اشي بدنا نعرّف OSPFداخل كل antonyms systemsوطبعاً ما بنشمل الlink إلّي بين الantonyms systems وهذا بكون للتخاطب الداخلي زي ما تعملنا سابقاً.

بعدين بروح على الراوترز إلّي على الأطراف عشان أعرّف عليهم الBGP عن طريق هذا الكوماند

```
Router (config)# router bgp <AS-NUMBER>
```

AS-NUMBERهون بتمثّل رقم الAutonyms system إلّي الراوتر بكون فيها.

بعدين بدنا نعرّف الجيران تبعونه عن طريق هذا الكوماند

```
Router(config-router)# neighbor <IP-ADDRESS-NEXT-INTERFACE> remote-as <AS-OF-REMOTE-NEIGHBOR>
```

هسا المفروض إنه الإشي يكون جاهز، ولكن ظل إنه نعمل طريقة تواصل بين الOSPF and BGPلانه هذولTwo different protocols لازم يكون طريقة تواصل بيهم، عن طريق هذا الكوماند لما نكون داخلين على الOSPF

```
Router(config-router)# redistribute bgp <AS-NUMBER> subnets
```

وهذا الكوماند لما نكون داخلين على الBGP

```
Router(config-router)# redistribute ospf <PROCESS-ID>
```

EXP #6 - Access Control Lists

For this experiment, Dr. Ibrahim sent us these slides: (https://drive.google.com/file/d/1jaznkpEmGPIEAyNjC_eCTr4OUWNcMDGe/view?usp=sharing). They are very useful and helpful, check them.

الجزء العملي

هون بدّي بس أنوّه على ملاحظة مهمة جداً، حط في بالك إنه عند تنفيذ الAccess control entries ببلش تنفيذهم من فوق إلى تحت على الترتيب، فا الترتيب هون مهم جداً، **خلّي الإشي الخاص بالأوّل ثمّ الإشي العام**.

EXPs #7-8 - Vlans

For this experiment, only the practical part is included – check the theoretical part in the lab manual.

الجزء العملي

الخطوات العامّة إذا كان مطلوب منّي أعمل vlans:

1- أعرّف ال Trunk ports for switches ، وهم أي مدخل مهوش مشبوك على End device .

2- أعرّف البورتس المستخدمة في الراوترز، إذا كان البورت بشبك بين راوترز بس، بنعطيه IP عادي زي ما كنا نعمل زمان، ولكن إذا البورت كان مشبوك على switch وعليه vlans ، بدخل على ال Virtual interface عن طريق كتابة Interface <IntName>.<sub interface number> ، بعدها مهم جداً اكتب مباشرة هذا الكوماند encapsulation dot1Q <VLAN-ID> ال VLAN-ID وال Sub interface number مش شرط يكونوا نفس الرقم، المهم إنه نخلي ال VLAN-ID نفس إلّي موجودة على ال topology وبعدين بعطي IP address لهذا ال interface، هذا ال IP address راح يكون gateway لبعض الاجهزة، فا إنزل وحطه مكان ال gateway في هذه الأجهزة. ومن ثم بعمل ال Routing Protocol المطلوب زي ما تعلمنا سابقاً، وما تنسى تحط كل vlan كشبكة لحال في هذا البروتوكول.

3- بنزل على ال switches ، بعرّف كل ال vlans إلّي بالشبكة **كاملة**، عشان ممكن يمر باكيت من هاي ال vlan على هذا السويتش، عن طريق ال commands ، Vlan <vlanID> then exit and repeat for all vlans . وظل أعرّف كل interface للسويتش ايش ال vlan المشبوك عليها عن طريق هذا الكوماند Switchport access vlan <vlanID>.

4- في حالة ال Multilayer switch ، بعمل نفس الخطوات إلّي فوق مع شوية فروقات ألا وهي إنه أول اشي بدي أخلّي الجهاز هذا يشتغل كراوتر عن طريق ادخل على ال Interface المعني، وأعطيه هذا الأمر No switchport ، وثم أعطيه IP address . ويكمن اختلاف بسيطة في تعريف ال vlans، بكتب interface vlan <VlanID> وبعدين بعطيه IP.

لتفعيل ال Routing Protocols عليه، بكتب أمر واحد وهو Ip routing ، ومن ثم بعمل Configuration to any Routing protocol.

وهيك بكون التلخيص جاهز بإذن الله، بالنسبة لآخر تجربتين سهلات كثير ان شاء الله، يعني ما بوخذوا معكم وقت في دراستهم من المانيوال، لا تنسونا من صالح دعائكم، بالتوفيق.

والحمدلله رب العالمين