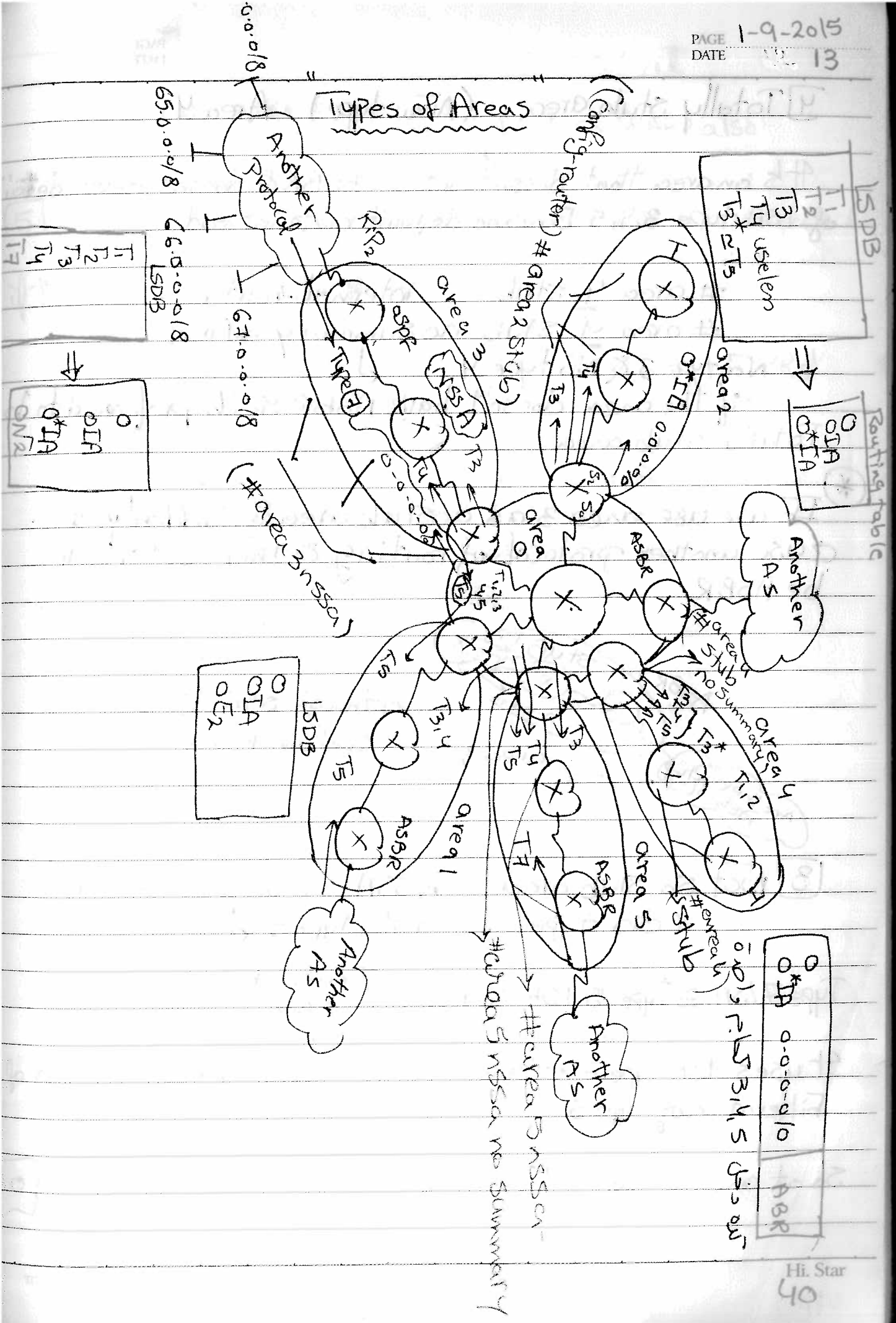


Types of Areas



* Types of areas

1] Backbone area "transit area" "From the figure" Area 0

It accepts all types of LSAs T1 → 5.

2] Ordinary area "normal area" Area 1

It accepts type 1, 2, 3, 4, 5 LSA.

Type 1, 2 → its own area

3, 4 → From other areas

5 → " another AS

3] Stub area (old type) Area 2

- It's an area that can't contain ASBR.

(config) # router ospf 50

network 50.0.0.0 area 0

(config-router) # area 2 stub

2 cmds = 2

- It doesn't accept type 5 LSA "Filteration"
 database, RTables

area 0 through ABR will send O*IA 0.0.0.0/0 of T5 to make area 2 know T5

- It uses default route instead T3* = T5 0.0.0.0/0

4] Totally stub area (New type) Area 4

It's an area that doesn't contain ASBR & doesn't need details of LSA type 3, 4, 5 By using default route instead.

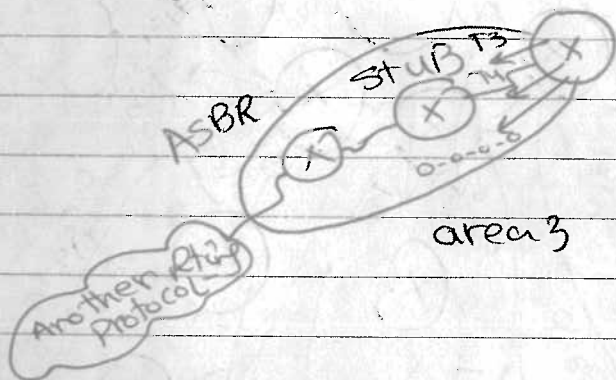
area 4 stub internal routers

area 4 stub no summary → ABR

No type 3 & No type 4 ↓

if the area doesn't have ASBR so it's preferred to be Totally stub area.

* If we use area 3 as a stub area & suddenly we use another protocol of routing & this router will be ASBR



Although stub doesn't contain ASBR.

3] Not so stub area = NSSA "Stub area + ASBR"
(old type) Filter type 5 ↓

Type 7 LSA ≅ Type 5 LSA in NSSA { Network
Mask
Cost

It uses LSA type 7 external routes injected in NSSA instead of Filteration of type 5

So at area 0 type 7 by binary will be changed to type 5 [052]

router ospf 50 }
area 3 nssa } in all routers & ABR also

[5] Totally NSSA Recommended "New type" area 5
if there ASBR & totally stub

totally stub + ASBR NSSA → ASBR
no T3,4,5 yes Type 7

area 5 nssa no-summary → ABR
area 5 nssa ASBR & other routers

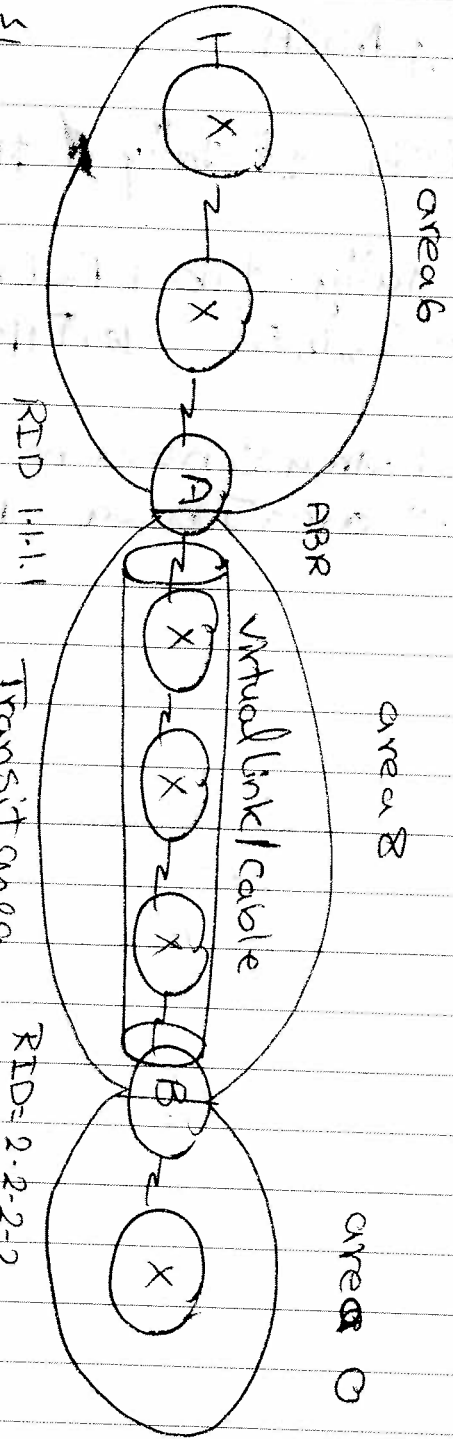
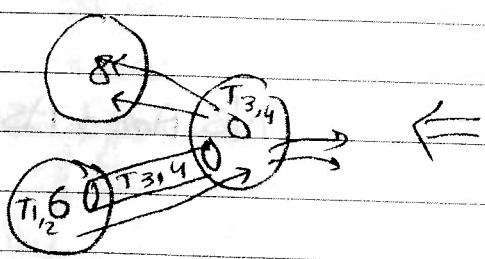
"In Lab Exam"

OSPF virtual Link: "OSPF virtual tunnel"

→ To connect both area 6 & area 0

Just to be only transit area.

by opening a tunnel virtually betⁿ area 6 & 0 (in area 8 the tunnel)



* So by Configuration

→ On area 8 ABR (A)

router ospf 50

area 8 virtual-link other RID

Transit=0

2-2-2-2

→ On area 8 (B)

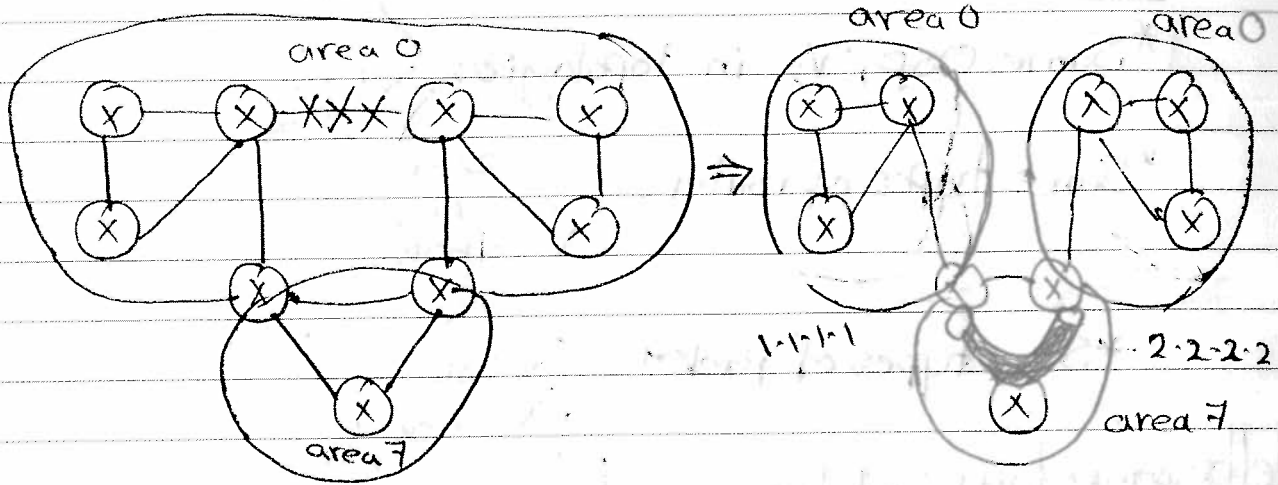
router ospf 70

area 8 virtual-link 1.1.1.1

other RID

broken down

if a cable in area 0 has been cut / dropped / break down



So we will make a virtual tunnel betw the 2 ABRs routers in area 7. But for area 7 it must not be Stub, Totally Stub, NSSA, Totally NSSA. It must be only ordinary area.

So → # router ospf 50
area 7 virtual-link 2-2-2-2

if IPv6 IPv6 router ospf

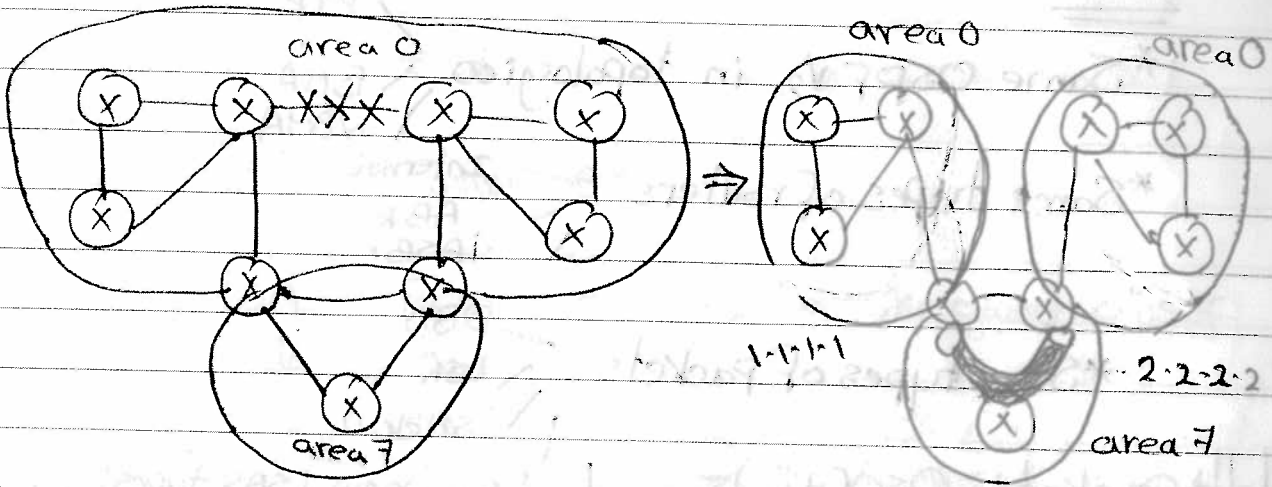
router ospf 70
area 7 virtual-link 1-1-1-1

IPv6 →

IPv6 router ospf 50
router-id 1-1-1-1
area 8 virtual-link 2-2-2-2

IPv6 router ospf 70
router-id 2-2-2-2
area 8 virtual-link 1-1-1-1

if a cable in area 0 has been cut / dropped / broken down / break down



So we will make a virtual tunnel betw the 2 ABR routers in area 7 But for area 7 it must not be

Stub, Totally Stub, NSSA, totally NSSA

It must be only ordinary area.

So → # router ospf 50
area 7 virtual-link 2-2-2-2

if IPv6 IPv6 routers ospf

router ospf 70
area 7 virtual-link 1-1-1-1

IPv6

IPv6 router ospf 50
router-id 1-1-1-1
area 8 virtual-link 2-2-2-2

IPv6 router ospf 70
router-id 2-2-2-2
area 8 virtual-link 1-1-1-1

* OSPF V3

* Same OSPF V2 in topologies
 / PTP
 \ BMA
 \ NBMA

* Same types of routers
 / Internal
 \ ABR
 \ ASBR

* Same types of packets
 / DBD
 \ LSR
 \ LSack

(Hello packet in OSPF V3)

LSu (new LSAs types)
Hello (2 differences)

Hello OSPF V2

Hello OSPF V3

Ver	type		
	RID		
	area ID		
	auth-key		
null clear	auth Method	MD5	Instance id

- No Authentication on Hello packet as we will use IPsec Esp
- global process "neighborship conditions" "Same" instance id. AH

* Types of LSAs in OSPF V3 :-

° Type 1 LSA } Empty details (IPv4 OSPF V2)
 ° Type 2 LSA }

so they will be by Type 9 LSA "Intra area LSA" IPv6
 "Intra area prefix LSA"

if Dual stack OSPF V2 & V3
 ↓ Type 1 & 2 ↓ Type 9
 ↓ OSPF 2 & 3

° Type 3 LSA "Inter area prefix"

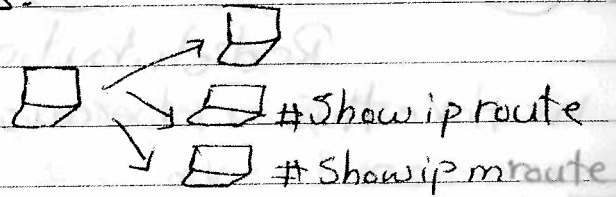
° Type 4 LSA ASBR

° Type 5 LSA External AS

° Type 6 LSA For multicast routing Like games & ospf will send the data to the routers.

It is Deleted

For multicast membership



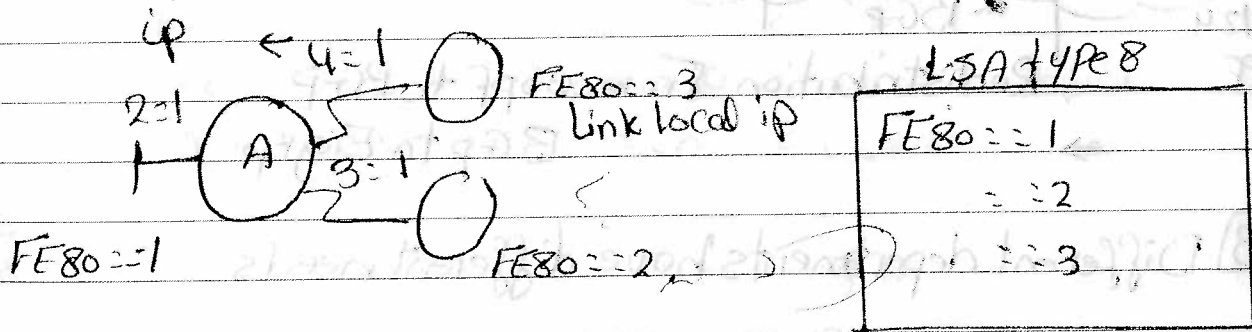
For class D (PIM)

Loopback LSA = 10, 11, 12, 13

For future use.

° Type 8 LSA "Link local LSA"

انا و جبراني



Flooded ~~to~~ neighbors only

(Config) # IPv6 router ospf 1-65535 locally significant

(Config-rtr) # router-id 1.1.1.1 optional

(Config) # interface Se

(Config-if) # IPv6 ospf Process id area 0 [instance ↓]

default = 0 *... (Arabic notes) ...*

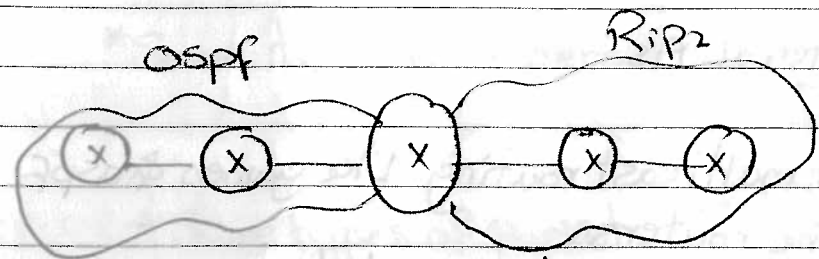
IPv6 ospf cost

IPv6 ospf ? to show

IPv6 ospf Priority —

* Manipulating many routing protocols - Redistribution

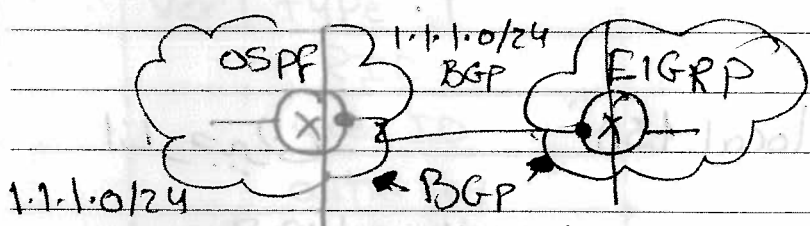
Implementing (mixing many routing protocols)



Redistribution

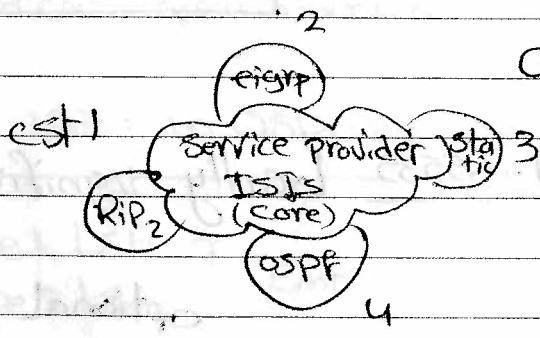
We make this because of:

- 1] Migration from old protocol to a new one
- 2] Boundary of / betn ASs



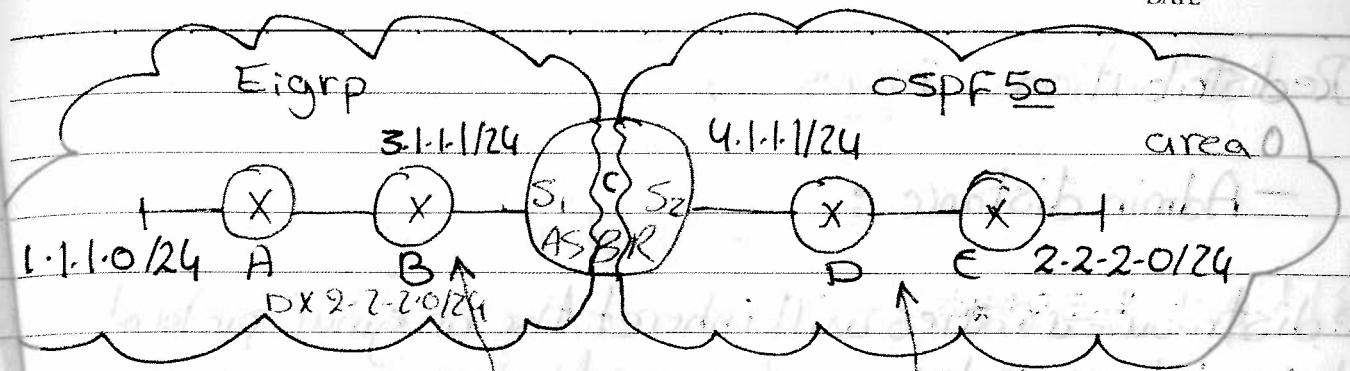
→ Redistribution From OSPF to BGP
→ BGP to Eigrp

3] Different departments have different needs



Analysis of Prot. & Req. for Redist. & Migration of ASs

It must be Boundary



D 1.1.1.0/24 S1 D 1.1.1.0/24 IS1 O 2.2.2.0/24
Dx 2.2.2.0/24 S1 O 2.2.2.0/24 S2 OE2 1.1.1.0/24

```
##router eigrp 100 1=65535                    #router ospf 50  
#network 3.1.1.1 0.0.0.255                    #network 4.1.1.1 0.0.0.0 area 0
```

→ Dex 2 Prots → jano aloy jano al

```
#router eigrp 100                    eigrp 1  
#network 3.1.1.1 0.0.0.255  
#redistribute ospf 50 (option) ospf dex
```

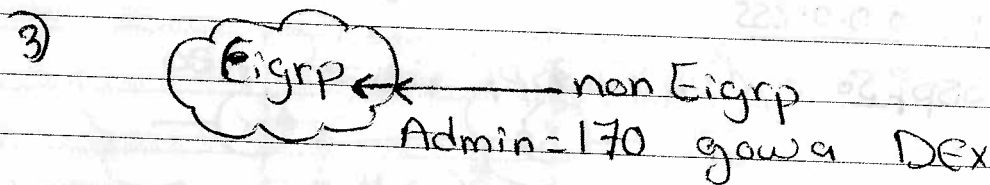
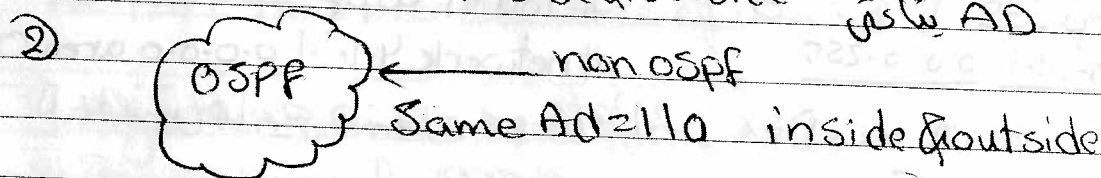
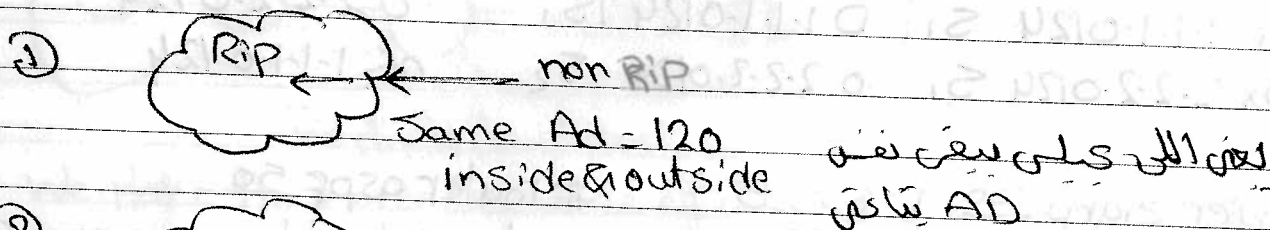
```
#router ospf 50                    ospf 1  
#network 4.1.1.1 0.0.0.0 area 0  
#redistribute eigrp 100 (option) eigrp dex
```

& There are options in ospf & eigrp

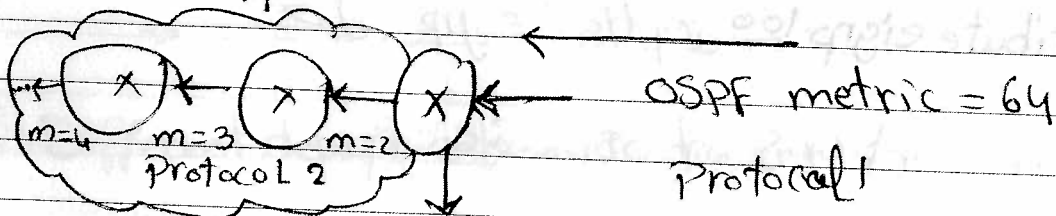
* Redistribution issues

- Admin distance :

redistributed routes will inherit the original protocol admin distance rules. (No special rules)



- Metric :



16 = ∞ و Max metric = 15 في RIP و 64 في OSPF

We configure seed metric & that metric grows according to the original protocol rules.

يفرض seed metric وانه يتم اقتطاعه لبروتوكول الـ 1 و يضاف اليه حسب القواعد التي هي عليه في الـ protocol الـ 1 و الـ 2

How to configure seed metric!

1]

(Config)# router Protocol (rip)

(Config-router)# default-metric 2

2

2] Adjust seed metric

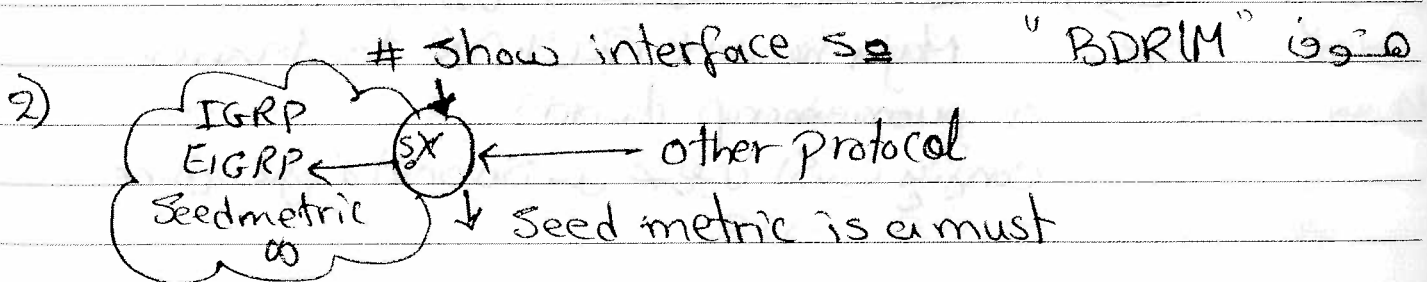
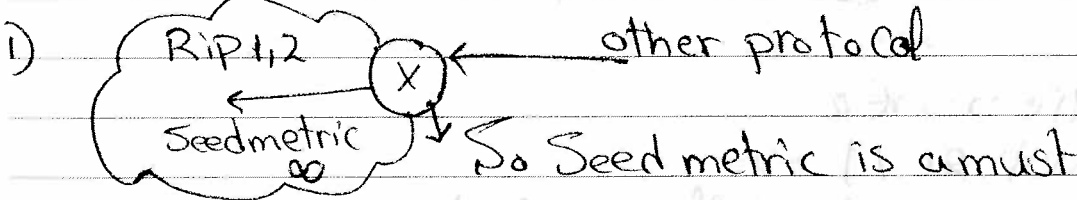
Redistribution Command:-

router rip

network

redistribute ospf 50 metric

* Default Seed Metric:



في الواجهة s0، اكتب في Sh cmd في الواجهة

router eigrp 100

redistribute ospf 50 metric 10000 100 255 1500

Bw Delay reliability

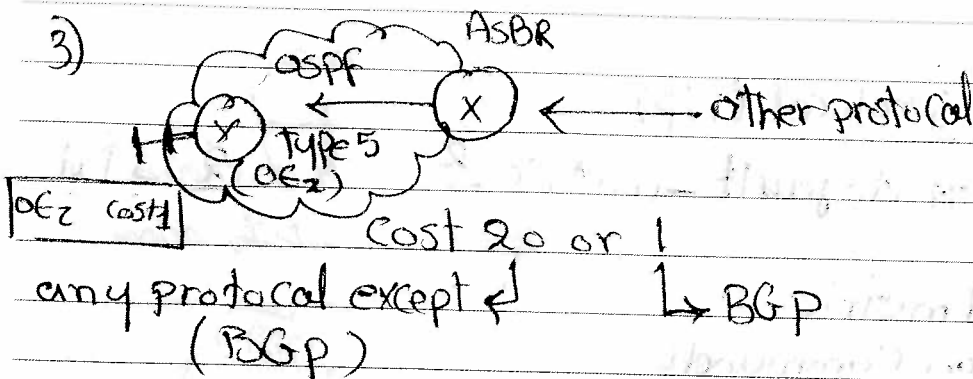
$$Bw = 10 \times Kbps = 10000 = 10 \text{ Mega}$$

redist ospf # metric

Bw Delay reliability Load MTU

Shows ip ospf border-router "ASBR, ABR"

3)



OE₂ = metric type 2

Doesn't include internal cost to external cost.

لا يشمل التكلفة الداخلية إلى التكلفة الخارجية
التي تأتي من المنطقة التي هي جزء من الشبكة

But

OE₁ internal costs calculation

→ Type 5 OE₂

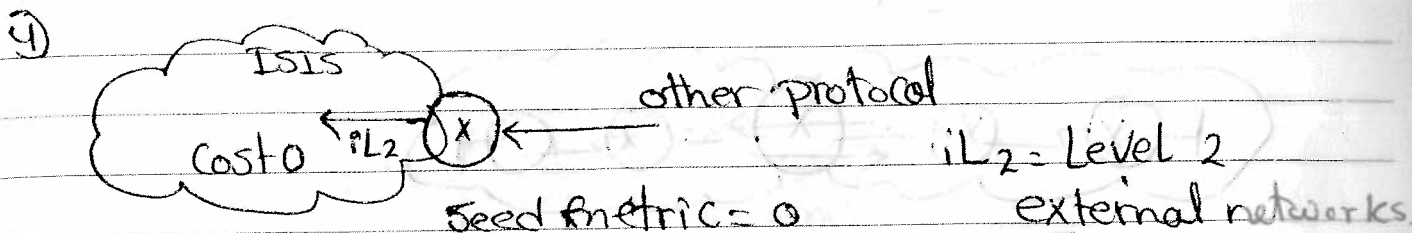
→ Cost 20 / 1

→ no subnets allowed but will take

Major network & CIDR to decrease

(cpu-memory-load)

تقليل عدد الشبكات و CIDR لتقليل الأحمال



* Redistribution Configuration :

(Config) # router protocol Protocol X
 (Config-router) # redistribute Protocol Y [metric-type -] [subnets]
 of protocol X: [metric]

Redistribution betⁿ any protocol & any protocol. But
 It must be same stack

IP-RIP ↔ IP OSPF

IPv6 RIP ↔ IP Eigrp

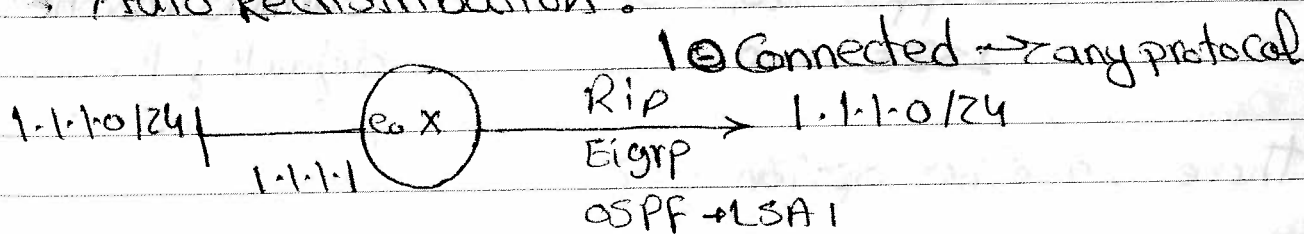
Network Cmd advantages.

Send & Rx updates

- take connected network & transfer to other

Mask (c) *(Arabic text)*

- Auto Redistribution :



router config: c 1.1.1.0/24 eo-

router rip

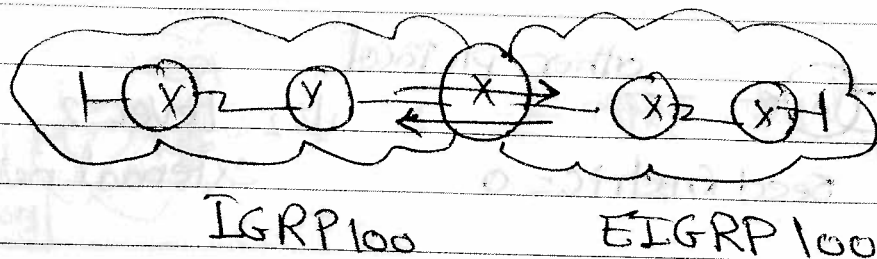
version 2

network 1.1.1.0 or 1.0.0.0

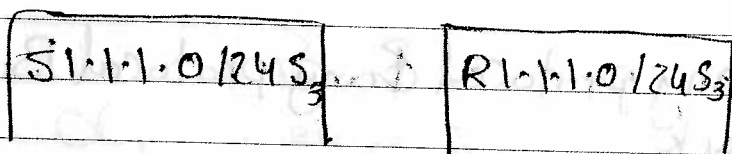
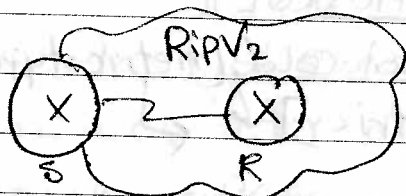
(Arabic text)

* Auto Redistribution *

20 IGRP & EIGRP But in Same Process id



30 Static with RIPv2 with "interface name in static"



(Config)# router protocol X

by default

(Config-router)# redistribute P [metric —] [metric-type —] [subnets —]

Seed metric of Protocol X 1/2

Rip₂, Eigrp 0 with OSPF only ↓

OSPF 20,1 subnets allow none

ISIS 0 default filter subnets

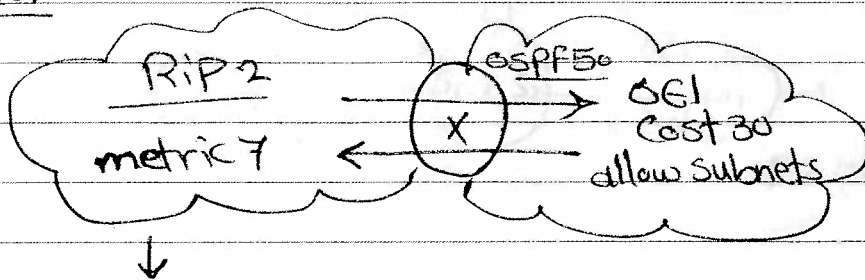
& there is another option

[router-map name or tag]

optimize filter

INDU

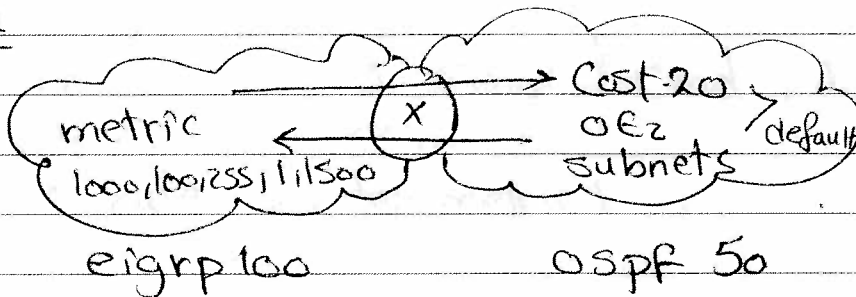
Ex.1



router rip
version 2
redistribute ospf 50 metric 7

router ospf 50
redistribute rip metric 30 metric type 1 subnets

Ex-2

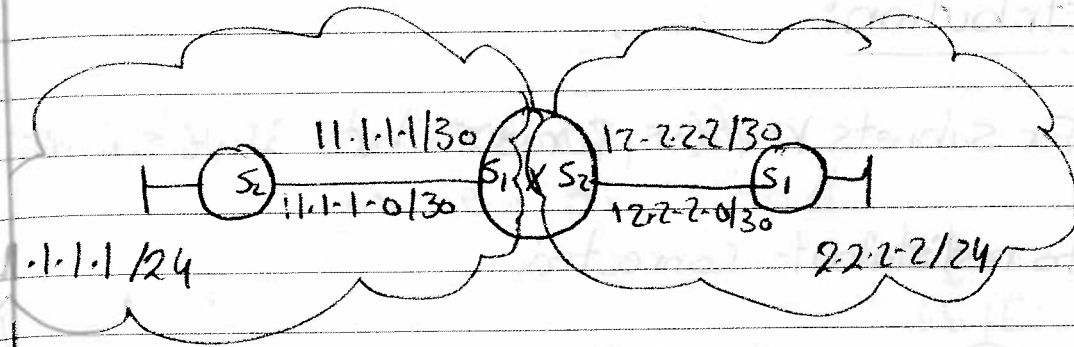


router eigrp 100
redistribute ospf 50 metric 1000, 100, 255, 1, 1500

router ospf 50 (▽ = space)
redistribute eigrp 100 subnets
↓ msh lazim aktho metric & type
default 5 8

Rip 2

ospf 33



- c 1.1.1.0/24
- c 11.1.1.0/30
- R 2.2.2.0/24 S2
- R 12.2.2.0/30 [120/1] S2
- c 11.1.1.0/30 S1
- R 12.1.1.0/30 S2
- R 1.1.1.0/24 S1
- O 2.2.2.0/24 S2
- c 2.2.2.0/24
- c 12.2.2.0/30
- O 2.1.1.0/24 [110/20] S
- O 2.1.1.0/30 [110/20] S

```

router rip
  version 2
  network 11.1.1.1 → S1 classful cmd (بیت و WCM)
  redistribute ospf 33 metric 1
  redistribute connected metric 1
  
```

```

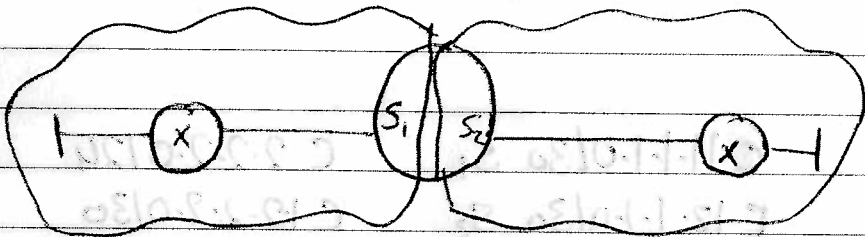
router ospf 33
  network 12.2.2.2 0.0.0.0 area 0 → S2 (wcm)
  redistribute rip subnets (rip) (c) (c in rip)
  # 1 Connected subnets
  R
  network 12.2.2.2
  passive-interface S2
  
```

connected) Just in case only

بالسبب ان 11.1.1.1/30 و 12.2.2.1/30 هما شبكات متجاورتين

* IPv6 Redistribution:

- No need for subnets key (ospf redistribute IPv6 subnets by default)
- No need to redistribute connected.



Ripng shiko

ospf v3 33

(Config) # ipv6 router rip shiko

(Config-rtr) # redistribute ospf 33 metric 1 include-connected

(Config) # int S1

optional

(" -if) # ipv6 rip shiko enable

rip default

(Config) # ipv6 router ospf 33

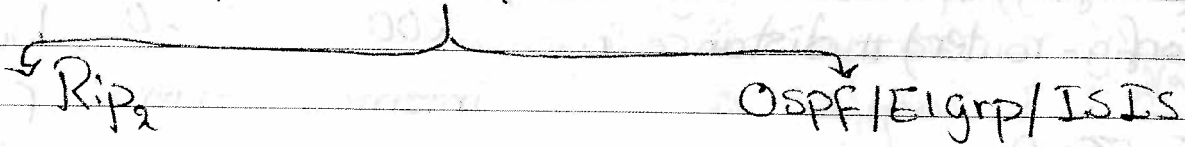
(Config-rtr) # redistribute rip shiko include-connected

(Config) # int S2

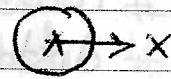
(" -if) # ipv6 ospf 33 area 0

* Controlling Routing Updates:-

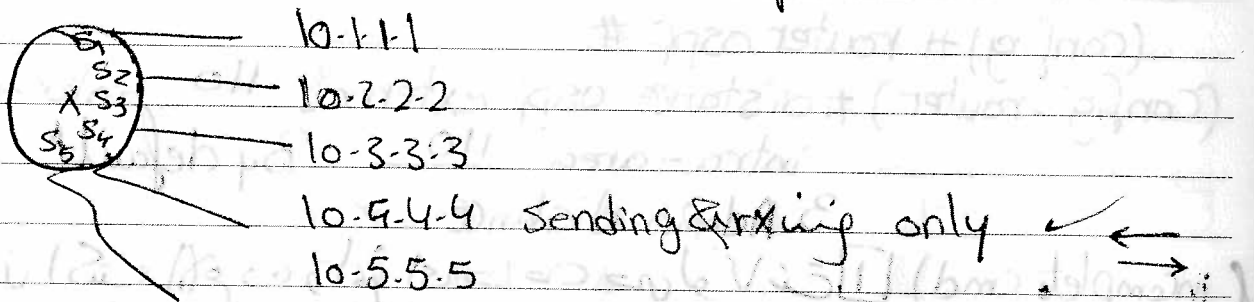
- * Use static & default static
- * Use passive-interface on



- Don't send updates
- it can accept updates



- Don't send hello/updates
no neighbor ship
- protocol will stop on that interface.



```
(Config)# router rip
(Config-router)# version 2
(Config-router)# network 10.4.4.4 -> 10.X.X.X
(Config-router)# passive-interface default all interfaces passive
(Config-router)# no passive-interface S4 all except S4
```

*Change Admin distance

RT من الـ RT الى الـ RT، من الـ RT الى الـ RT

For BGP

(config) # router bgp #
(Config-router) # distance bgp 200 20 by default
internal external

For EIGRP

(config) # router eigrp #
(config-router) # distance eigrp 90 170 by default
internal external

(betw different AS/prot)

For OSPF

(config) # router ospf #
(Config-router) # distance ospf external 110 inter-area 110
intra-area 110 By default

3 Admin distance

(incomplete cmd) []

To avoid loops if we have 2 ASBRs

For Rip & any other protocol: (All protocols)

(config-router) # distance admin distance [list of networks
(Filteration)] by default all net work

1-1-1-0/24	110
2-2-2-0/24	130
3-3-3-0/24	110
4-4-4-0/24	130

we need 2-2-2-0 & 4-4-4-0 have admin = 130

(config) # router ospf 33
(config-router) # distance 130 (64) 1-99 (acl)

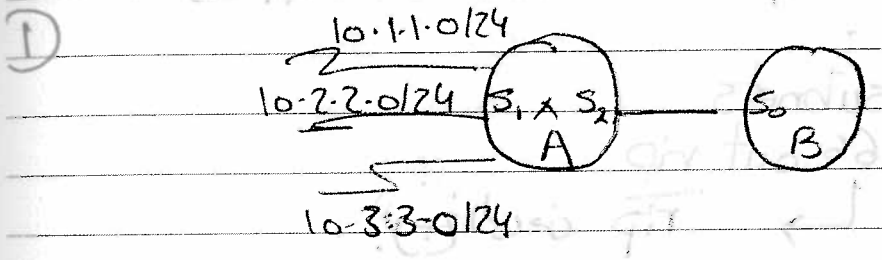
(config) # access-list 64 permit 2-2-2-0
" " " " " " 4-4-4-0

Selective tools

* Use Router Filter (Distribution - List)

(Config)# router Protocol if exist # of List
 (Config-router)# distribute-List # of List
 List of networks with redistribution reject
 while receiving updates in interface
 out int
 Protocol (another)
 while sending updates

Ex) We need router A (not to accept) update 10.2.2.0/24
 accept all routes & advertise only 10.1.1.0/24 & 10.3.3.0/24



To not accept update 10.2.2.0/24

(Config)# access-List 65 permit 10.1.1.0

10.3.3.0

Create Acl

OR

66 deny 10.2.2.0

66 permit any

(Config)# router eigrp 100

active Acl

(Config-router)# distribute-List 65 in S1

on R(A)

10.1.1.0/24
10.3.3.0/24

⬇
 (A) If only

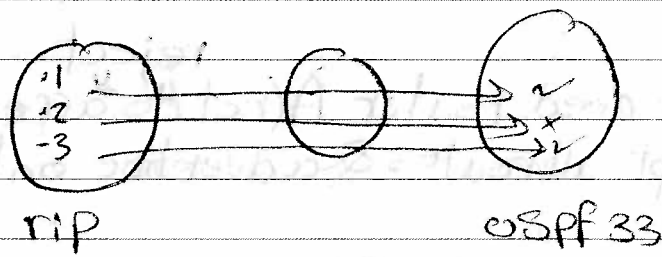
بیا بریم به روتر که بعد از اون
و در دستورات و تنظیمات میزنیم

2) we need (A) to accept all routes & advertise 18.3.24

```
A (Config) # router eigrp 100
(Config-router) # distribute-List 66 out S2
```

+ Same cmds of permit & deny.

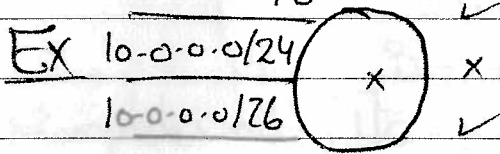
if betw 2 protocols.



```
router ospf 33
redistribute rip subnets
distribute-List 66 out rip
```

↳ رجوع کنی به rip

10.0.0.0/8



گفته می شه که این فرض ال 10.0.0.0
که به جدول و در Subnet Mask

So we will use Prefix-List "List that uses subnetmask"
(network) ←

1) (Create Prefix-List)

```
(Config) # ip prefix-list name # Permit/deny Prefix / Prefix length
(optional) Line seq # ←
```

So Line seq: عددی که در اول خط میزنیم تا بدونه خط بعدی

```
(Config) # ip prefix-list Mero 5 permit 10.0.0.0 / 8
```

```
(Config) # ip prefix-list Mero 10 permit 10.0.0.0 / 26
```

cmd و کلماتی که در خط اول خط بعدی میزنیم

if I wanna add

```
(Config) # ip prefix-list Mero 3 permit 10.0.0.0 / 28
```

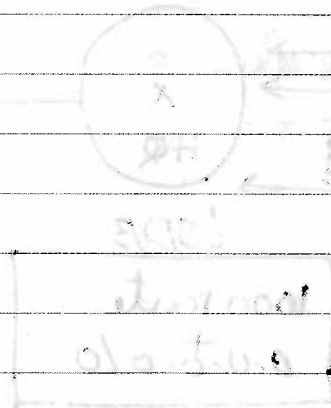
2) (Apply Active Prefix List)

(config)#router eigrp 100

(Config-router)#distribute-list prefix-List name

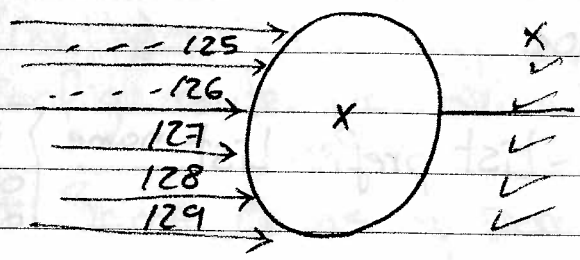
in	int
out	int
out	int

Prefix & acl need low cpu



Ex Filter the following :

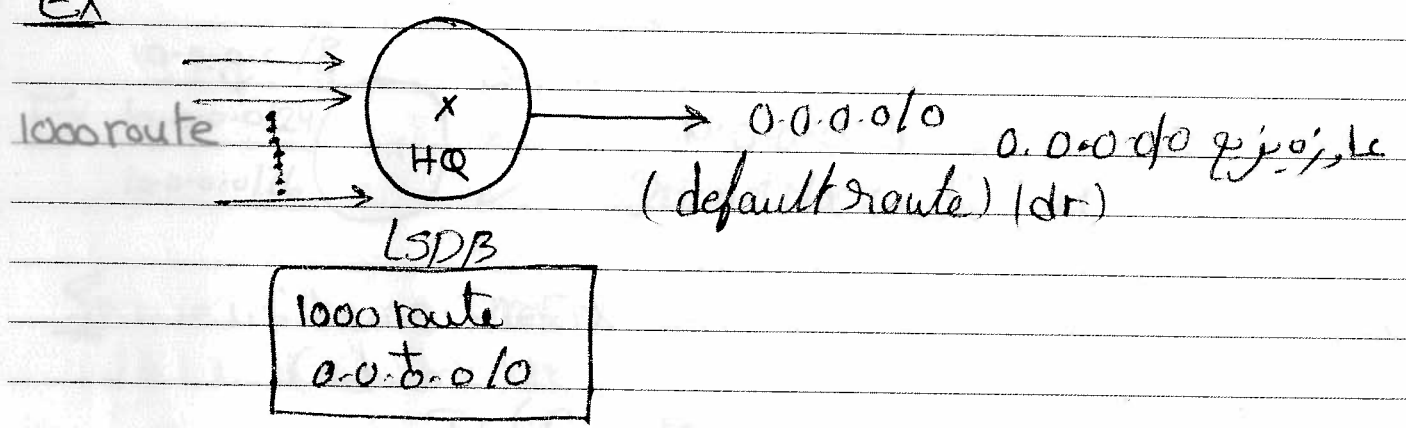
192.168.1.0/24



(config)# ip prefix-list mohab permit 192.168.1.0 255.255.255.0
OR equal or less than ←

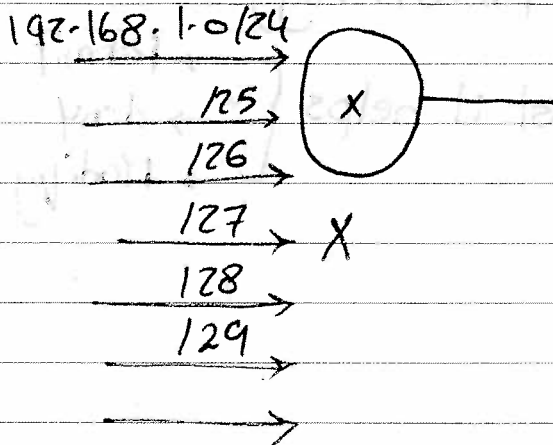
(config)# ip prefix-list mohab permit 192.168.1.0 255.255.255.0
equal or greater than ←
(Range of masks) , list 1 or 2

Ex



By using Default-information originate (only) always (cmd)
(ASBR) (as perizun lab) (dr) perizun
(config)# ip prefix-list mohab permit 0.0.0.0/0

Ex



So

(config)#ip prefix-list A permit 192.168.1.0/24 le 126
128 le 129

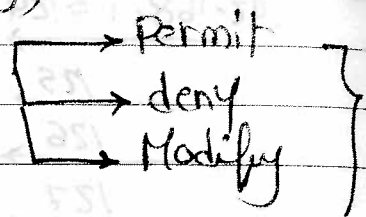
OR

~~(config)#ip prefix-list A 192.168.1.0/27~~

(config)#ip prefix-list A deny 192.168.1.0/27
permit 0.0.0.0/0 le 32
= any

* Route-Map - (needs high processing)

It's a sophisticated Access List it helps (complex)



update or data path

* Benefits :-

1- Route-filter

2- Policy based routing (PBR) (Routing the data as I like)
 Routing table is use of file

3- BGP policies (weight-Community, -- etc, --)

4- NAT

↳ #ip nat inside source list 3 pool TE Data

↳ #ip nat inside route-map M pool TE data

It consists of Lines, each line has many statements & sub statements

(Config) # route-map ^{name} name (tag) { permit/deny } (Press Enter)

* This is main statement.

(Config-route-map) # match condition

(net. name IP/protocol)

(Config-route-map) # Set modification

(Config) # route-map name { permit/deny }

(Config-route-map) # match condition

Set modification

(Filters are on Routing table only)

PAGE
DATE

* Route-map for updates:

↳ Permit → Permit update
↳ deny → deny "

* Match conditions

(P/d) و \rightarrow no-map (g) by use the order.

1. match ip address #ACL (but Ach must has only permits)
2. match ip address prefix-list # (ip & mask)
3. match metric # 20.
4. match interface # So
5. match ip next hop 10.1.1.1

(R.T)

Protocol	Network / Mask	Distance	Vector
0	1-1-1-0 / 24	(110 / 50)	So, 10.1.1.1
0E2			

اقول / اقول
اي حياهم قبلي

* Set modifications (metric)

Set metric 50

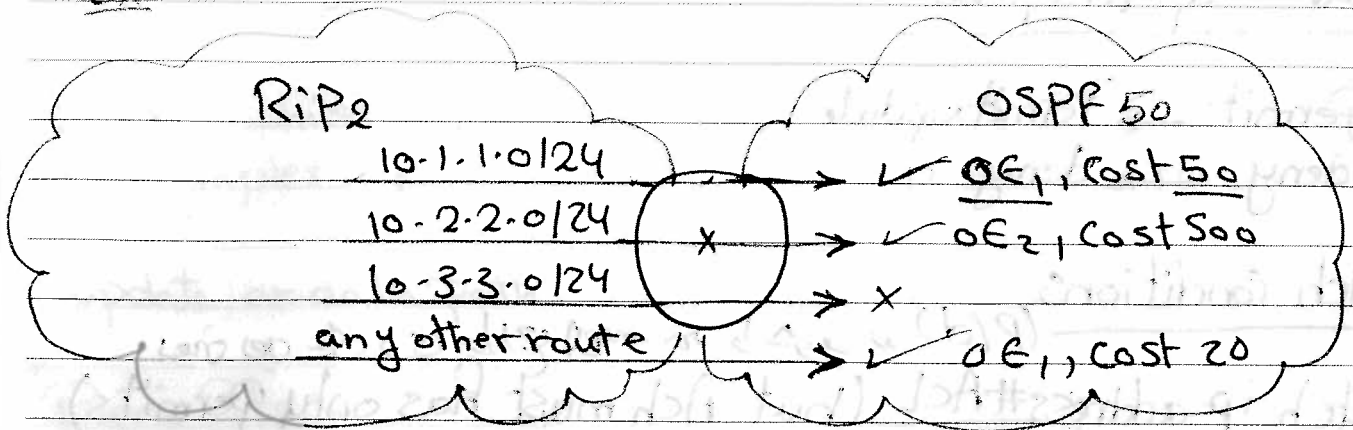
Set metric - type Type-1 / Type-2. special case just in OSPF

0E1 ↓ ↓ 0E2

#ACL و P/d و في #route-map
او في #ACL و Permit في الـ #ACL او الـ او الـ

او الـ او الـ route-map و الـ او الـ

Ex



in this case I'll use (route-map) as there are p/d & metric
sol:

```
(Config) # access-list 1 permit 10.1.1.0
# ip prefix-list 2 permit 10.2.2.0/24
# access-list 3 permit 10.3.3.0
```

```
(Config) # router ospf 50
(Config-router) # redistribute rip subnets route-map Bohsen
```

```
(Config) # route-map Bohsen permit line seq # 10
(Config-route-map) # match ip address 1
# set metric 50
# set metric-type type-1 (means (rip))
```

```
(Config) # route-map Bohsen permit 20
(Config-router-map) # match ip address prefix-list 2
# set metric 500
```

at route-map Fixed line-sequ #
10, 20, 30, ...
فنان سرة اسع طورا و اسع الرق

(Config)# route-map Bohsen deny 30 } Line 3
 (Config-route-map)# match ip address 3

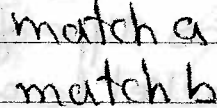
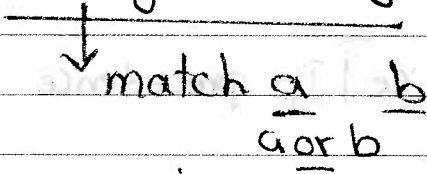
(Permit any)

(Config)# route-map Bohsen permit 40 } Line 4
 (Config-route-map)# set metric-type type-1

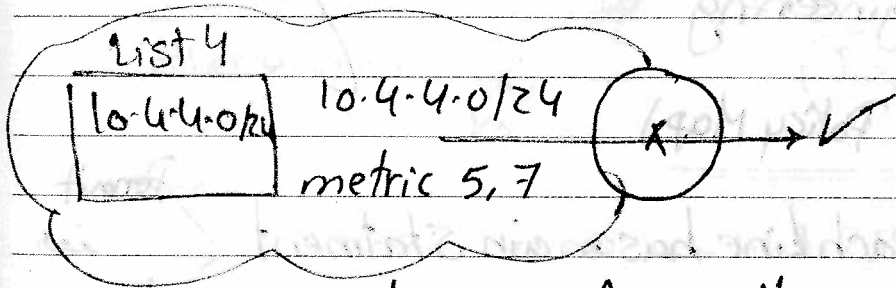
no match statement = Matching by default

cost 20 by default

ORing & Anding



Ex



route-map A permit
 match ip address 4
 match metric 5 7

network 10.4.4.0
 & metric 5 or 7

refresh set (OR)

* Policy Based Routing

Use Route-map for data (policy map)

- Permit
- Deny
- Modify

* Benefits

normal routing is based on comparing dst Ip in data to R-table

Routing based on:

- Source Ip
- (8bit) - Tos type of service / Ip precedence
- Packet length

→ Static Traffic Engineering

Route Map For PBR (Policy Map)

It consists of Lines, each line has main statement

- Permit
- deny

of policy

Permit = permit policy

deny = use normal R-T

use normal R-T

& has also sub statements

Match

Set

match ip address Acl # on source ip

match Tos

match ip precedence

match Length min max (byte)

} match ?

set interface

set ip next-hop

(default rou) *لوم قلا و جمل و قلا*
 Routing Prot *لا قلا و جمل و قلا*
 R-T *لا قلا و جمل و قلا routers*

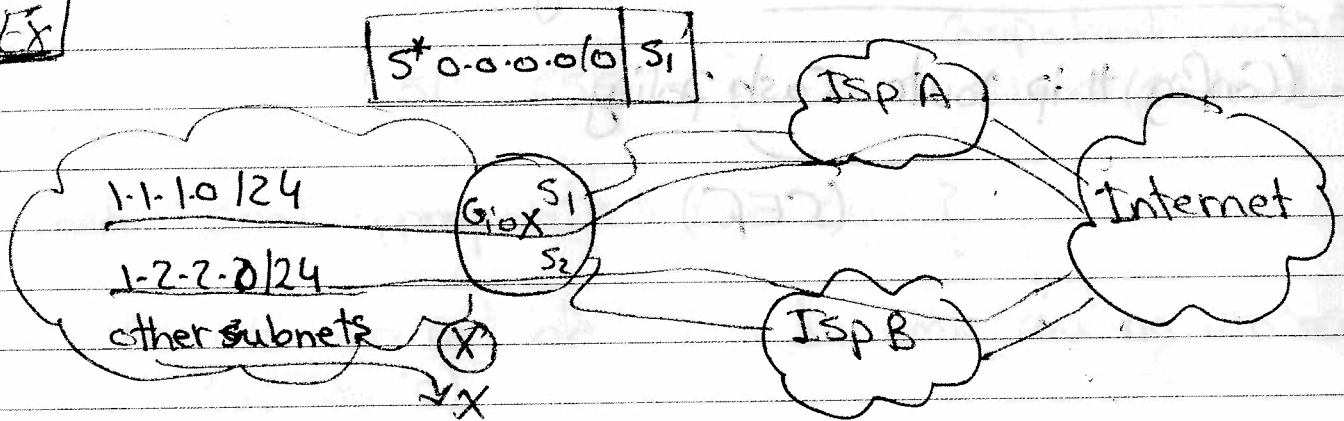
So U should have exact match for destination in routing table,
(not 0.0.0.0/0)

If R.T is using 0.0.0.0/0 ~~So~~ (default route) مفروض

Set default interface So تفاهي

Set default ip next-hop 1.1.1.1

Ex



we need:-

data sourced from 1.1.1.0 → 1.1.1.255 should use ISP A

" " " 1.2.2.0 → 1.2.2.255 " " ISP B

" " " other devices " be dropped

IPs 1's Range of data 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31

(Config) # access-list 1 permit 1.1.1.0 0.0.0.0 255

(Config) # access-list 2 permit 1.2.2.0 0.0.0.0 255

(Config) # route-map Dongel permit

(Config-route-map) # match ip address 1

(or) if the cable
→ dropped

" # set default interface S1 (S2)

(Config) # route-map Dongel permit 20

address 2

interface S2 S1

permit 30 (deny)

set default interface

(Activation of Acl) *data 11, Policy*

(Config) # int Gi 0
(Config-if) # ip policy route-map Dongol
software
To speed it up

* For H/w implementation:- Page 62

(Config) # ip route - Cash policy.
(CEF)

* Session Agenda

* BGP Border Gateway Proto.

Prot no: 179

It's an EGP Path vector proto.

↳ Runs betⁿ ASs

group of networks under single technical administration.

old no's (16 bit) = 0 - 65535

new, (32 bit) = 0 - 4XXX XXX XXX

BGP overview

BGP Clc's

.. Neighborhood

.. operation

.. Requirement

23456

inter

Compatibility bet^s them

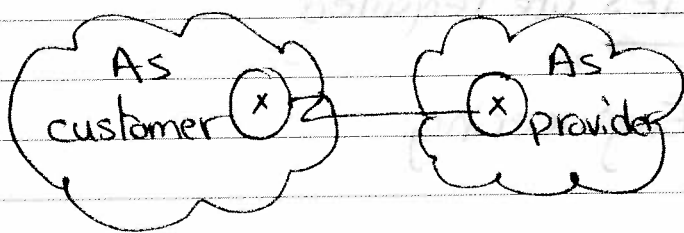
(Private AS = 64512 - 65535)

الموافق (الرقم) لعدد

When it's not appropriate to run BGP?

Betⁿ AS it's not acceptable to run dynamic routing protocols except (BGP, static)

↳ SOL 1] Single path From AS to AS.



So use Static Routing.

2] IF router's memory isn't sufficient

3] " " " " CPU " " "

4] " Bw betⁿ ASs is slow

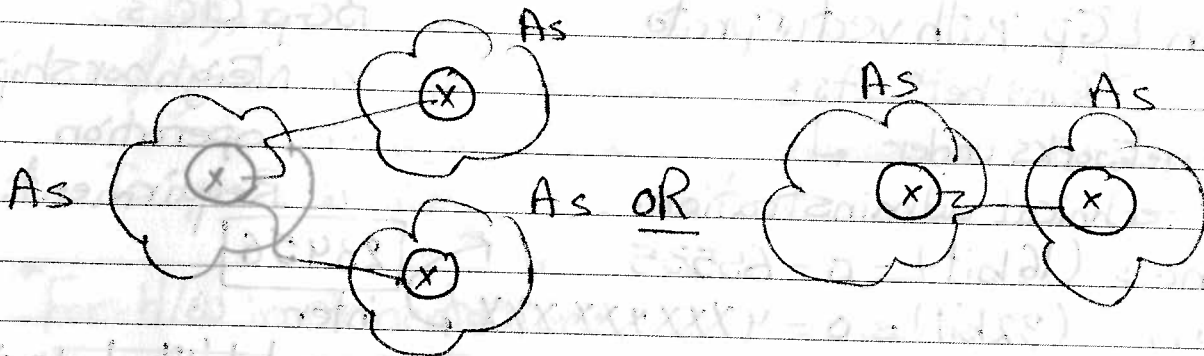
(BGP internet changes can reach 1000 change/min)

updates will take the whole Bw so there is no Bw for data

5] IF there is limited understanding of BGP.

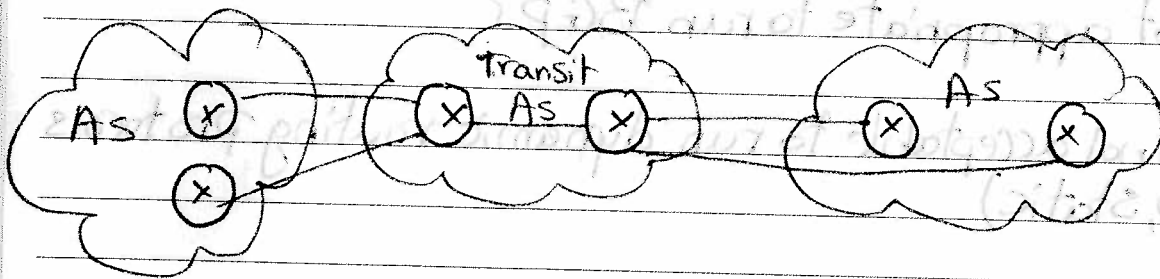
When BGP is appropriate?

1 Multiple paths betⁿ ASs



2 If yr AS is a transit AS.

Service provider



3 If dynamic policies are required

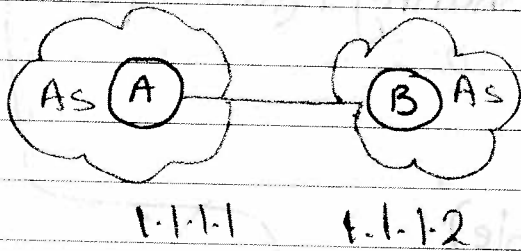
Dynamic Traffic Engineering

BGP tables

□ BGP neighbor table

Statically using neighbor cmd

neighbor	state	As	
	idle		"Neighbor" Table
1.1.1.2	active	2	
	Established		



A(Config) # router bgp #1 (My As)

A(Config-router) # neighbor 1.1.1.2 remote - As 2
 (neighbor As) ←

Show ip bgp summary (to know the neighbors)

There is no (bgp network show)

[2] BGP data base table (BGP table)

all learnt routes (like topology table, neighbor)

Network	Mask	metric (attributes)
11.0.0.0	/24	next hop Lp w8 MED
11.0.0.0	/24	2.2.2.2 100 0 50
11.0.0.0	/24	2.2.2.2 200 100 100

L.p: local Preference, w8: weight

BGP doesn't support load sharing, just 1 path.

show ip bgp

[3] Routing table (FIB table)

it contains the best paths

network	Mask	Distance	vector	next hop	next hop next int
11.0.0.0	/24	(20)	(100)	2.2.2.2	
		(AD)	(MED)	next hop	

show ip route bgp

show ip cef

to know the forwarding routes

* BGP Msgs

- 1] open msg 2] keep alive 3] update 4] notification

open msg: hand shaking hello at start only one time

keep alive: periodic hello every 60 sec. & hold time = 3 x hello, Dead, " = 180 sec.

update msg: (network, mask, metric, containers)
it contains best paths in BGP table. ➤

Network Mask Ip. MED AS

notification msg: msg sent if error happens it could be

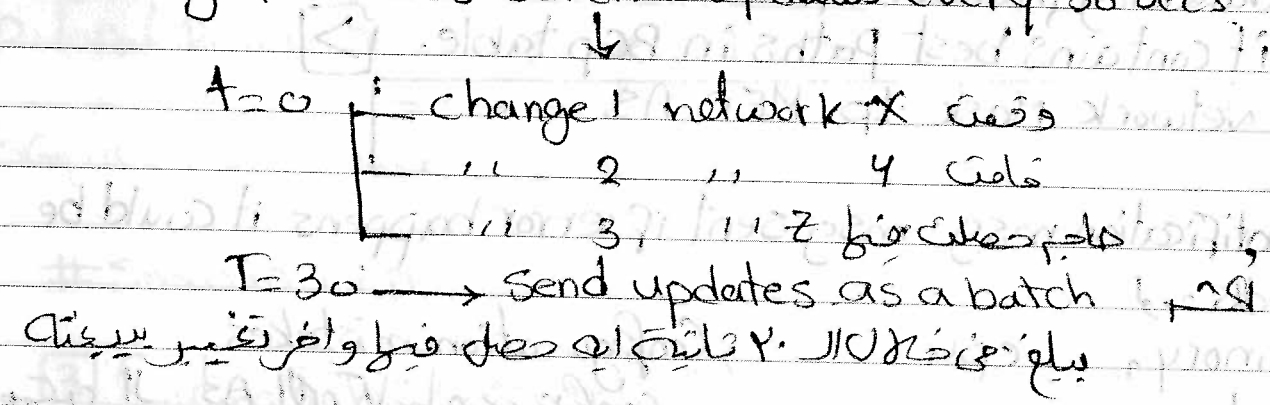
memory, cpu, Configuration mistakes.

updates & (as notification) as notif.

memory
cpu
Config. mistakes

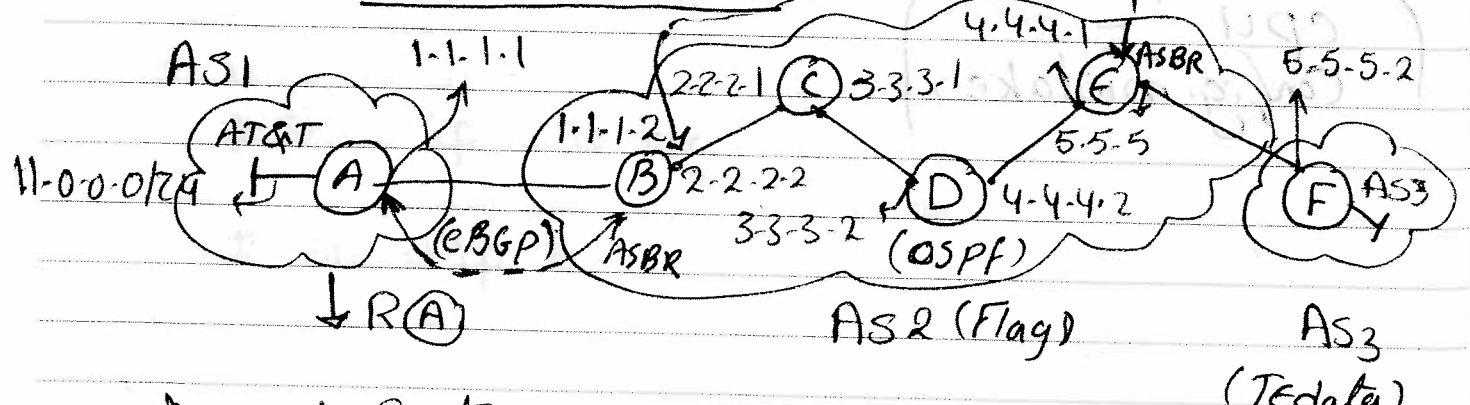
BGP C/S

- 1- It's a path vector BGP
- 2- It sends all its msg's using unicast addresses to the manually configured neighbor.
- 3- Using TCP port 179
- 4- Supports VLSM & CIDR. (classless proto.)
- 5- Supports Auto summarization at discontinuous boundary
- 6- @ change, it sends batched updates every 30 secs



- 7- Symbol in Routing Table "B"
- 8- Admin distance = 20 eBGP, 200 iBGP
- 9- Metric is attributes used for policy routing.

BGP Neighborhood (iBGP)



روتر AT&T (1, 0E2) Router Tedata (1, 0E2)

AT Router (A)

router bgp (1)
neighbor 1.1.1.2 remote-as (2) 2 different AS

* eBGP neighbors -- should be directly connected

all msg's (unicast, TTL, 1) it's by default

AT Router (B)

router bgp 2
neighbor 1.1.1.1 remote-as 1

ASBR R(B) or R(E) AS 2 (OE₂, 1)

E, B in Tunnel (iBGP)

router bgp (2)

neighbor 1.1.1.1 remote-as 1

neighbor 4.4.4.1 remote-as (2) Same AS So iBGP

* iBGP neighbors

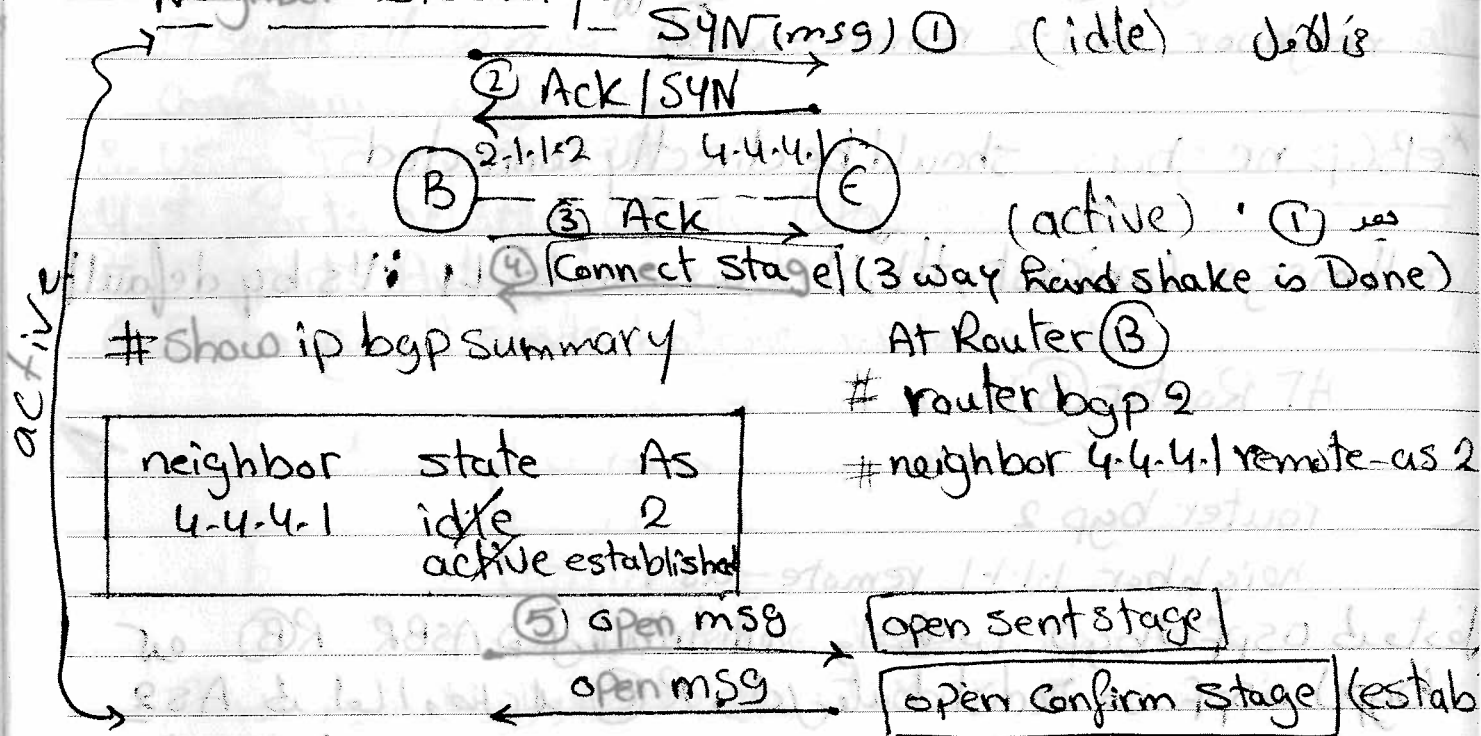
May not be directly connected but reachable using

OSPF (IGP)

TTL msg = 255 by default

BGP operation & Startup:-

* Neighbor Discovery:-



show ip bgp summary

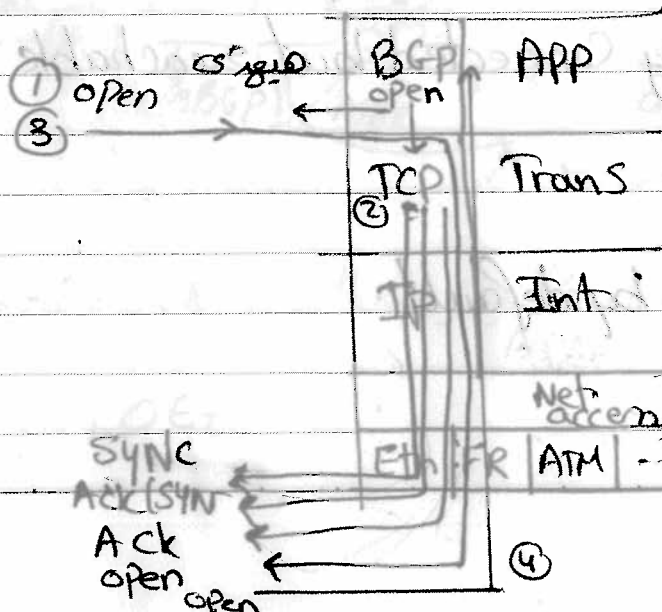
neighbor	state	As
4.4.4.1	idle	2
	active	established

At Router (B)
 # router bgp 2
 # neighbor 4.4.4.1 remote-as 2

idle: 3/6 (no changes yet)
 Router didn't send any BGP msg yet (Router searching for neighbor in routing table)

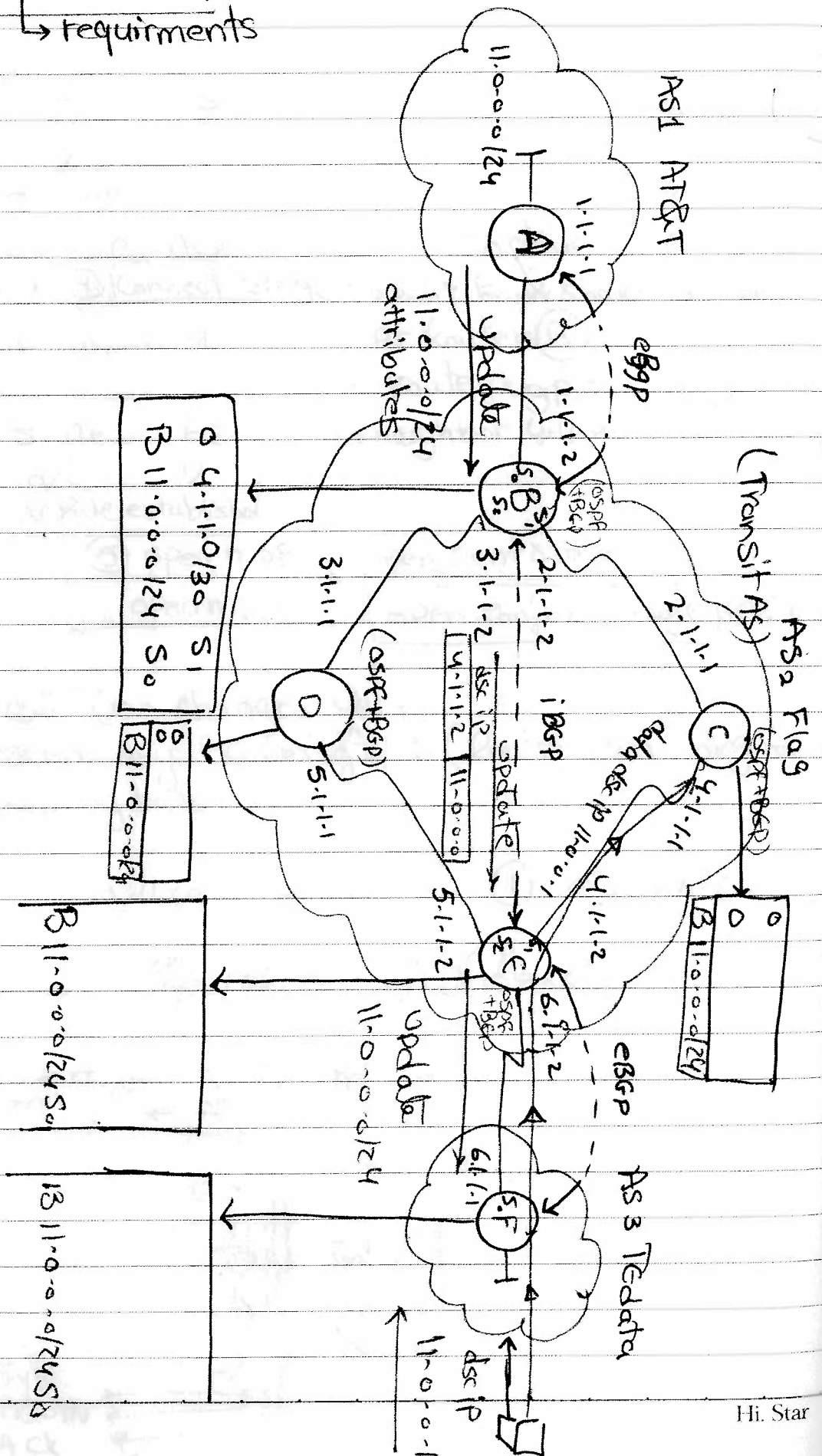
Active: 3/6 و مستقر الرد ① من البداية

Established: 3/6 و مستقر الرد Syn/open



* BGP route discovery

→ requirements



BGP route discovery :-

① Run BGP on Borders

② // IGP // all routers in Transit AS.

③ (a) redistribute BGP int IGP (not scalable)

At Returned bk:

or (b) Run iBGP on all transit AS routers.

(ospf & BGP) \rightarrow \rightarrow

There is a problem that R (e & D) don't know data of (BGP) So

data will face a black hole

BGP/ospf روتروں کے درمیان Routers کے درمیان

Source of updates behaviour :-

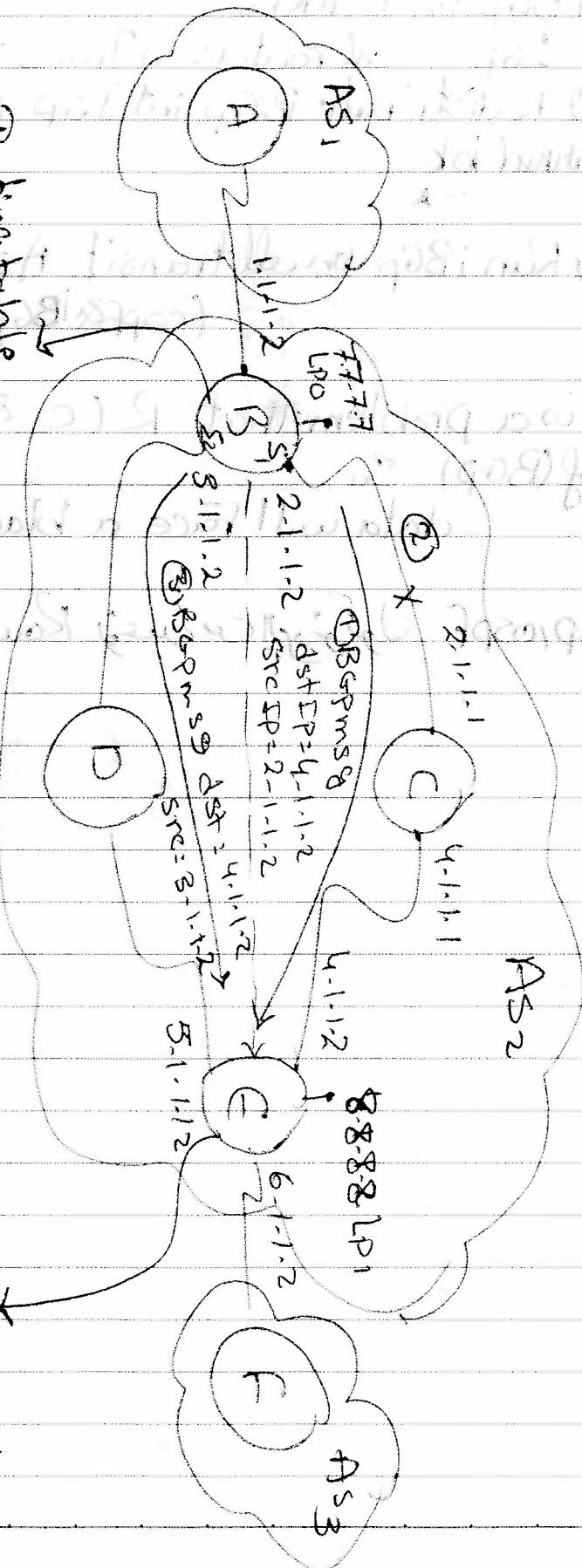
0 4.1.1.0/30 S2
0 5.1.1.0/30 S2
0 8.8.8.8/32 S1

Routing table

Dst IP = 8.8.8.8-8
Src IP = 7.7.7.7

neighbor	As
2.1.1.2	2
7.7.7.7	7

BGP neighbor table



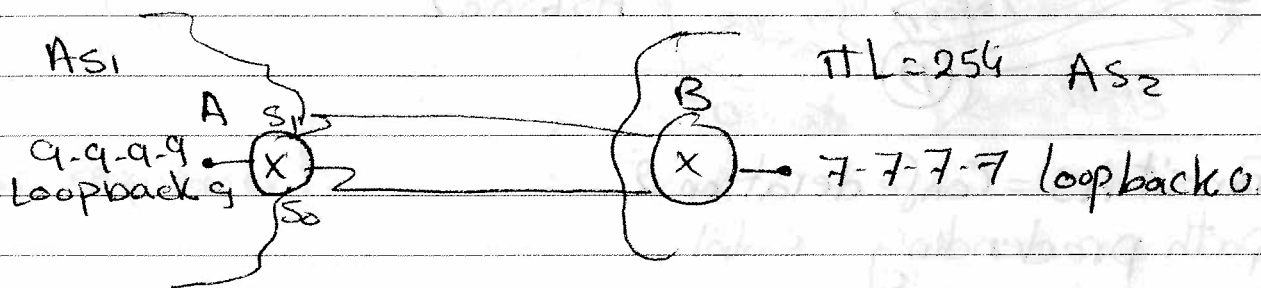
B(config)# router bgp 2
#neighbor 4.1.1.2 remote-as 2

E(config)# router bgp 2
#nei 2.1.1.2 remote-as 2

B(config)# router bgp 2
#nei 8.8.8.8 remote-as 2

E()# router bgp 2
#nei 7.7.7.7 remote-as 2
#nei 7.7.7.7 update-source loopback

eBGP multiphosp



①

A(config)# router bgp 1
A("r")# nei 7.7.7.7 remote-as 2

②

A(config)# ip route 7.7.7.7 255.255.255.255 S1
" " " " " " " " " " S2

A(" -)# nei 7.7.7.7 update-source loopback 9

A()# nei 7.7.7.7 ebgp-multiphosp [2] 255 default

BGP Consideration

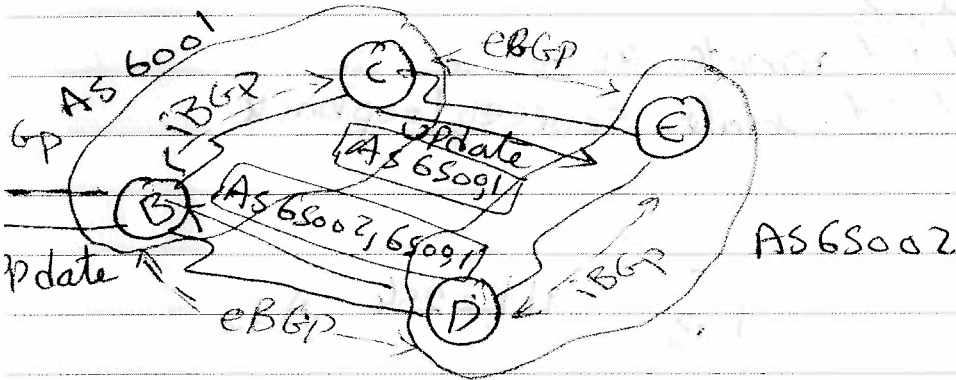
① Neighbor Command:

(Config-router)# neighbor 1.1.1.1 remote-as 2

2) Neighbor Ip is reachable

using IGP $\left\{ \begin{array}{l} \text{ospf} \\ \text{Connected} \\ \text{Static} \end{array} \right\}$ use routing table

- 3) source of updates \rightarrow loop back
- 4) ebgp multihop.



Transit AS = Confederation 2
AS path prepending

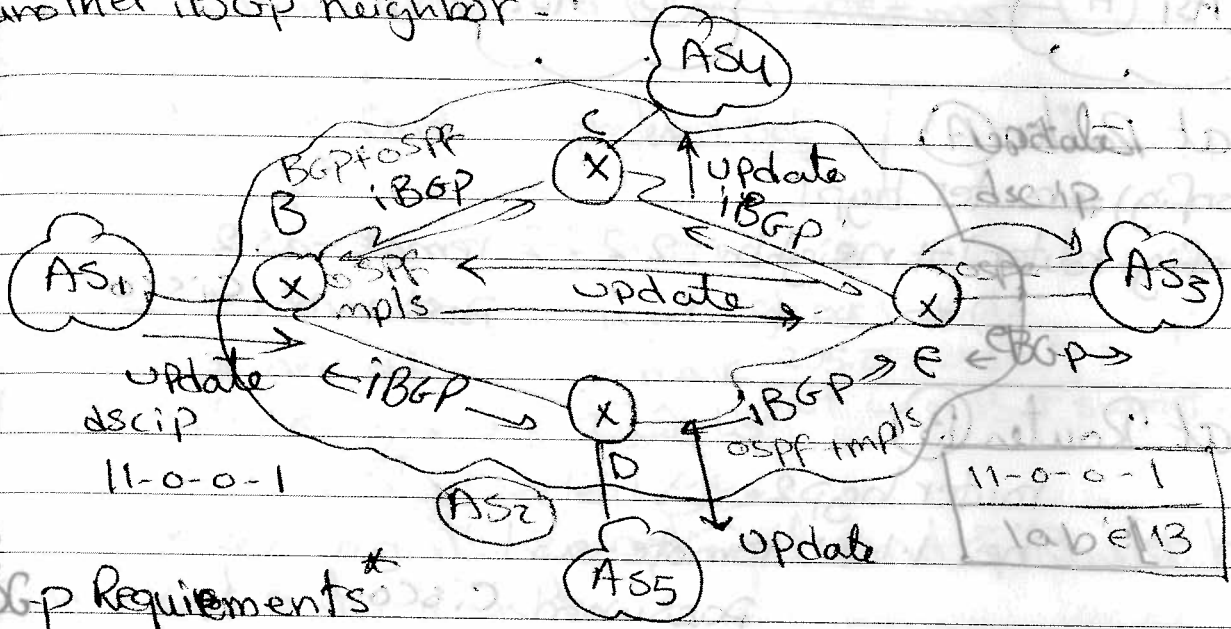
- It's used also as loop prevention mechanism betn AS
- update having my AS in it's AS path, should be dropped.

Config. of Router B: Same Conf. for C, D, F

```
#router bgp 2
  nei 1PofG remote-as 2
Config. of Router E = RR
(Config)# router bgp 2
onfig-router# nei B remote-as 2
// C
// D
// E
// B route-reflector-client
// e
// D
// e
```

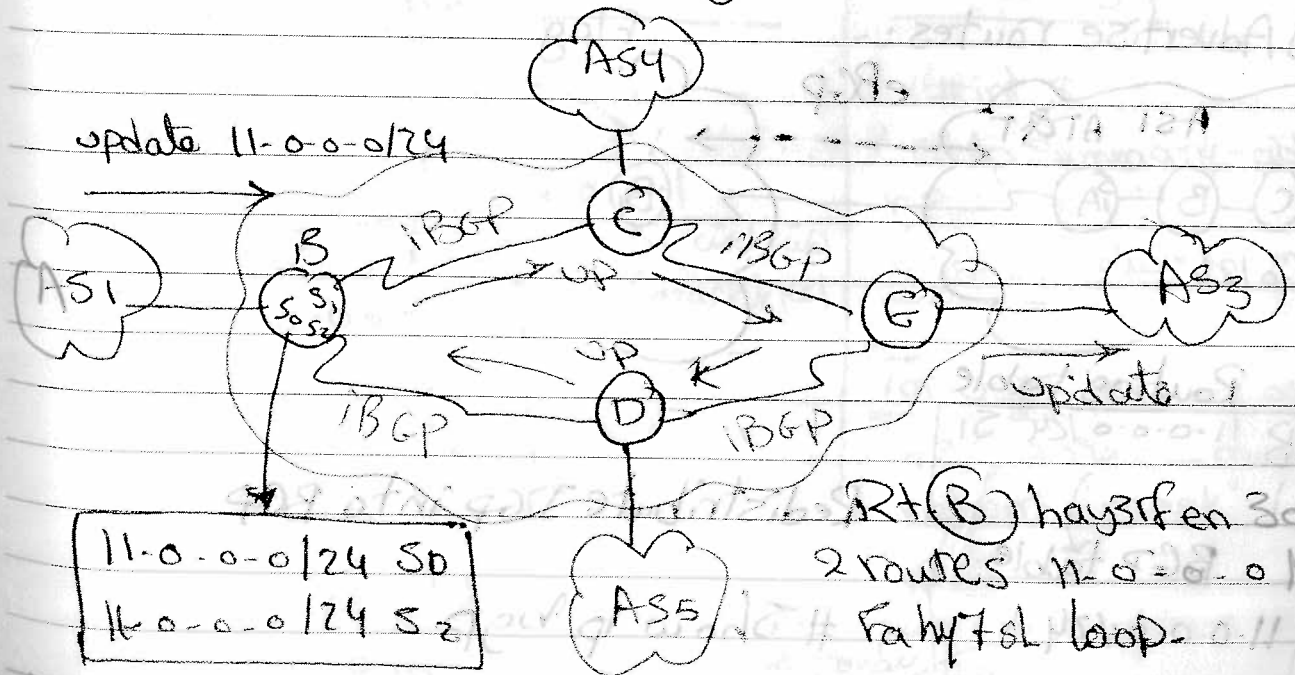
BGP Split horizon To avoid loops inside As.

Route from iBGP neighbor should never be advertise back to another iBGP neighbor.



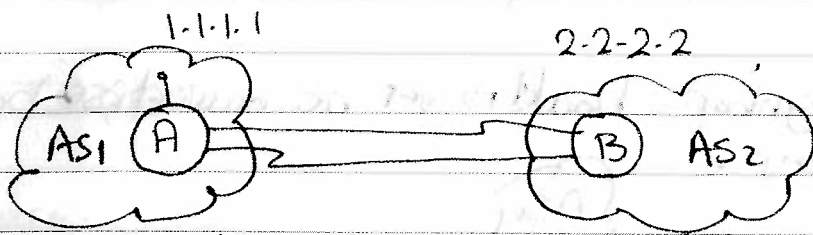
BGP Requirements

- Run (IGP) ospf on all transit As routers to avoid black holes
- Full mesh iBGP router reflector (star, BGP) (BGP split hor rule)
- Confederation (Divid main As into sub As)
- MP-BGP (multi prot. BGP) (Core Free BGP) run ospf/impls on all routers & BGP on edges.



RT(B) has 3 rten 3 ando
2 routes 11-0-0-0/24
fa by 7 sl loop.

BGP Authentication :-



→ at Router (A)

```
(Config)#router bgp 1
```

```
int (config-router)#neighbor 2.2.2.2 remote-as 2
```

```
( )# " " password CISCO
```

→ at Router (B)

```
router bgp 2
```

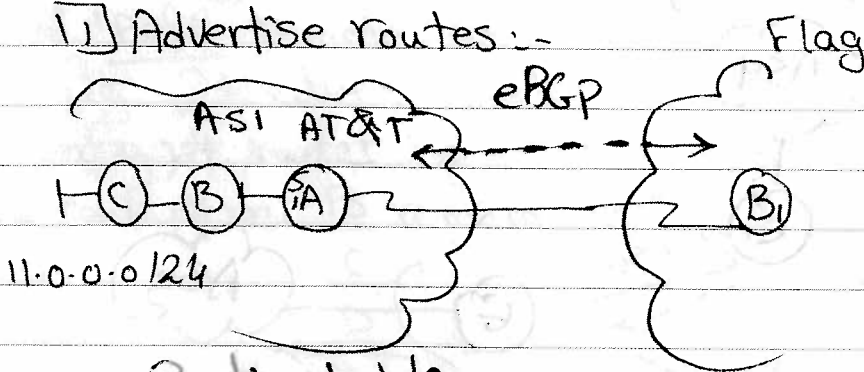
```
nei 1.1.1.1 remote-as 1
```

```
password CISCO
```

- ↳ Null
- ↳ Hashed MD5

* Updates Consideration :-

1) Advertise routes :-



Routing table

B	11.0.0.0/24	SI
1		

Redistribute IGP into BGP

BGP table

11.0.0.0/24

Show ip bgp
advertise

I a) redistribute IGP into BGP

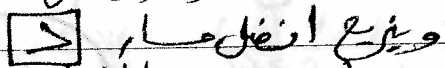
```
#router bgp 1
# redistribute eigrp 100 route-map
```

origin
?

b) network cmd. preferred sol

```
#router bgp 1 + neighbors cmds
# network 11.0.0.0 (mask 255.255.255.0)
```

(BGP) في R-ت موجوده في R-ت not wcm But subnet mask

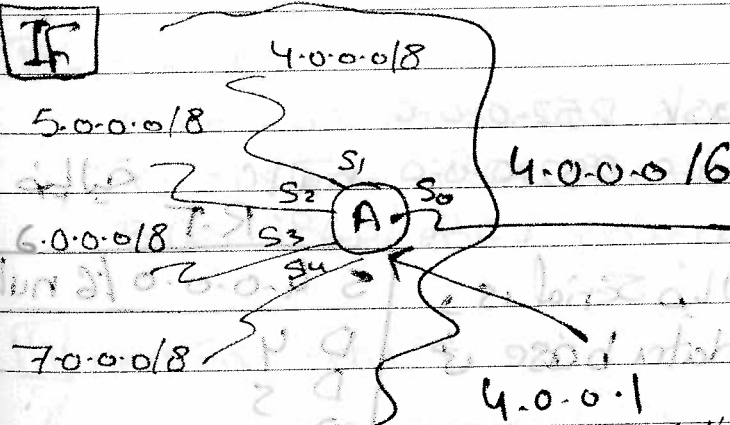


mask cmd it's an optional cmd & Router has to find exact match in R-t.

(class A, B, C) لا يفرق

في R-ت موجوده في R-ت not wcm But subnet mask

II



S-4-R-1 4.0.0.0/16	
D 4.0.0.0/8	S1
D 5.0.0.0/8	S2
D 6.0.0.0/8	S3
D 7.0.0.0/8	S4

BGP table

4.0.0.0/16

Summary on interface -
* For Rip/eigrp:

```
#int S0
#ip summary-address
rip
eigrp 100 network mask
```

```
* For OSPF #router ospf
Type 3 #area range
network mask
```

```
Type 5
#summary-address network
mask
```

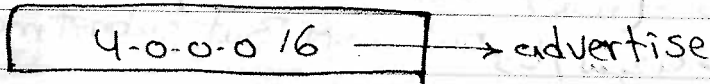
☐ manual Summarization

For BGP

Config # router bgp 1
 (Config-router) # aggregate - address 4.0.0.0 252.0.0.0 [Summary only optional]

if [Summary-only] router will advertise summary & details.

BGP-table



if we can use network cmd. by using static config.
 Tricky Summarization by using

☐ network cmd + static route

```
#router bgp 1
#network 4.0.0.0 mask 252.0.0.0
+ (config) #ip route 4.0.0.0 252.0.0.0 null 0
```

Serial 5, BGP data base (1,2,3,4)

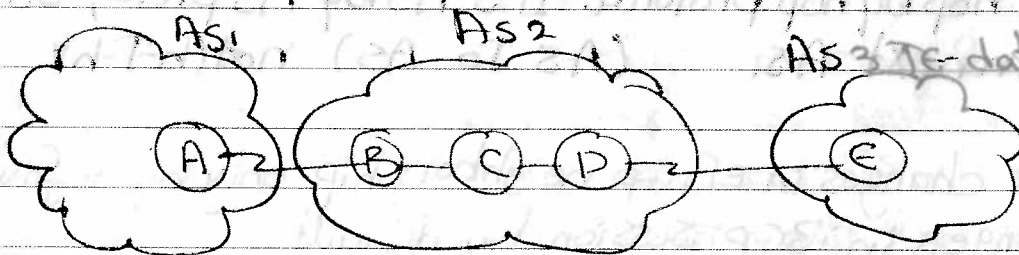
S	4.0.0.0 /6	null 0
D	4	
D	5	
D	6	
D	7	

2] Satisfy BGP requirements:-

- iBGP full mesh
- Router reflector (Last session)
- Confederation
- MP-BGP (multiprotocol BGP)

3] Disable BGP Synchronization

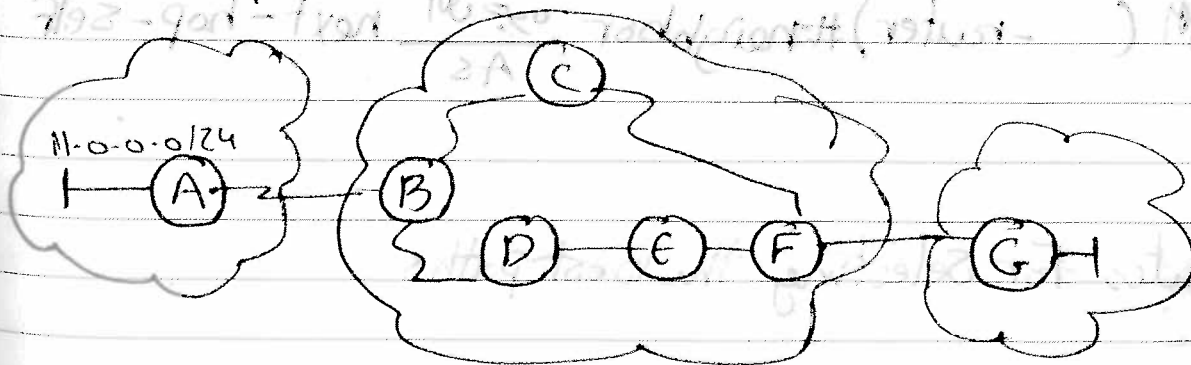
```
#router bgp 1  
#no synchronization default on recent IOS.
```

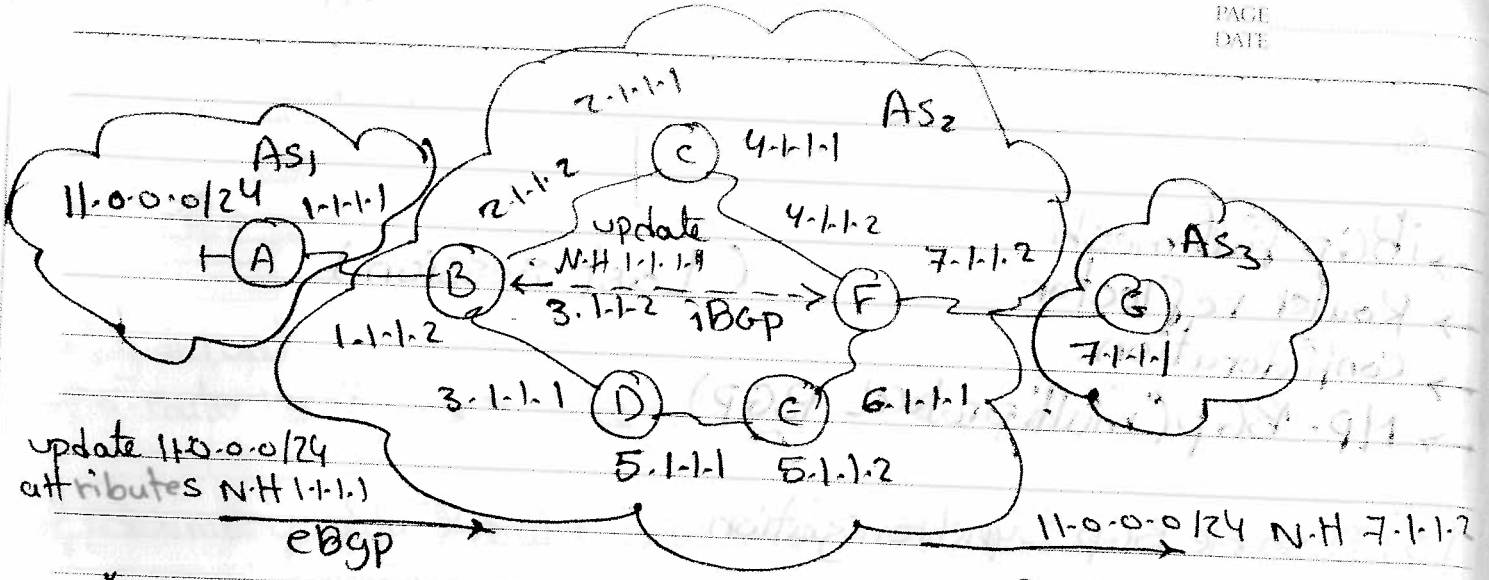


BGP Sync:-

- To help as avoid black holes
- routes from iBGP should never be advertised to any BGP (iBGP/ eBGP) neighbor unless it exists using IGP.

4] next hop behaviour.





* Next hop behaviour :-

- BGP isn't hop by hop protocol. It's AS by AS proto, So NH is Router in next AS. (AS To AS) not (h-T-h)

N.H attribute changes in eBGP neighborhood only by default & never changes in iBGP session by default.

* On Router B

router bgp 2
neighbor F next hop Self

on border router / edge

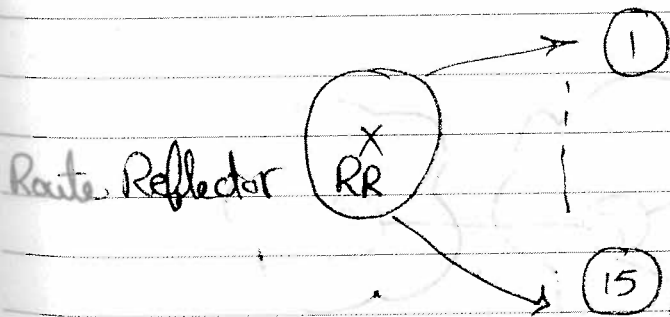
So
edge (router) # neighbor As next-hop-self

* Attributes For selecting the best paths

Peer group: Neighbor List (For easy Config)

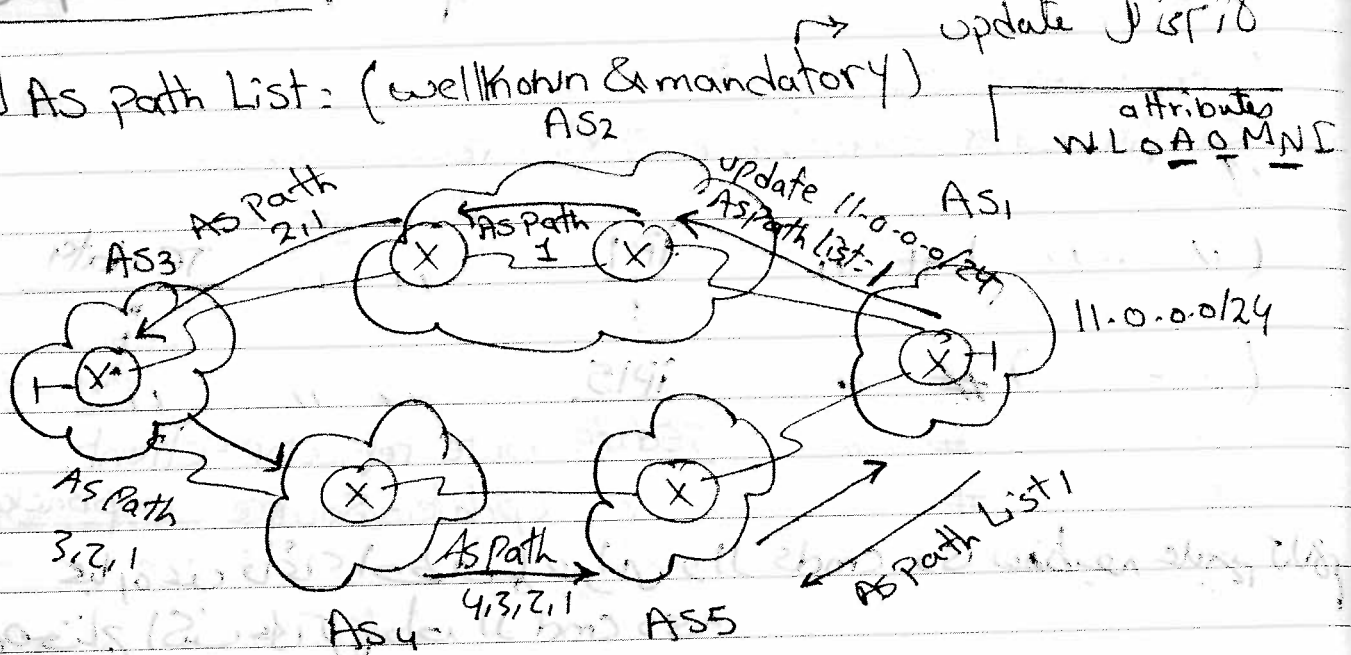
```

(Config) # router bgp 2
(Config-router) # neighbor TEdata remote-as 2
( " - " ) # " " Peer-group
( " - " ) # " IP1 " " TEdata
      :
      :
( " - " ) # " IP15 " " "
( " - " ) # " TEdata route-reflector-client
( " - " ) # " update-source Loopback 0
( " - " ) # " ebgp-multihop 2
( " - " ) # " next-hop-self
      password cisco
      { Distribute-List # }
      { Prefix-List # }
      { route-map # }
    
```



* BGP attributes (Metric)

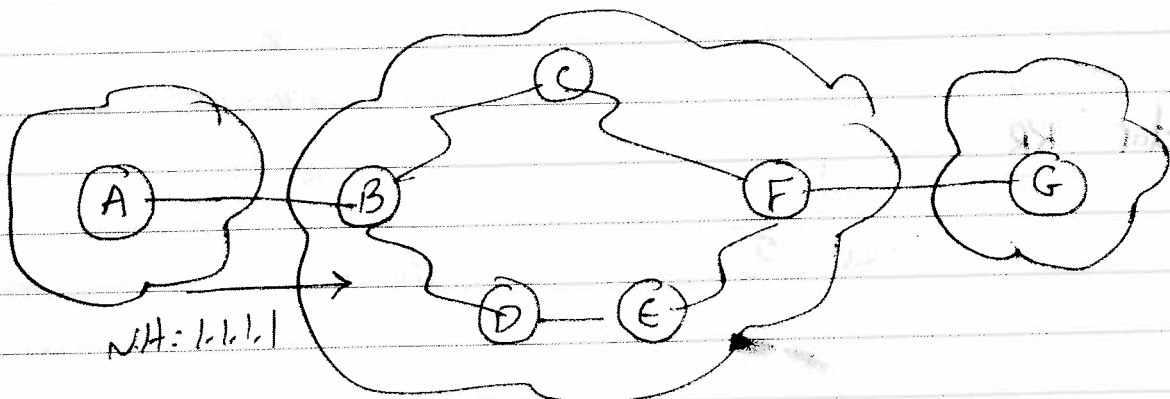
1] As path List: (well known & mandatory)



As path List is used as loop prevention mechanism betⁿ ASs

Router chooses best path according to Least As path List

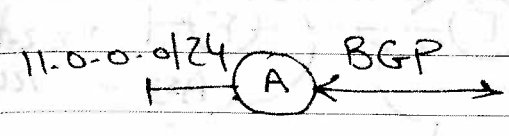
2] Nxt hop attributes (well known & mandatory)



N:H not changed in iBGP session only changed in eBGP

OS dot
③ Origin attribute (well known & mandatory)

(origin of update) → Redistribute IGP in BGP
network Cmd

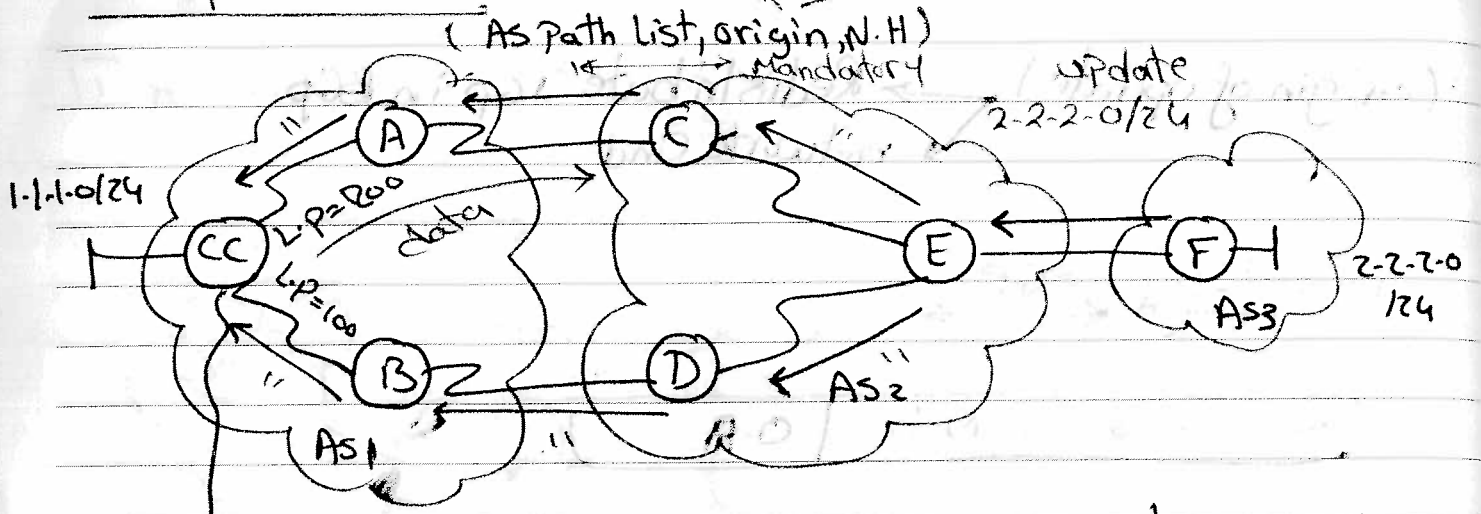


AS Path List	N.H.	O.A
--------------	------	-----

Router prefers internal origin over incomplete

if Redistribute = Origin incomplete
network Cmd = origin internal

* BGP attributes :- Network cmd → redistribute



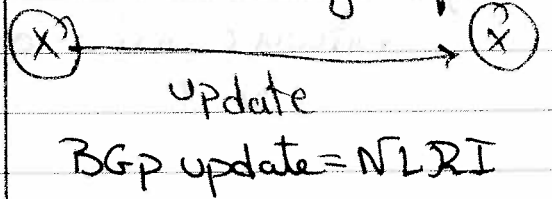
BGP table

Network	(N.H)	L-P
2-2-2-0/24	A	200
..	B	100

N.H = Next Hop

Network / mask attributes

NLRI
Network layer
Reachability Info



* Local Preference :-

- It's an attribute used inside AS to force outgoing traffic

↳ data goes out AS
ترافیک خارج از سیستم از طریق خروجی

- It's By default = 100.
- Highest is best 0-65535 probability.

* At RT (A)

router bgp 1

bgp default local-preference 200

So RT (C) will choose the best path is From RT (A)

OR

(Config-router) # neighbor cc route-map out

+ (Config) # route-map x permit

(Config-route-map) # match ip address ↓

Set local preference 200

L-p كونه أولوية الشبكات المصنفة حسبها ليدخل L-p في شبكة ولدي L-p

- L-p is well known & discretionary update (معرفة من قبل كل update) ودرجة داخل As من بين جميع As ← A

data L-p القائله داخل As على أساس (المرجع الأخرى) في ال data ومن حاجيات (origin, As path, N-H) mandatory

(R.F) وفيه 24/20-2-2 cmd من ال R.F لأن (R.F) بأنه عنده من الأول (connected) وهو صيغول للباقي وهذا

* Weight

في الراوتر التي لها 2 paths وهو ليس هو التي هي أكثر بين

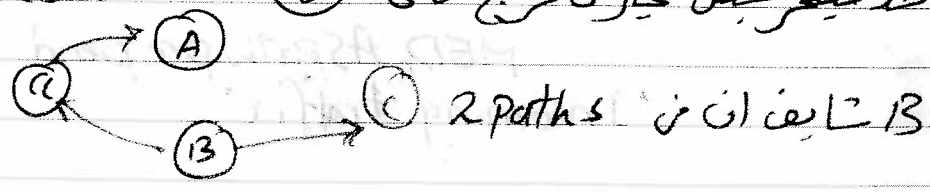
- It's an attribute used in the local router "local significant" (not advertised) used to force outgoing traffic.

- It's cisco Attribute يقدر أيضا best path و هو ليس الى يغير

- It's by default = 0

- Highest is Best.

لوعاد كل ال AS يخرج من مكان واحد R.T واحد ميفر حيث يخرج تاني (B)



At Router C

B (config) # router bgp 1
neighbor D weight 500

IP	N.H	L.P
2-2-2-0/24	A	200
2-2-2-0/24	D	100

منه A ن.H و 200
و D ن.H و 100

از کجا دی هیتا، A

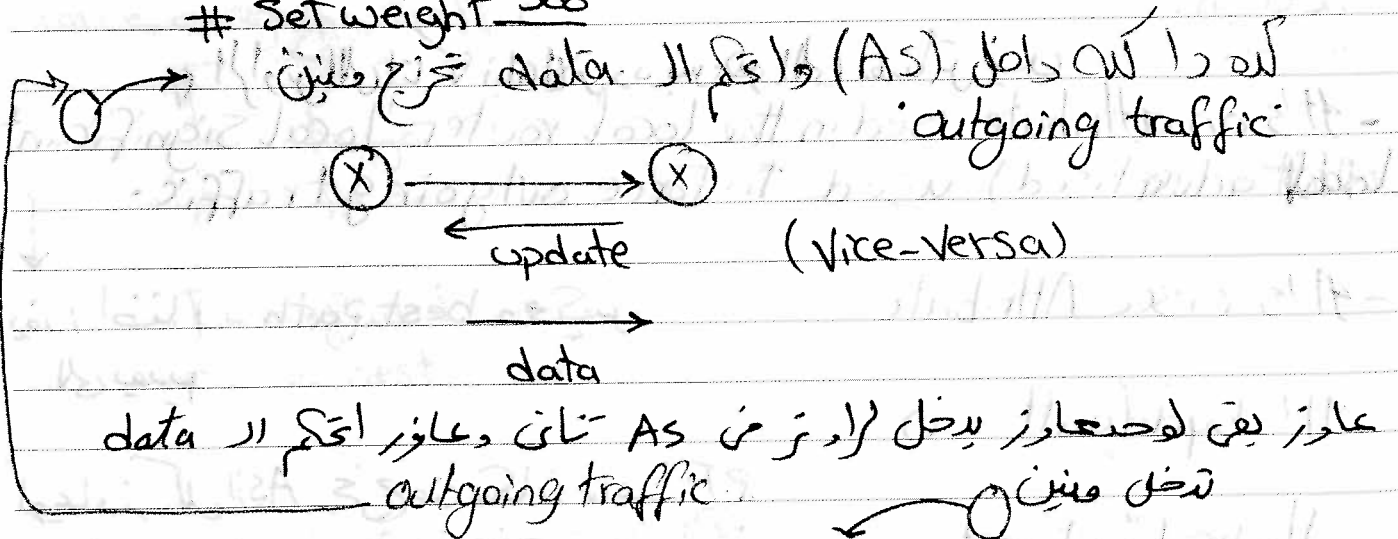
لوانا عاوزه هیتا، C

IP	N.H	L.P	W8
2-2-2-0/24	A	200	0
2-2-2-0/24	D	100	500

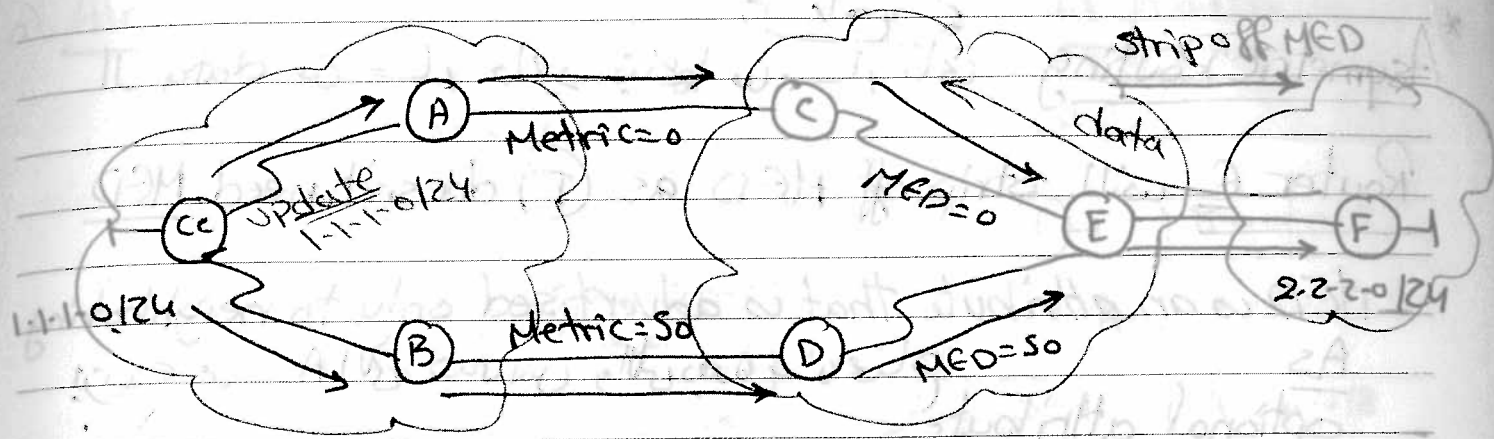
کده هیتا، R-T (D) ویدی منه

OR

match _____
set weight 500



MED, AS path pre-pend
'Incoming traffic'



* MED Multi Exit Discriminator = Metric

- It's an attribute used inside of both AS to force incoming traffic

(A) *نقل البيانات من (CC) إلى (A) من خلال (C) مع MED=0*
 (B) *نقل البيانات من (CC) إلى (B) من خلال (D) مع MED=50*

Default = 0

- Least is best (R-T) *القيمة الأقل هي الأفضل*

* At BGP table of (E)

IP	N.H	L.P	weight	metric
1.1.1.0/24	E	100	0	0
"	D	100	0	50

So on R-T (B) only *فقط على (B) من خلال (D) مع MED=50*

B(Config) #router bgp 1

default-metric 50

OR #neighbor R route-map X out *على R.D*

route-map X permit

match ip address 1

set metric 50

MED

* Asymmetric Routing ^{راجع} ^{راجع} ال data من م، وارد يتلقى من م، تاي

Router E will strip off MED as (F) doesn't need MED

- MED is an attribute that is advertised only to neighboring AS
- optional attribute

strip off is by default in R-(E)

* AS path prepend ممكن اجراء Router او مخصص ال data من م، يتلقى عن طريقه او ياتي ازيد ال (R)

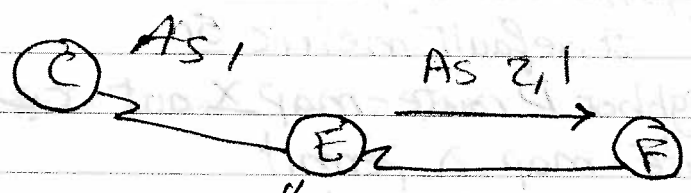
```

B # route-map X permit
  # match
  # set as-path prepend 1 1 1 1
  
```

As a way to add AS to the AS path list to force incoming traffic

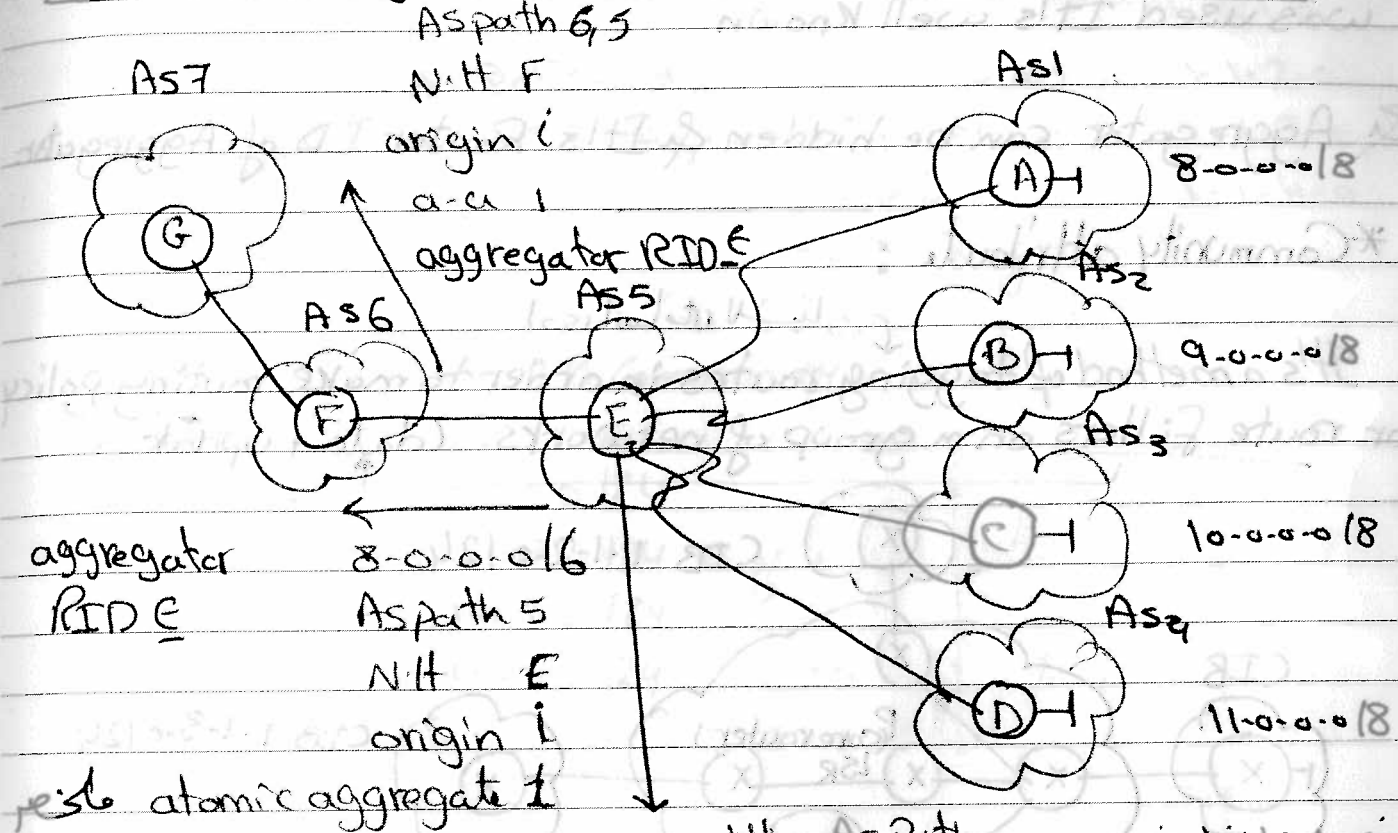
IP	Med	AS path
1.1.1.0/24	0	C 1
	50	D 1 1 1 1 1

AS 1
AS 2, 1
WLOA OMNI
1 2



"(F) MED على وجهه م"

a) Atomic Aggregate attribute b) Aggregator Attribute



N.H.	AS Path	ليست على اى اى
8.0.0.0/8	A: 1	تكون قدامه والى
9.0.0.0/8	B: 2	جميعه على E فانه سهل
10.0.0.0/8	C: 3	Extra/troubleshoot وليس اضنا
11.0.0.0/8	D: 4	افضل لانه تصيب من Bp
8.0.0.0/16	0000	table قاربه و 0.0.0.0

* at RT (E)

```
E (Config)#router bgp 5
#aggregate-address 8.0.0.0 252.0.0.0
```

```
#aggregate-address 8.0.0.0 252.0.0.0 Summary-only
```

atomic aggregate its 1 bit

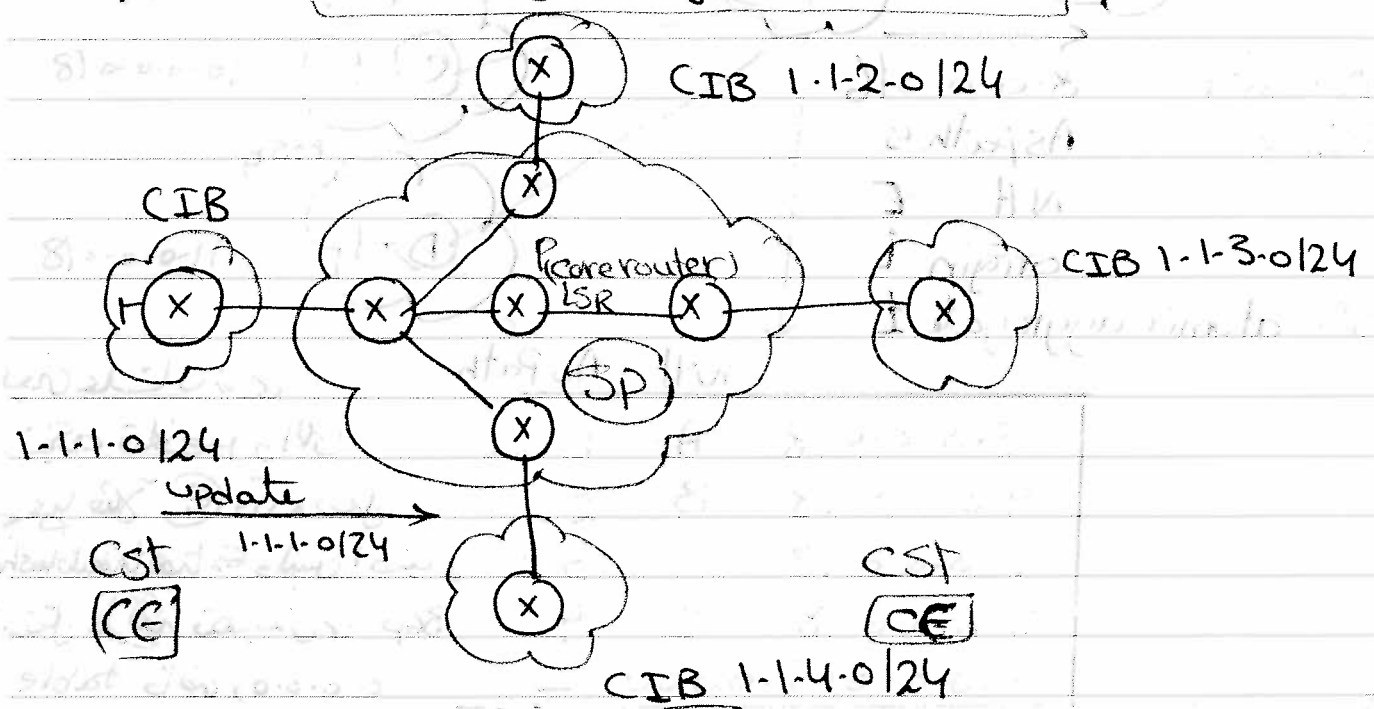
0 →
 1 → this is not network cmd it's aggregate address

So Atomic agg: indicator if aggregate address command was used It's well known

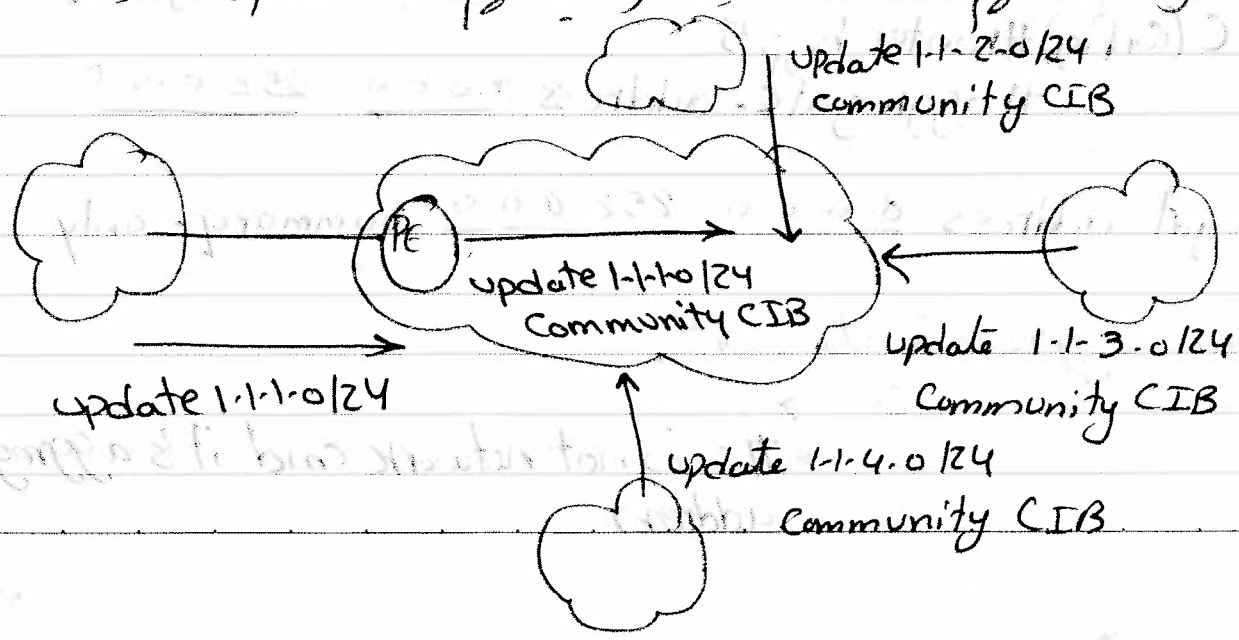
& Aggregator can be hidden & It's Router ID of Aggregator

*Community attribute :

It's a method of tagging routes in order to make routing policy or route filters on a group of networks. (data + updates)



since updates are able to be received



Core router انشايف ان CIB Communities له وديكتور

1-1-1-0

ويكون له اما على ال Policy على شبكة واحدة

1-1-2-0

او Filter انه على على Community

1-1-3-0

1-1-4-0

Permit deny

"CIB Community"

1-1-1-0	/24
1-1-2-0	/24
1-1-3-0	/24
1-1-4-0	/24

* BGP best path Selection Criteria *

Route should have a valid next hop, then
Next hop (next hop self solution) \downarrow reachable

Weight Highest \rightarrow Locally significant

Local preference Highest \rightarrow inside AS

① self originated (locally originated)

AS path List (shortest)

Origin

MED (Least) (AS & betⁿ AS)

Neighbor (external/internal) \downarrow preferred

I Least Router ID iBGP لو جابو سكتينه

- \downarrow اغيره
- { manually static preferred
- highest loop
- physical active Ip Interface

"attribute" (route-map ره پو ايسو اغيره)

Self originated

IP N.H
1.1.1.0/24 0.0.0.0



"Self originated" (N.H) انا ال

لو 8 ب و P لتساوي يستوف اقل N.H وفضل نتنا 0.0.0.0

N: Neighbor

البا الى الزاع لي اصل هو داخل AS و لا خارج

نتنا، السكة التي جايه من eBGP اذ نتنا iBGP

دا لو ممكن نش اعين من Lp وكل حاجة متساوية نتنا eBGP

↳ WLOA omni

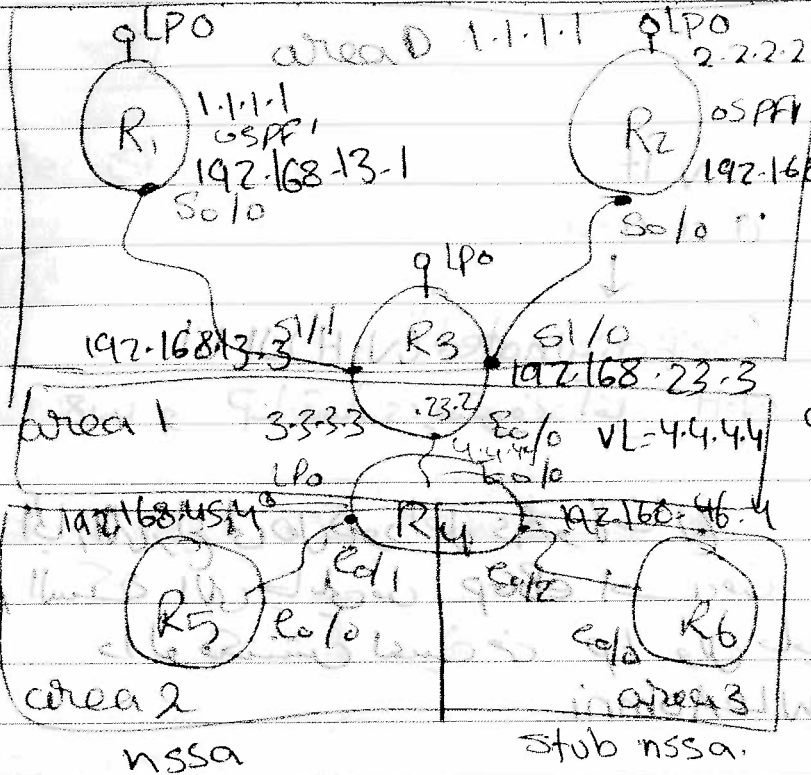
"route map" apply اذ نتنا اعل

#clear ip bgp ip of neighbor

جار مين

OR

#clear ip bgp * كل الجيران واعيد من اول وهدر



192.168.34.0
 ↓
 area 1 network
 192.168.45.0 area 2
~~area 2~~ 192.168.46.0 area 3
 area 3 = 4.4.4.4

OSPF network type betw R2 & 3 is non broadcast
 R3 & R4 are running virtual link to connect
 Area 2 = nssa area 3 = totally stubby area

Q1 on R5
 # Show ip ospf database
 "ASBR Summary"

13-8-2015

7

16
↓
31
Summary
116
112

"IPv4 Types"

unicast 1 to 1 A/B/C

multicast 1 to many class D

Broadcast 1 to many

Loopback
224.0.0.1

255.255.255.255

224-X-X-X

239-X-X-X

> 224.0.0.0/4

RIPv1

IGRP

APIPA

Private in LAN only

169.254.X.X

224.0.0.1

.2 EIGRP

.2 all IPv4 routers

DHCP

TDP!

10-X-X-X

192.168.0.0/16

224.0.0.5

.6 OSPFv2

Private in LAN & WAN

6-X-X-X

192.168.0.0/16

172.16.0.0/12

.9 RIPv2

.10 EIGRP

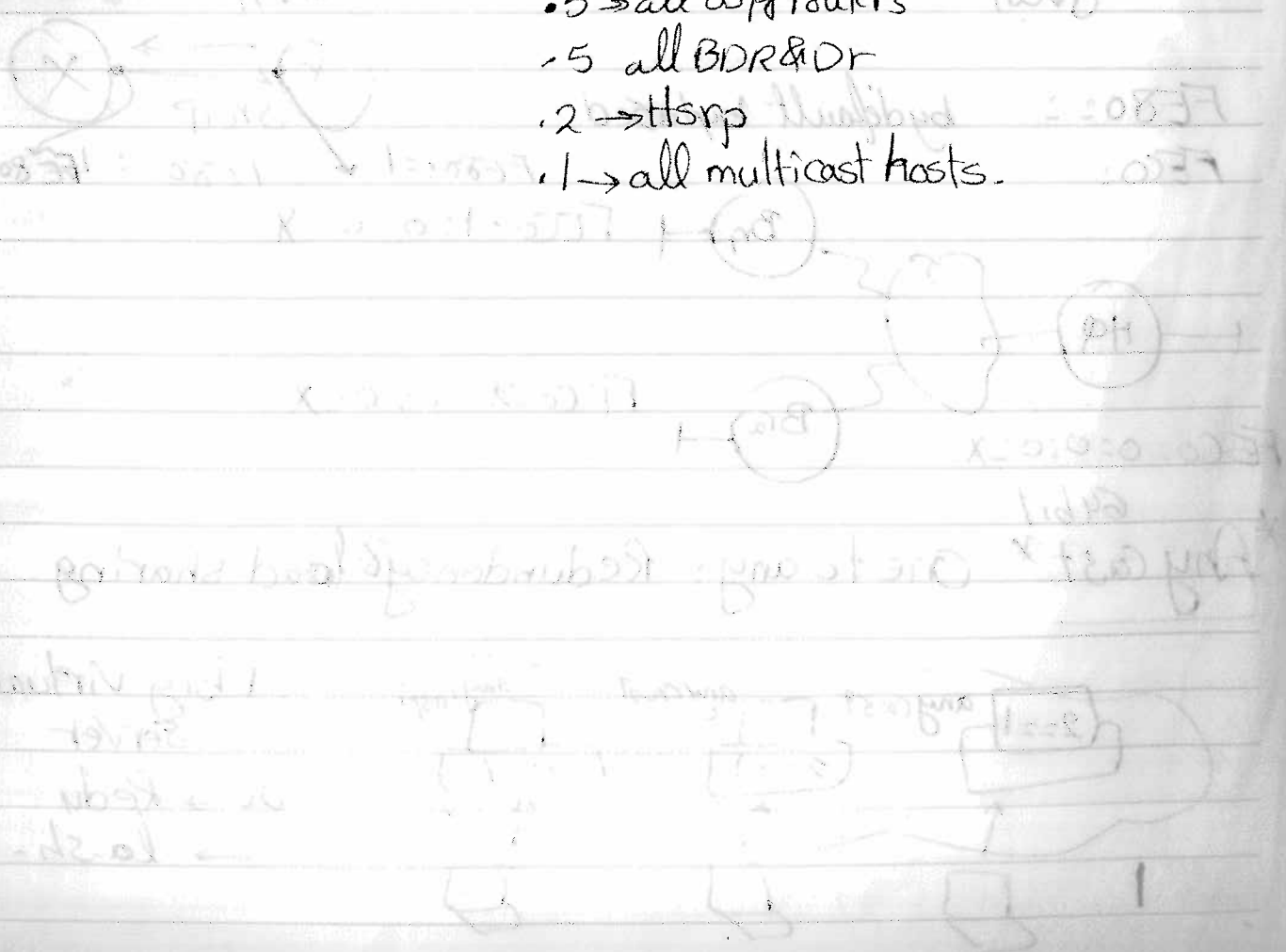
Public IPs

.5 → all OSPF routers

.5 all BDR & DR

.2 → HSRP

.1 → all multicast hosts.



"IPV6 Types"

Unicast

Multicast

AnyCast

Broadcast

Loopback

FF00::: >
FFX:X::: >

Not supported

2:1 /128 1IP

FFXX:X---

Link local

2¹²⁰ IP

Private in LAN, Non routable

FE80:: No 164 1L=1

FF02::1 all IPV6 Multicast hosts

site local

FF02::2 u.s.a. Routers

FE00:: 110

FF02::5 > OSPFv3

Global

FF02::9 RIPv3

2XXX::

FF02::A EIGRPv6

3XXX::

update
ospf = FE80::2::5

IPv6

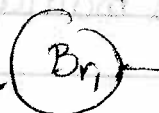
FE80:: by default bytased

FE00:

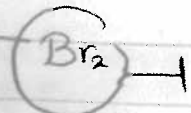
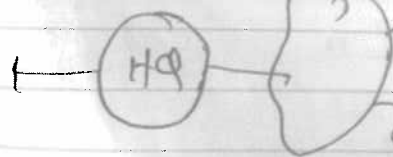


FE80::1

FE80::1 FE80::7



FE00::0:0:0:X

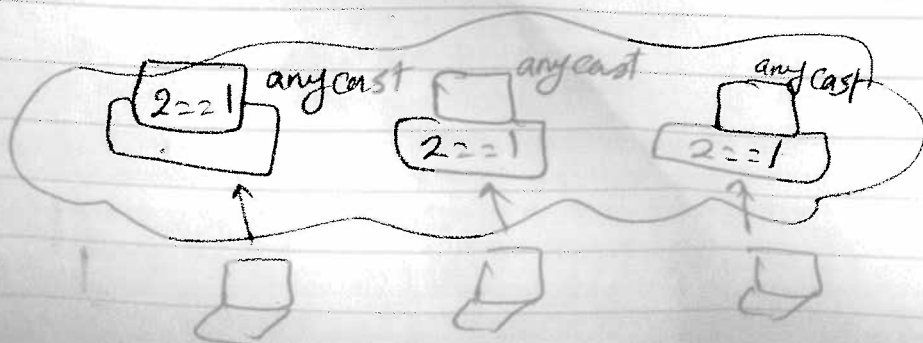


FE00::2:0:0:0-X

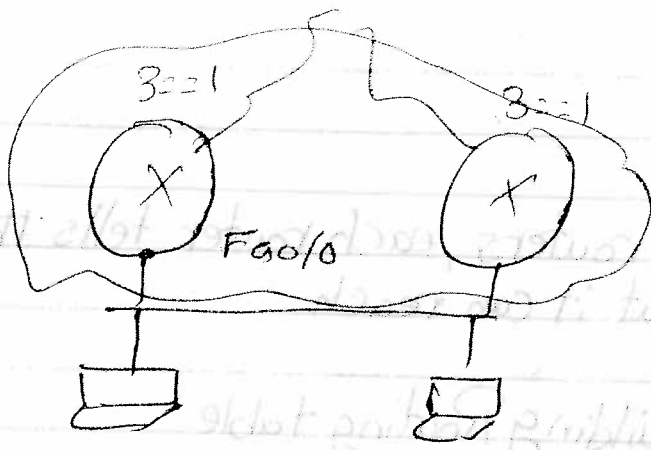
FE00::0:0:0:0-X

64bit.

* AnyCast * One to any :- Redundancy & load sharing



1 big virtual server
So -> Redu
-> load sh.



* Routing protocol
 - The exchange betw
 about the network that is connected with the

1 Virtual Router

d.g = 3 == 1 by - Manually

- Auto config
- dynamically

* on Router Built in

(Config) # int Fa 0/0

(// - if) # IPv6 address 3 == 1 / 64 any cast

Infinite no. of routers.

* Routing Protocols

→ It's exchange betⁿ routers, each router tells the others about the networks that it can reach.

→ The final target is building Routing table.

* Routing Procedure

1 - check IOS validity for required Rip & Red protocols.
→ License + version checking

2 - check if router processor is active

(Config) # ip routing : exist by default on routers

→
on IPv4

on IPv6 its not active so we need to activate it by using

(Config) # IPv6 unicast-routing : doesn't exist by default

sh IPv6 route

3 - Activate The Routing Protocol.

(Config) # router rip in rip Mixed rip (1+2)

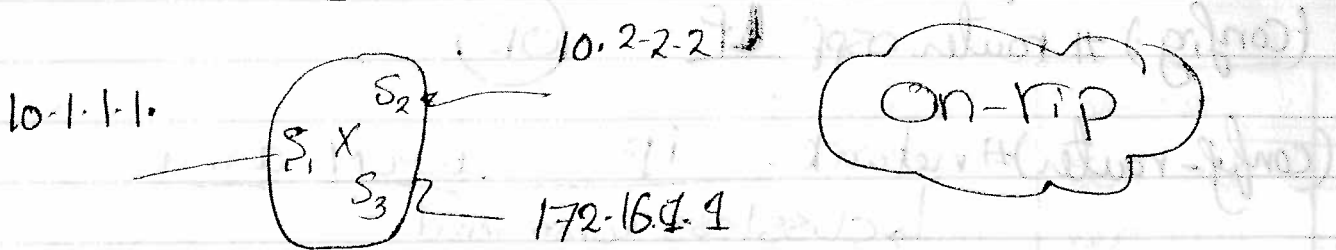
" # version 2

ospf global Process = AS # 1 → 65535

ospf local Process = Process ID # " 10

config-router)# network 10.2.2.2 / 24

Ex: on all routing Protocols :-



For rip

Classful Cmd: \rightarrow (config-router)# network 10.0.0.0 / 8

(config-router)# network 172.16.0.0 / 16

Classful Cmd:

A: 0.255.255.255

B: 0.0.255.255

C: 0.0.0.255

like: wild Card Mask

To Not use certain Serial # passive - interface #

#network passive-interface

On-OSPF

(config) # router ospf IP (OR)

(config-router) # network IP w-CM area
↳ classless command

router ospf 1

S₁ → network 10.1.1.1 0.0.0.0

S₂ → , , , 172.16.1.1 0.0.0.0

On Eigrp

(config) # router eigrp

(Config-router) # network IP [wildcard Mask] optional A
is cāv (N) interfaces ll je wā ↓

By default classful cmd. & it can be changed → cmd

On OSPF

(OR) (config) # int S₁ ip ospf 1 area 0

(Config-if) # ip ospf 1 area 0

(config) # router ospf 1

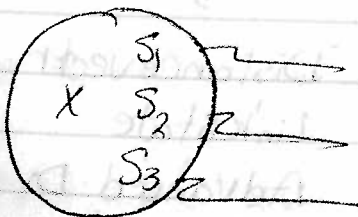
→ No of IPs that I can reach

4- Routers will send/receive updates.

5- Forming routing table

Protocol	Prefix Network	Prefix length Mask	Distance	vector
C L: local R D DEX	10.1.1.0	12	[120/3] AD Metric 120 9017015=summary 1515=115 ospf=110 BGP=20 eigrp=9017015 Rip=120 hop Cost = $\frac{10^8}{Bw}$ Composite ($\frac{10^7}{Bw} \times 10^{del}$)	So IP of next hop So 1.1.1.1
C: CIS				
0 OIA OE1 OE2 ON1 ON2				

L: local = this is my IP



R	15.0.0.0/24	[120/3]	S1
O	"	[110/128]	S2
D	"	[90/20xxxxxx]	S3

lagim nbs network

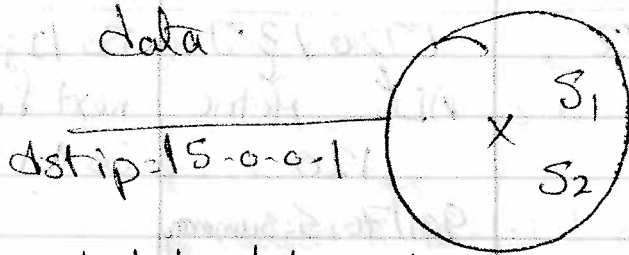
Least Admin distance if not admin then least metric.

en load balancing Max 4 paths, by default 16 or more by config. MAX 4

CCNP

Different Mask

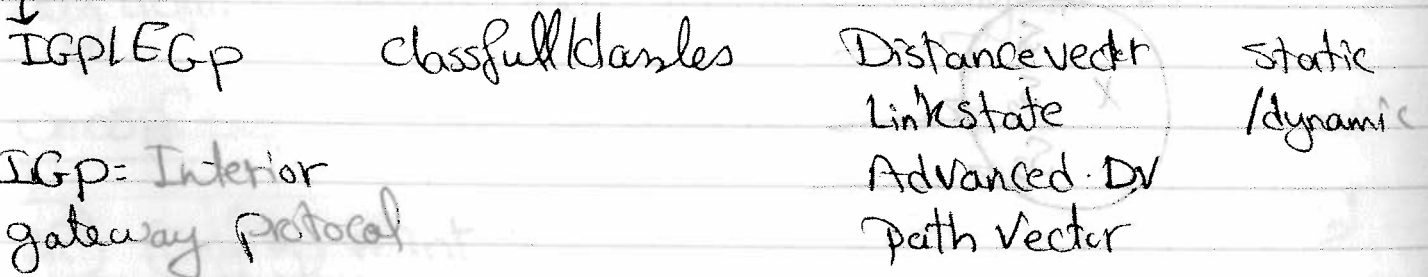
R	150.0.0.0	/28	[120/3]	S ₁	16 IP
B	"	126	[110/128]	S ₂	64 IP
S	"	124	[90/20x--]	S ₃	256 IP



Longest bit Match "Longest Mask
More specified 128

- Least admin
- Least metric
- load sharing

* Routing table classification *



IGP: Interior gateway protocol

routing protocols that work inside As

EGP: Exterior gateway routing protocols that work betn As.

As: Group of devices under single technical administration

IANA Made As no: 1 → 65535

As private no.s

(64512 → 65535) For configuration

IGP/EGP Protocols:

IGP			
Rip	RipV2	↙	→ EGP
IGRP	Eigrp	↘	→ BGP
ISIS	ospf	✓	

classful / classless

classful = doesn't send Mask ⁱⁿ updates

Rip V1, IGRP, EGP

classless: Send Mask in updates

RipV2, Eigrp, ospf, ISIS, BGP

Distance vector Link state

Advanced DV Path Vector

(Rip, Igrp)

(ospf, ISIS)

Rip2, EIGRP (BGP)

↓
(hybrid)

Static / Dynamic

Static: If network is simple one path exists to dst

Dynamic: If network is complex many paths exist to dst

(Static)

(Config) # ip router IP network vector (Metric)

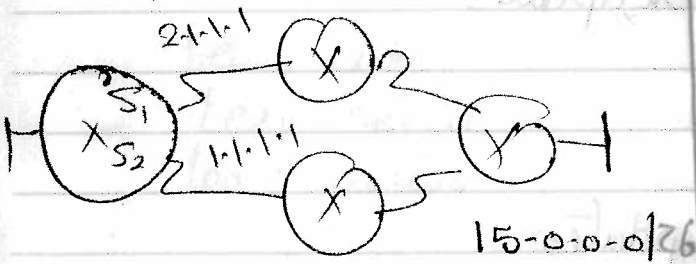
admin = 0 / 1

(Dynamic)

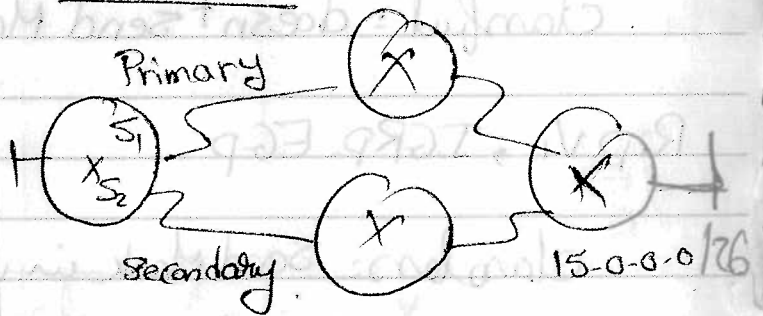
(Config) # router name of the protocol

(Config-router) # network _____

Static
* Load balancing *



Dynamic
* Redundancy *



(Config) # ip route 15.0.0.0 255.255.255.192

(Config) # S1 1.1.1.1

(Config) # ip route 15.0.0.0 255.255.192 S1

(Config) # ip route 15.0.0.0 255.255.255.192 S2 10

Kadafesh Far2 ben
Serial & next hop.

Kda huzmel load balancing
Bade.

(AD) قائمة
مخارج

No delay time at Floating
static when there is
a problem & we need to
use the Secondary
path

NTP: Network Time Protocol.

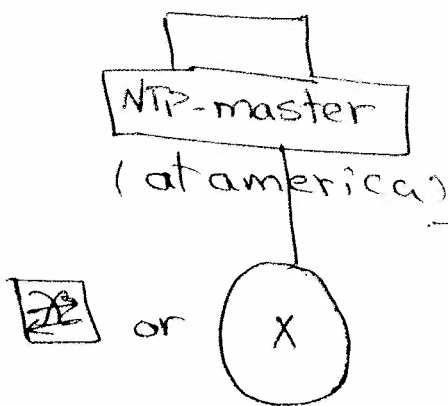
* 4-10-2015 *

It's an app, using UDP Port 123
Used to synchronize network device time.

* Network Management

- NTP
- SNMP
- NetFlow
- IP SLA

atomic clock
contains = cesium



→ Send msg contains
timers to devices
in hierarchical
design
for security & network
management.

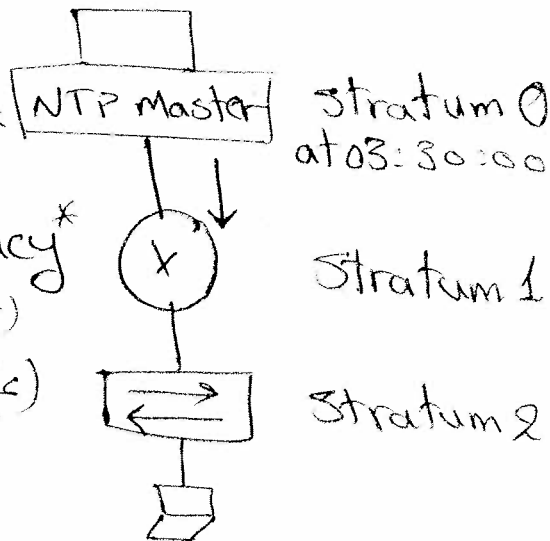
* To assign the time

Dynamically by using master device
& send to other device acting as
a server for ex of router → server.
at any place'

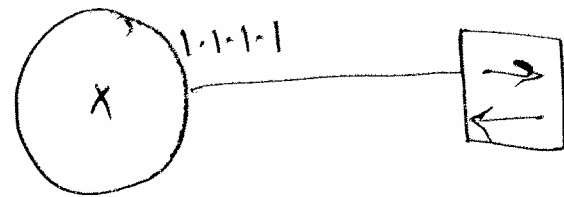
* higher accuracy*
(directly connected)

because of delay

* Least accuracy*
(1 hop) (←)
(2 hop) (←←)



(Stratum no: 0 up to 15)



@ server

NTP server

NTP client

(Config) # NTP master 1 → = server
 ↳ 1 = stratum
 @exam master 10
 so stratum 10

@ client

(Config) # ntp server 1.1.1.1
 to be master to other devices
 أنه اول ما يفتح في اخره
 1.1.1.1 server

(Config) # ntp master 2

(Config) # ntp broadcast
 ↓
 accept broadcast from
 server. (@exam)

BC كل server كل 5 min
 يقول لا devices
 master في كل 5 min
 وكتب ال cmd في الجا
 وهو انه
 by default

For Authentication It's optional cmd (null/md5)

@ client

(Config) # ntp server 1.1.1.1 [key 1]

(Config) # ntp authentication -key 1 md5 cisco
 Pass.

@ server

(Config) # ntp authentication -key 1 md5 cisco

SNMP - Simple Network Management Protocol

It's an app. on UDP port 161, 162

It's used to monitor all network devices

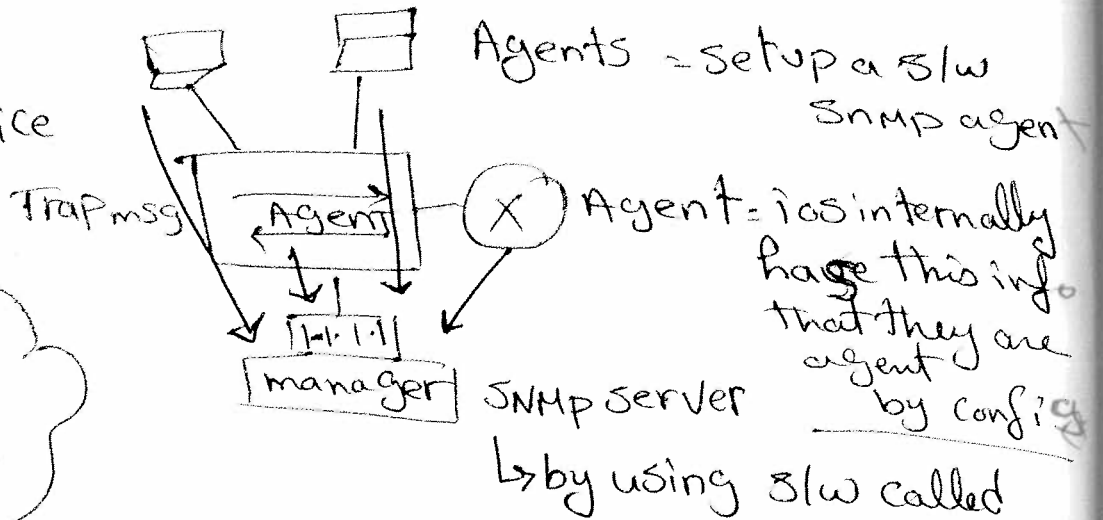
in order to draw network topology & detect any changes on any device by reading traps from agents (devices)

After drawing the topology we can write (Read write) on the devices (Configure them remotely).

real's OSPF vs virtual links OSPF

أقدر ادخل على أي جهاز عن طريق البرمجيات في الشكل التالي
 الشبكة و بديلة عن أي البرمجيات، بدلاً من
 instead of .telnet / SSH.

Agent: the managed device



- NMS
- Cisco works
 - IBM Tivoli
 - HP open view.

NMS: Network management station / servers s/w.

Ex: Cisco works

Info in trap msg called MIB - Management Info-Base (List of things needed to be managed)

- CPU
 - Memory
 - Proto.
 - Config. change
- MIB List

عند إعداد
 By default all info will be sent & we can optimize

SNMP operation is IMAMN
Trap is sent From MIB of Agent to Manager NMS

* SNMP Versions

SNMP Version 1 - Limited MIB (disadvantage)

- No Security use Community string
(network name)

Same Community string for NMS & agents (CIB, ...)

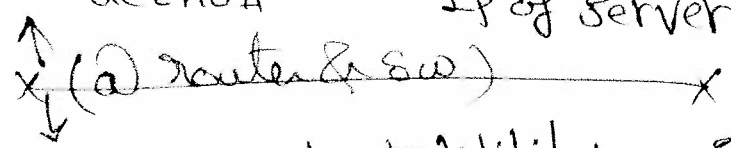
(Config) # snmp-server community-string CIB (on Rts / Swes)

(Config) # snmp-server community-string CIB ro or rw 10 (acl)

(Config) # access-list 10 permit 1.1.1.1
acl no # IP of server

↳ read ↳ read/write
اقرأ و اكتب

OR



(Config) # snmp-server host 1.1.1.1 trap {v1/v2} CIB ro/rw

(By default rw)

IP server

version 2c

exam

(& by default v1)

↓
Community string name

SNMP Version 2

- Extended MIB
- No security

SNMP Version 3

- Extended MIB
- Security

Confidentiality
الطمأنينة
(encrypt msgs)

~~Identity~~
Integrity
الطمأنينة
الرسائل والبيانات
من التغير

Authentication

(unchanged msgs)

SNMP Version 3 modes on authentication

- No auth
 - No privacy (encryption) } mode (1) (no auth no pri) Like V1 & V2
- & use username instead of community string

(c) [(config)# snmp-server host 1.1.1.1 trap version 3 no auth ^{user}nam

(c) no auth so use username-

(c) Mode 2

- ~~no auth~~ no priv → auth is ok & no encryption.

(config)# snmp-server host 1.1.1.1 trap ver 3 auth

(c) Mode 3

auth priv → auth & encryption

(config)# snmp-server host 1.1.1.1 trap ver 3 priv

to show these statistics

show ip flow-export

(a,b) choices.

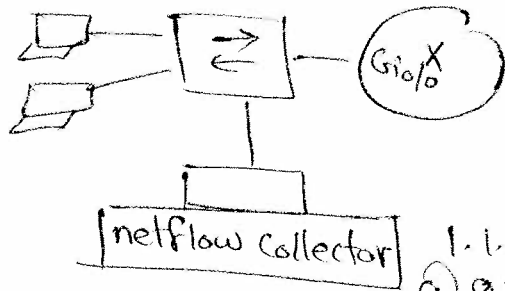
* to check router memory *

exam {memory utilization}

show memory summary

show memory allocating-process table

instead of show export we can use a server instead of router; (server has a netflow s/w)



(Config) # ip

assign the port no. more than 1024 (5858)

(Config) # ip flow-export destination 1.1.1.1 UDP Port no 5858 #

To know that there is a session betⁿ router & server

show flow exporter →

1.1.1.1	5858	return code = ok
---------	------	------------------

↓
means collector status is ok

(display)

it shows the current state of server

Server status is ok

Recommended use (cef) to decrease the processing

IP SLA For network management For monitoring
Service level agreement

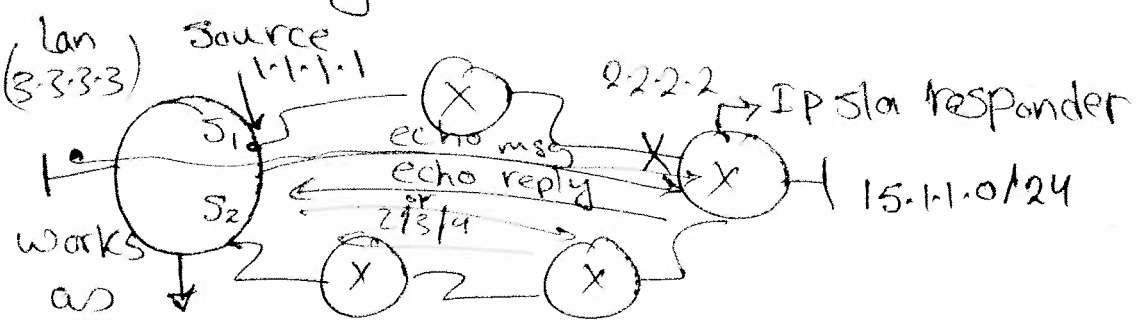
It's a service used to generate bogus traffic betn devices in order to detect delay, Jitter & Packet Loss

Jitter: delay variation

Exam

Problems @ realtime app.

Suitable delay: 150ms for voice



Traffic generator

Exam

- 1 - icmp - echo
- 2 - RTP - Jitter
- 3 - TCP sessions
- 4 - HTTP, DNS, DHCP, ...

Router can be traffic generator or responder

Show ip sla statistics.

↓
 delay
 Packet loss

To make these types (gene / resp)

SLA Source

(Config) # ip sla 11

(Config-sla) # icmp-echo 2.2.2.2 source 3.3.3.3 num-packets

create

↓
ip of source
number of packets
= 10
Exam

(Config-sla) # frequency 5 Exam
(Activate) ↓
sec

(Config) # ip sla schedule 11 start-time now Life Forever

or certain time

(Config) # ip route ~~15.1.1.0 255.255.255.0~~ S1 track 2

+
(Config) # track 2 sla 11
↳ = track 2.

if cable failed back to fig.

Q show ip sla statistics

return code : ok
↓
sla is ok

if not ok
ip route S Backup del p18's

(Config) # ip route 15.1.1.0 255.255.255.0 S2 7

↓
metric

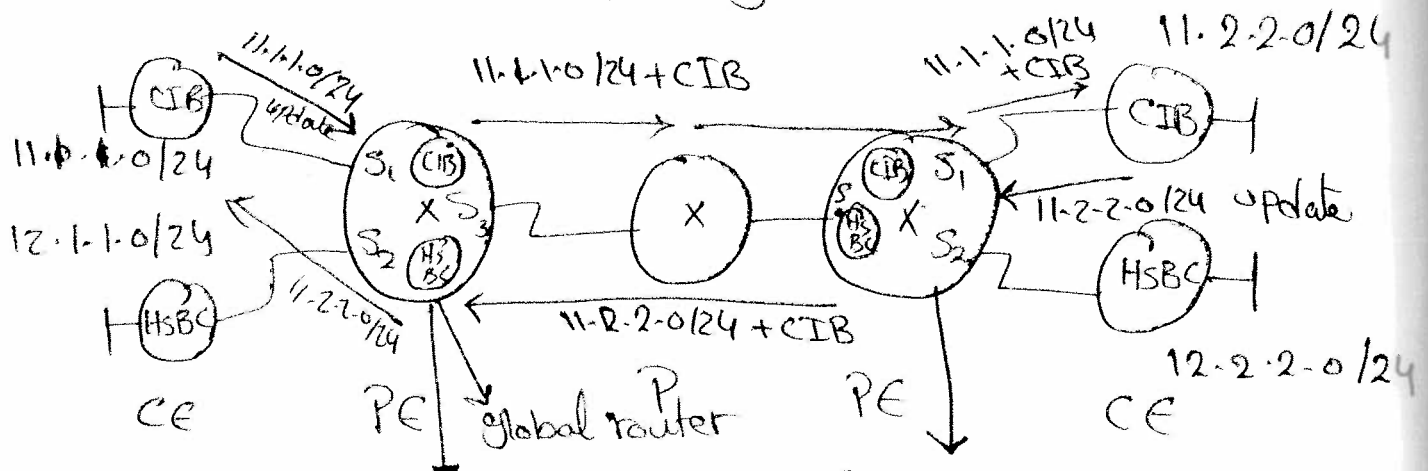
at AD not used

VRF Virtual Routing & Forwarding (Cisco)

It's a technology used to form network virtualization, that technology is used by service providers & big enterprises to separate csts routing updates & data.

⇒ VRF helps in

- network separation
- Increase network efficiency
- Easier network optimization



(FIB) Routing table CIB

0	11-1-1-0/24	S1
0	11-2-2-0/24	S3

Routing table HSBC

D	12-1-1-0/24	S2
D	12-2-2-0/24	S3

Routing table CIB

0	11-1-1-0/24	S1
0	11-2-2-0/24	S1

Routing table HSBC

D	12-2-2-0/24	S2
D	12-1-1-0/24	S0

I can use diff. Proto & ID

```

PE1(Config) # ip vrf CIB
(Config) # interface S1
(Config) # ip vrf forwarding CIB → Delete the previous IP
(Config) # ip address IP mask → create global table
(Config) # router ospf 1 vrf CIB → global router → VRF
(Config) # network _____
activate
create
    
```

```

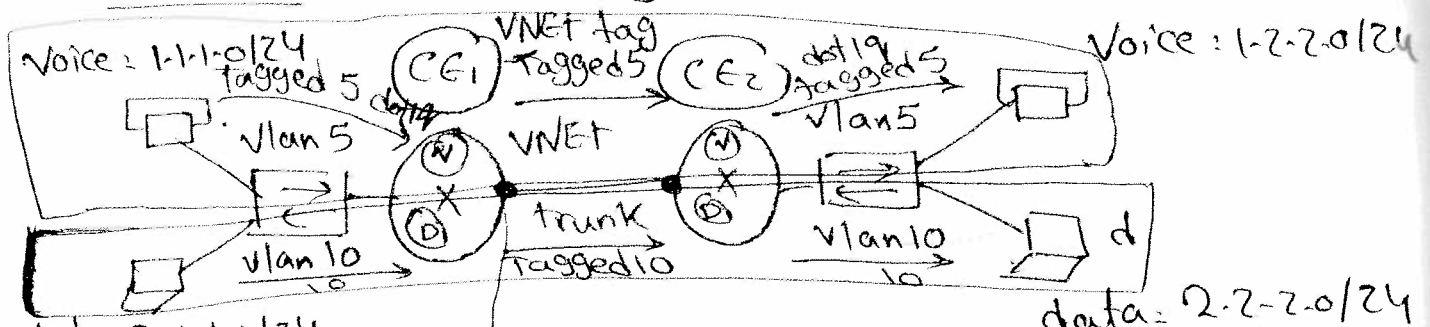
PE 1(Config) # ip vrf HSBC
( " ) # int 32
( " - f ) # ip vrf forwarding HSBC
( " - " ) # ip address _____
(Config) # router eigrp 100 → not related to AS
(Config-router) # address-family ipv4 we can give a name vrf HSBC
( " - " ) # autonomous-system 1
( " - " ) # network _____ ↳ no of as

```

@ exam make as after vrf add-family cmd

There is (VRF Lite) used in (CE) not (PE)
(Separating data & voice)

→ VRF-Lite = EVN Easy Virtual (Network / WAN)



VNET trunk: Virtual Network trunk.

```

@ CE1
(Config) # vrf definition data @ voice voice
(Config-vrf) # vnet tag 10 5
(Config) # interface _____
(Config-if) # vnet trunk
( " - " ) # ip address _____

```

to make it trunk

Same 4 byte of (dot10) vnet

encapsulation
 @ exam a - dot10 encap
 ↳ no need for subinterfaces
 @ exam

VPN = virtual private network :-

- MPLS VPN: (out of course scope)

- Tunnel based VPN:

* GRE Tunnel

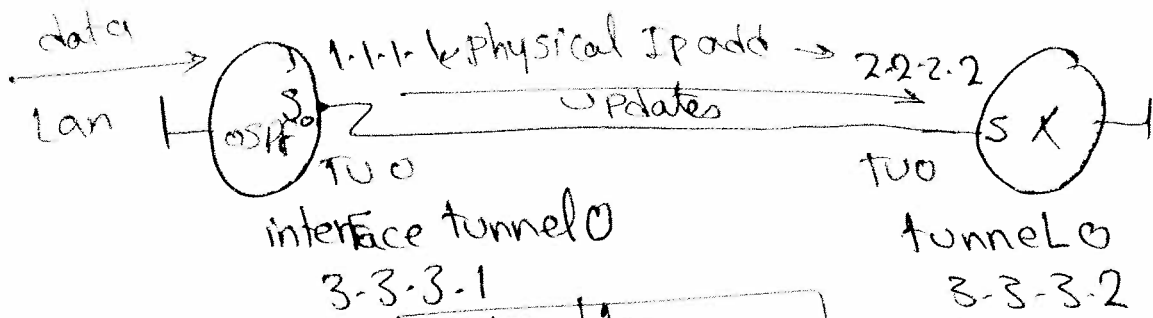
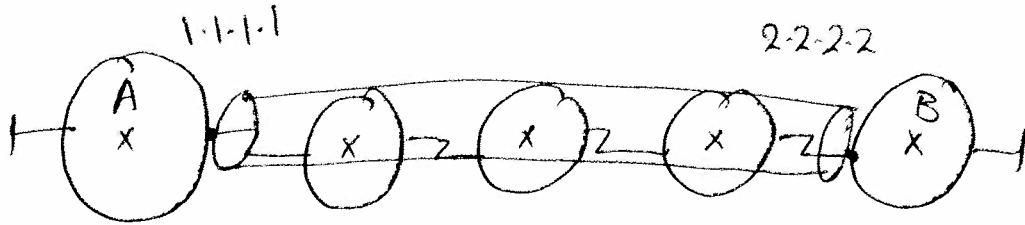
* DMVPN

* multipoint GRE (mGRE)

* IPsec

GRE Tunnel Generic Routing Encapsulation.

- It's protocol no-47 @ exam (acl deny proto.47) @ used to encapsulate any other proto. (IPV4, IPV6, IPX)
- It works unicast & multicast (ospf, Eigrp, Rip2)
R.B or R.A to data network



src IP 1.1.1.1	dst IP 2.2.2.2	Lan data
-------------------	-------------------	----------

{ virtual int del }
tunnel 0

(Config)# int tu 0

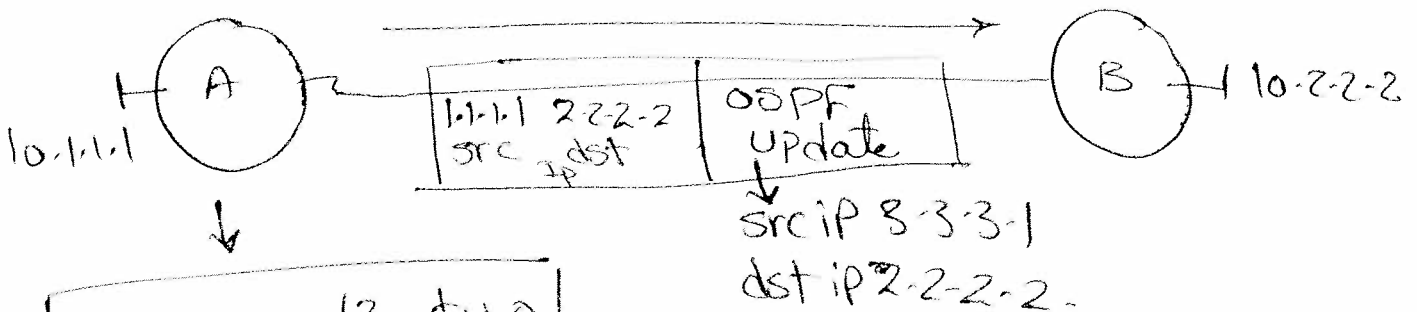
("-if)# ip address 3.3.3.1 255.255.255.252 130 (PTP)

("-")# tunnel-source 1.1.1.1 dst ip 2.2.2.2

("-")# tunnel-destination 2.2.2.2

("-")# tunnel-mode gre by default

if I wanna work as ospf prot betw R.A & B

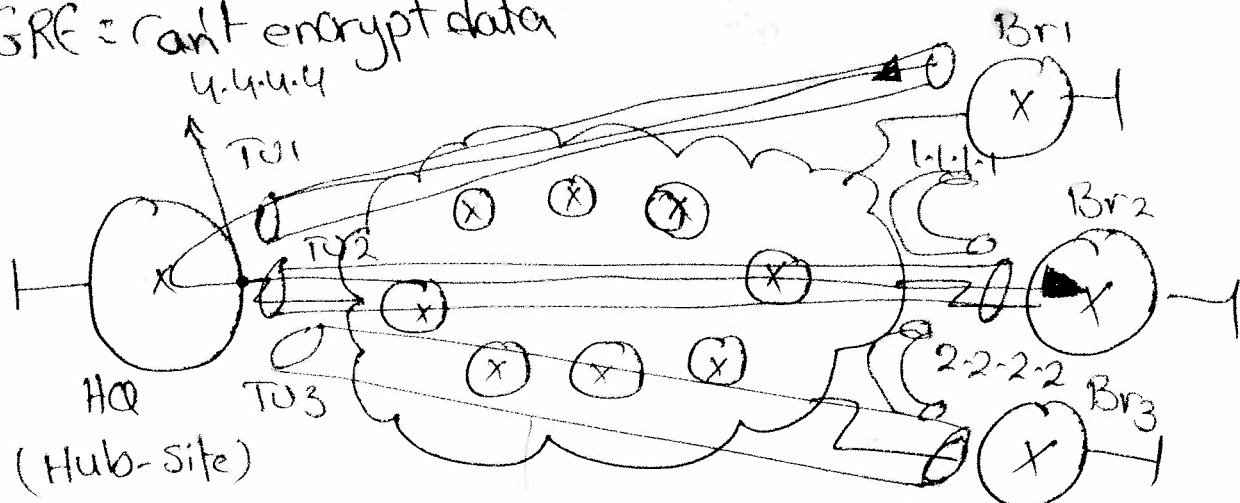


c 3.3.3.0/30 tu 0

router ospf

network 3.3.3.1

GRE = can't encrypt data
4.4.4.4

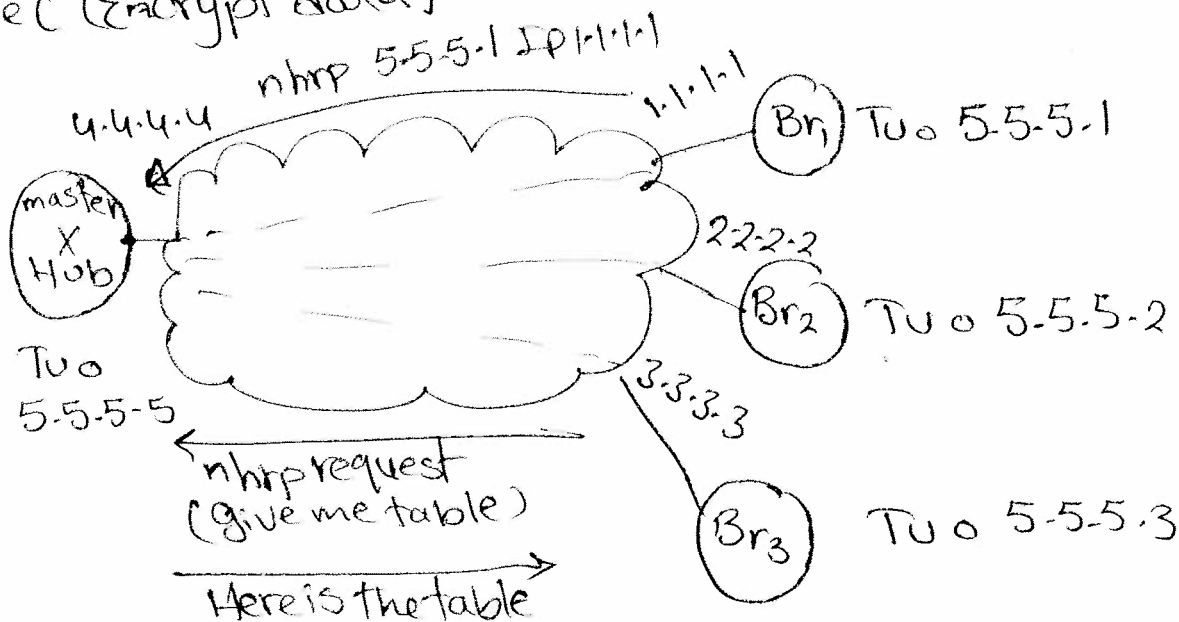
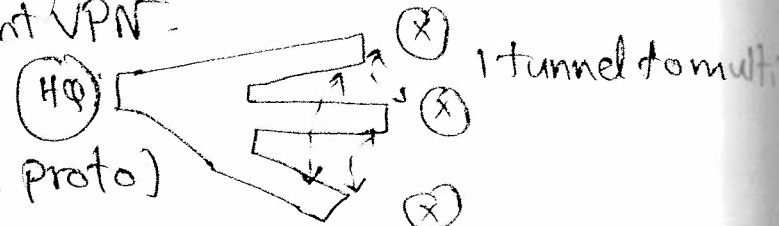


→ There are so many tu & cmds 3.3.3.3
It's so much & we will make tunnels betw branches.

DMVPN Dynamic Multipoint VPN

we use:

- mgre (multipoint gre)
- nhrp (next hop resolution proto)
- IPsec (Encrypt data)



make tunnel & hiding So we will make nhrp table / each next hop & give physical IP.

TU0	IP Physical
5.5.5-1	1.1.1.1
5.5.5-2	2.2.2.2
5.5.5-3	3.3.3.3

nhrp (table)

if Br needs to connect to another so Br will ask the HQ about nhrp request = give me a table & HQ will reply here is the table

So at all branches

not PTP (PTM)

↓

```
# int tu0
# ip address 5.5.5.X 255.255.255.0
# tunnel-mode gre multipoint
# tunnel-source x.x.x.x
# ip nhrp map 5.5.5.5 4.4.4.4 → out master
# ip nhrp map multicast 4.4.4.4 →
```

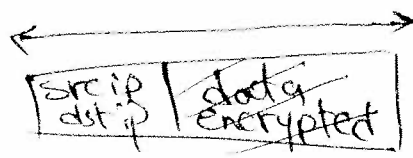
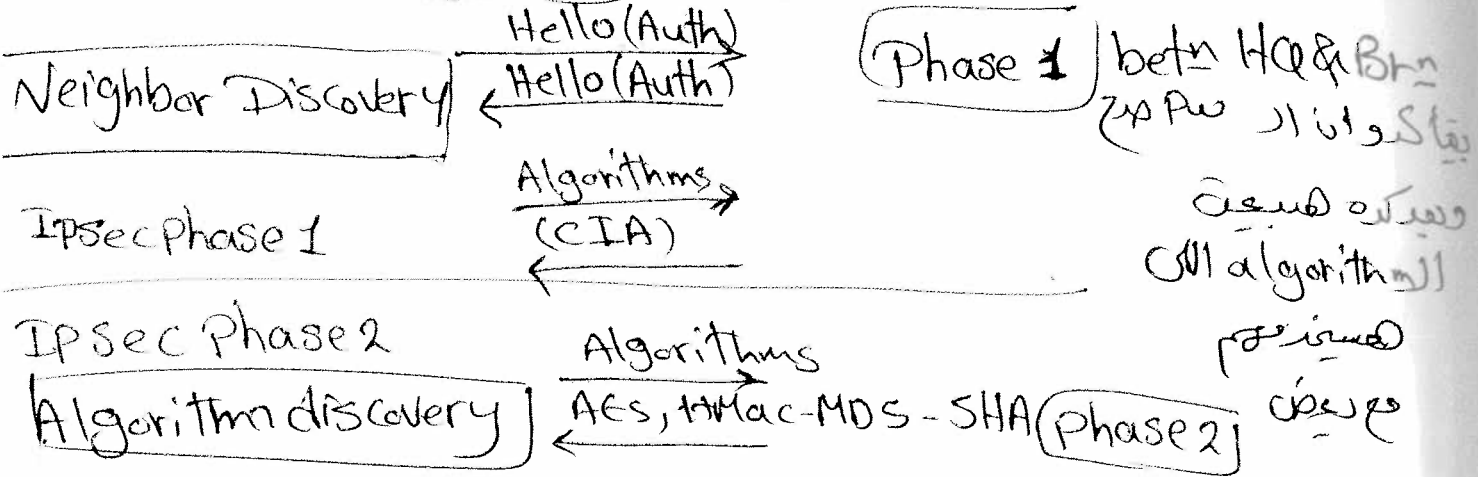
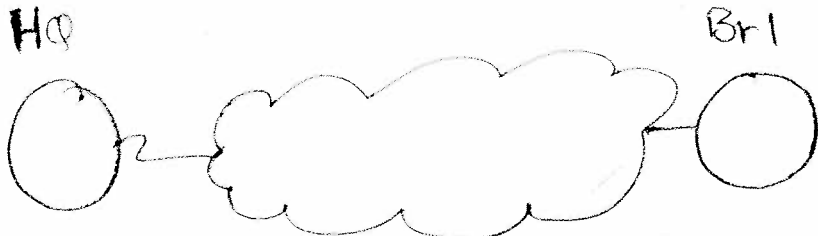
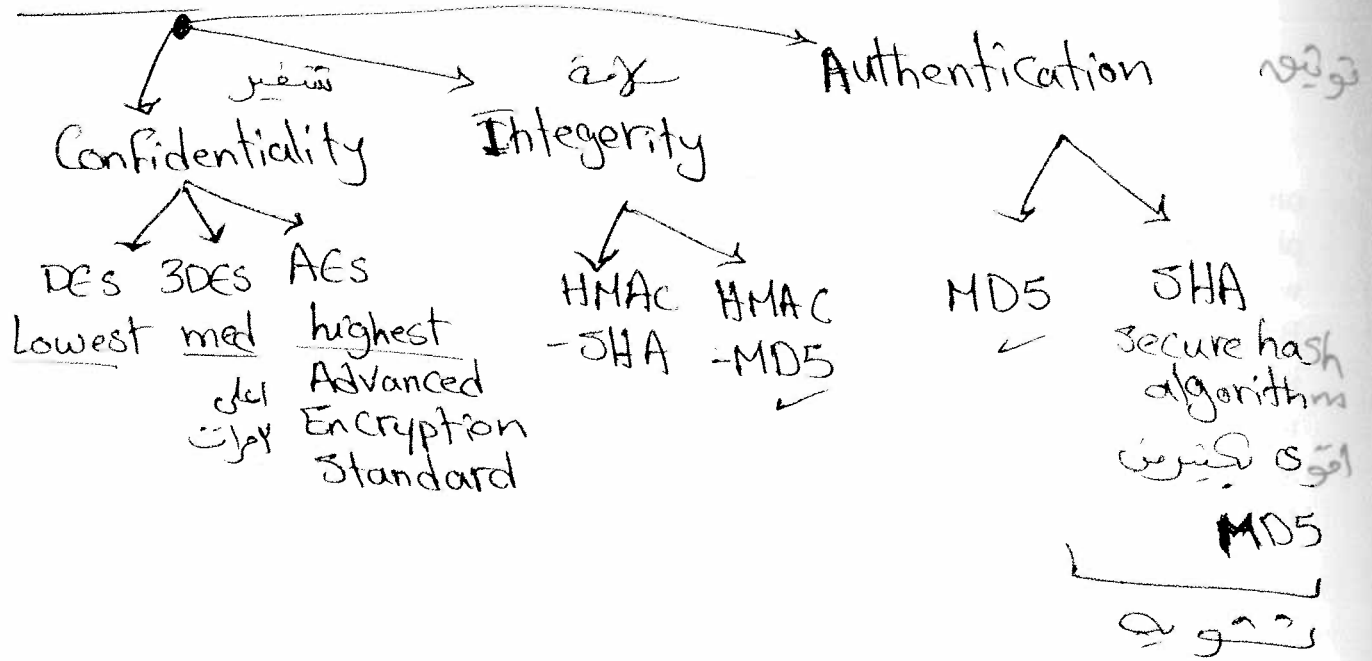
مفاتيح
التي تعرفه الوصول
IP Phy
وال تعرف ال
Tu0

HQ

```
# int tu0
# ip address 5.5.5.5 255.255.255.0
# tunnel-mode gre multipoint
# tunnel-source 4.4.4.4 →
# ip nhrp map multicast dynamic →
```

لانه مفاتيح ان
Brs
التي تعرفه الوصول
HQ

IPSec :



IPv6 Que 2

Dual-Stack Method: it requires edge routers to run both IPv4 & V6 while inside the routers only run (IPv4). At the edges IPv4 packets are converted to IPv6 packets before sending out.

6 to 4 tunnel (Tunneling) (IPv6 Packet in IPv4 packets for delivery across IPv4 infrastructure)
it's a technique relies on reserved add. space 2002::2/16
it determine the appropriate add.

IPv6 network over IPv4 sites
رouters (التي كالتالي) tunnel ال IPv6
Path. , ()

NAT-PT:

Provides IPv4/IPv6 Protocol translation

By installing it betⁿ IPv4 & IPv6 network. all IPv4 users are given access to IPv6 network without modification in the local IPv4 hosts.