Subject: ICND 2

Year. Month. Date. ( )

Review

How to get the most from this series:

Repetition, Repetition, Repetition
Take notes, Write down "key" info
Build a lab "GNS3" / Viral away!
Study Hard, Dig Deeper, Fall in "Love"

GNS3 $\xrightarrow{NO}$ S0/0
(S1/0 Instead)

Differences between GNS3 and Actual H.W
Video 03

Some Base Conf Already there.

GNS3
3. Already has "logging synchrous" command → (Config-line)#

1. Hostname R1

2. Telnet and Console Password:

(Config)# line vty 0 4
(Config-line)# Password " "
} Telnet

Console:
(Config)# line con 0
(config-line)# Password
(config-line)# login

No Password by default
Pass enables by login cmd

4. (Config)# line con 0
(config-line)# no exec-timeout
or
exec-timeout 0

PAPCO

(Config)# Service Password Encryption (encrypts Passwords with weak Algo)

Subject:
Year. Month. Date. ( )

(Config)# enable Password → Anybody sees (Show Run Cmd)
(Config)# enable Secret → Hashed Password

Preventing mistyped commands in previleged mode from Hanging for 30 sec:
(No telnet to incorrect places "typed words".) → No asking DNS
(Config)# NO IP Domain-lookup

Log-on Banner: → delimiting Char "أي حرف"
(Config)# banner motd %
⋮ } → banner
% → done

(Config)# int s1/0
*(Config-if)# no shutdown

Video 5

Basic Rip V2 Commands:

R3(Config)# router rip
R3(Config-router)# version 2 → Class less (different Subnet masks)
# no auto-summary → needed Must

1. (except) # network 10.0.0.0
advertise to networks starting with 10

show ip protocols
show IP route

2. # Passive-interface fa 0/0

Or 1. # Passive-interface default → more secure method
2. # no Passive-interface serial 1/0

PAPCO

* Layer 3 switches: No IP Routing *

Subject: Video 6
Year. Month. Date. ( )

Static Routing: going on each router and: (router connected to the internet) default Route
R2(config)# ip route 0.0.0.0 0.0.0.0 10.24.0.1

Or

Simply use Rip Protocol and Let it do the work for us:
R1 is our default route
R1(config)# router
* (config-router)# default information originate
(Send info about default route to other routers)

R3
or
if: R2# Show IP route
R* 0.0.0.0/0 via 10.24.0.1
Rip learned

Video 7: Trunking & Vlan

S1(Config)# int fa 1/1
S1(Config-if)# Switchport mode trunk
(if old sw: Pick encapsulation First dot1q)

S1# show interfaces fa 1/1 switchport (Checking trunking enabled)
S1# show cdp neighbour (Cdp: Cisco discovery protocol)

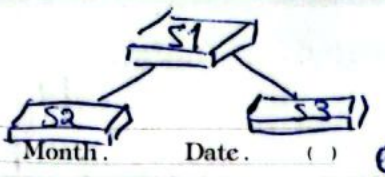
Vlans: (using VTP to save configuration time)

Default (Vlan 1): 10.24.0.0/24
Accounting (Vlan 5): 10.24.5.0/24
IT Team (Vlan 2): 10.24.2.0/24

Scenario
Giving Flash Memory in setting
UTP is not a Supported feature in GNS3
Cisco Best Practice

S1# Show VTP status
* VTP Domain NAME *
VTP Mode server/client/transparent
S1(config)# VTP Domain CBTNUGGETS

PAPCO



Subject:
Year. Month. Date. ( )

Vlan
ensure these Vlans (and the default) are the only Vlans allowed to pass between all switches.

S1(Config)# interface range fastEthernet 1/1 -2 (two interfaces Selected)
S1(Config-if-range)# Switchport trunk allowed vlan 1-2,5,1002-1005

S2(config)# int fa1/0
S2(config-if)# switchport trunk allowed vlan 1-2,5,1002-1005
Must Be there

S3 → Just like S2

Video 8 Router on a stick & DHCP *Must watch Video

R1(config)# int fastEthernet 0/0.2 ← → Sub Interface Num
R1(config-subif)# encapsulation dot1q 2
R1(config-subif)# ip address 10.24.2.1 255.255.255.0
R1(config)# int fa0/0.5
R1(config-subif)# encapsulation dot1Q 5
R1(")# ip address 10.24.5.1 255.255.255.0

DHCP server for Vlan 2&5:

2.100 ~ 2.150

R1(Config)# ip dhcp excluded-address 10.24.2.1 10.24.2.99
" ip dhcp " 10.24.2.151 10.24.2.255

Same for
5.1 5.99
5.151 5.255

DHCP Pool:

Vlan

R1(config)# ip dhcp pool IT
R1(config)# Network 10.24.2.0/24
R1(dhcp-config)# dns-server 4.2.2.2 8.8.8.8
R1(dhcp-config)# default-router 10.24.2.1

=> Same for Accounting Vlan

Video 9 NAT

gns 3 → needs more memory

Subject:

Year. Month. Date. ( )

First step in NAT: What are Inside/OutSide interfaces?

```
R1(config)# int s1/0
R1(config-if)# ip nat outside
R1(config)# int fa 0/0
R1(config-if)# ip nat inside
R1(config-if)# int fa 0/0.2
R1(config-subif)# ip nat inside
R1(      "      )# fa 0/0.5
R1(      "      )# ip nat inside
```

Second Step in NAT: Creating an Access List that Identifies "what terrafic shaud be NATed out".

Nammed Access List: (Name of Access list)

```
R1(config)# ip access-list standard Nattable
R1(config-std-nacl)# permit 10.24.0.0 0.0.0.255   → wild card → Vlan 125
                    "       10.24.2.0 0.0.0.255
                    "       10.24.5.0 0.0.0.255
```

Check command ⇒ do show ip access

```
R1(config)# ip nat inside source list Nattable ***
                                  ***
```

(Access list; *** → interface serial 1/0 overload)

Check Command ⇒ R1(config)# ip nat translation (after Ping)

PAPCO

Standard ACL

Video 10:

Subject:

Year. Month. Date. ( )

Only Inside network can use ssl/telnet

R2(config)# ip access-list standard LIMIT_TELNET
R2(config-std-nacl)# permit 10.0.0.0 0.255.255.255
*R2(config-std-nacl)# deny any *

Check Command ⇒ R2# show access-lists

Inbound

R2(config)# line vty 0 4
*R2(config-line)# access-class LIMIT_TELNET in *

Check Command ⇒ R1# telnet 10.24.0.2 /source-interface s1/0 → outbou

Connection refused by remote host

*Config should be done on All of our network devices * switches & Routers

P4PCO

Security tip: Never use vlan 1 anywhere especially on trunk connection

Subject: Video 24 Core routing - Routing Table

Year. Month. Date. ( )

Not All routes but bests of the bests

Rip Config:

```
R1(Config)# router rip
R1(Config-router)# version 2 (classless version)
R1(Config-router)# network 10.0.0.0 (lazy Config)
```

Check Command => R1#Show ip route

Rip update time is 30 sec

↓ output sample

```
R   10.34.34.0 [120/1] via 10.13.13.3,   Serial 1/1
R   10.24.24.0 [120/1] via 10.12.12.2,   Serial 1/0
C   10.13.13.0 is directly connected, serial 1/1
C   10.12.12.0 is directly connected, serial 1/0
R   10.4.4.0 [120/2] via 10.13.13.3      Serial 1/1
             [120/2] via 10.12.12.2      Serial 1/0
C   10.1.1.0 is directly connected, FastEthernet 0/0
```

6 subnets

hops

124

Redundant Routes

C distance is 0

3

Criteria that must be considered:

1. Next hop → /24 is more specific than /16
2. Route specificity → Forgotten criteria
3. Administrative distance (Default Distance Value Table) lower is Better
4. Metric

Connected interface	0
Static Route	1
EIGRP summary	5
External BGP	20
Internal EIGRP	90
IGRP	100
OSPF	110
IS-IS	115
RIP	120
⋮	
Unknown	255

Floating Static Route "works for backup Route"

```
R1(Config)# ip route 10.4.4.0 255.255.255.0 10.1.1.254 "121"
```

Distance Metric for this Route

IF Rip Routes do not work or goes down, then next best route would be best distance after 120

Standard Rip Default Distance Value

121 ← used for a custom back up Route is Rip goes wrong

PAPCO

Video 25 Distance Vector vs Link State

Subject:

Year. Month. Date. ( )

*DV

Only knows what the neighbor tells it

Memory / Processor efficent

* Loop prevention mechanism needed

*LS (OSPF, ISIS)

Maintains a map of the network system

Resource Consuming

* Loop Free by nature

Most of the time/majority of protocols are DV → RIP, EIGRP, BGP

DV only knows what the neighbor tells it, therefore there's chance that looped info comes in. No Big Picture Vision

Link State

BGP is an exterior protocol

RIP, EIGRP are interior protocols (CCNA Focused-on)

RIP LOOP → caunt down to infinity ← Putting mirrors Face to Face

"advertising a dead link which was advertised by neighbors beforehand" and adding hops

Loop Prevention Mechanism:

Triggered Updates "sends an update immdiately after a failure" "link is dead after t wards"

Maximum metric "rather than counting to infinity, count to a certain number"

Route Poisoning "Immidiately set the metric to the maximum and poision it"

*SPLIT Horizion "Router will not send an update to the interface, that it recieved the update on"

↳ causes most of the problems. → specially in Frame rely networks

solation → using sub Interface

SPLIT Horizion causes problems in EIGRP

One physical Interface connects to multiply locations (NBMA) None Broadcast Multi Access ← Frame relay, MPLS, ATM, Metro ethernet

Subject: Video 26 OSPF overview

Year. Month. Date. ( )

Ying Yang: OSPF / EIGRP

EIGRP: Simple (Old) | 1 Priority | Supports Less

OSPF: Complex (new) | 1 Priority | Supports more

OSPF, Link State, interior, maintains LSDB

RFC standard

Only widely used

Protocol (Interior Gateway routing protocol)

Link State Data Base

Global view of the entire topology

OSPF / IS-IS then came Integrated IS-IS

OSPF: Based on TCP/IP

IS-IS: Based on OSI

Integrated IS-IS: adapted to run TCP/IP (super-fast, rarely used) Less than 2%

OSPFv2 / OSPFv3

IPv4 IPv6

NP-IE

Simple Single Area / Advanced Multi Area → Multiple LSDB

CCNA

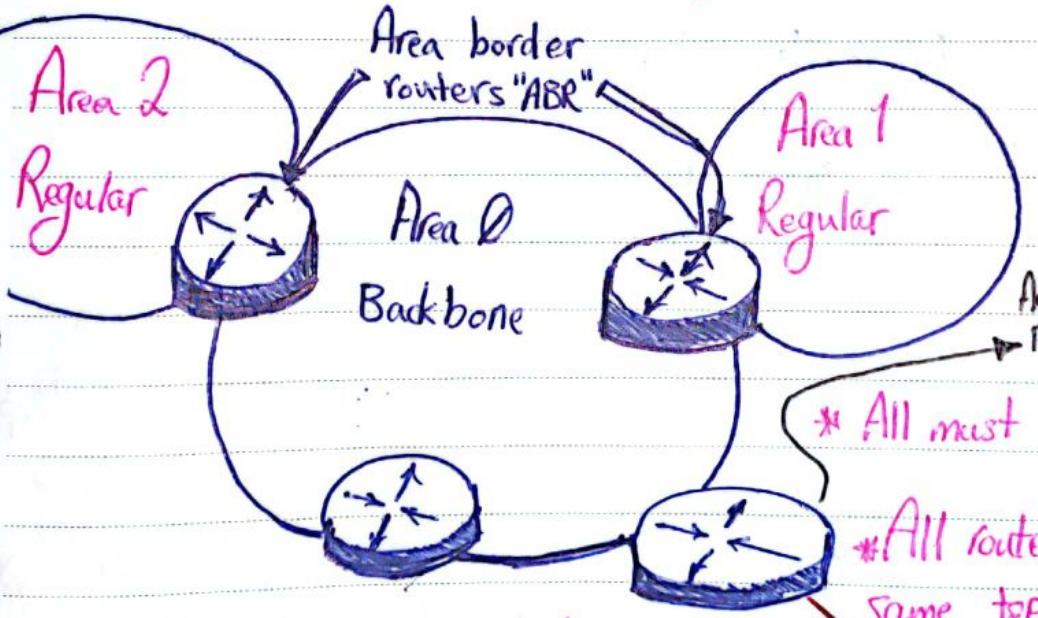
* Both IS-IS & OSPF use DIJKSTRA SPF Algo.

Shortest path first.

OSPF doesn't use UDP/TCP. Stands alone.

↓

has its own acknowledgment mechanism.



Autonomous System boundary Router "ASBR"

* All must connect to Area 0

* All routers in an area have the same topology table.

* Goal: Localize updates within an area

* Requires a Hierarchical design.

↳ Summerization [Between Areas only]

WAN LINK

Partner / Company division

Internet

Areas are mostly divide geographically. "Localized" updates inside an Area. ★

Video 27 OSPF Neighbor Relationships

Subject:

Year. Month. Date. Important topic # troubleshooting # ICND2

if relationship forms, ospf works mostly perfect

1. Determine your own Router ID

Router ID is simply the router's name in the ospf protocol.

How Router ID is going 2 B found: Highest Active Interface IP Address when ospf starts (Loopbacks beat physical Interfaces)

Auto matic

manual: Can be hard-coded using the router-ID command.

R1(config)# router ospf (1) → process ID

R1(config-router)# router-ID 1.1.1.1 → In the form of an IP Address not an IP Address

It's rather name of the router

It doesn't matter what it is as long as it is unique between all the ospf routers in the system.

Check Command } R1# Show IP Protocols

All should be done in the begining

Otherwise causes down time

* Router ID won't change until we reboot the router.

or using command: R1# Clear IP ospf process

2. Add interfaces to the link state database

(Dictated by the network command) to identify

It's kind of like network command in rip protocol. The Idea is which of routers interfaces should run ospf and send "Hello" messages to form neighbor relationship.

Most Important step

Hello message is actually a hello envelope

* 3. Send a Hello message on chosen Interfaces.

- Once every 10 sec on broadcast/P2P networks } By default
- Once every 30sec on NBMA Networks. customizable
- Contains all source of Information:

Router ID / Neighbors / router priority

Hello and dead timers / Network mask

DR or BDR IP Address / Area ID

Authentication Password

First step of troubleshooting OSPF is finding out your neighbor is forming. If not: probably some of info in the hello envelope do not match. This is incompatable neighb

Subject:
Year. Month. Date. ( )

4. Receive Hello

- Check Hello/Dead Interval
- Check Netmasks
- Check Area ID
- Check Authentication Passwords

5. Send Reply Hello

- Am I already listed as a neighbor in your Hello Packet?
  - If Yes: Reset Dead Timer
  - If No: Add as new neighbor

continue

6. Master / Slave Relationship Determined

- Determined By "Priority", Router-ID Breaks Tie (Higher Router-ID is going to Speak First)
- Master sends Database Description "DBD" Packet.
  - DBD = Cliff notes of Link-State DB (summary)
- Slave sends its DBD

7. DBDs are Acknowledged and Reviewed

Slave Requests Details (Link State Request "LSR")
Master Sends Updates (Link State Updates "LSU")
Master Request Details (LSR)
Slave Sends Updates (LSU)

8. Neighbors are Synchronized!

"Full State" (Full neighbor)

Only Send Hello Messages

Now they use DIJKSTRA algo to generate Routing Table.

OSPF Packets:
Hello, DBD, LSR, LSU, LSA, LSACK

Link State Advertisement (Smallest Unit in OSPF Packets)

Every single Routes in the DBD is considered a LSA.

LSA are also inside part of LSUs.

Single Route info

Sends back for every Packet ← Acknowledgement

Except for "the Hello"

Hello, are being Acknowledged by another Hello.

LSA ares inside other Packets. (Inside envelope)

Video 28

Subject:

Year. Month. Date.

DR and BDR → Back up

President — Vice-President

Chosen, Nominated

DR: Designated Router

Any router is in Full Relationship with DR.
Any routing update is only being send to DR.
IF Anything happen to DR then BDR takes the control.

Multicast address that Only DR & BDR tune into: 224.0.0.6

Multicast address for all the routers: 224.0.0.5

* How a router becomes DR? By Priority

R1#conf t
R1(config)#int Fa 0/0
R1(config-if)#IP OSPF Priority <0-255>

never becomes DR or BDR

→ DR Based on Interface basis

*Any Router is DR of its own ethernet segment
*On P2P links there is no DR "All updates goes to 224.0.0.5

Only need DR when we have Multiaccess Segment.
Special network topologies need DR to be configured. → Very Intentional about choosing DR

"Cloud" where everyone think they are fully connected together
But they are not, really!!!

Any router rather than DR & BDR that are in a shared segment (they) are in a 2-way relationship. Do not exchange routes. only Hello and being compatible

* Full Relationships only form with a DR & BDR.

Drother = NOT DR or BDR

OSPF Higher Priority is based on Router-ID, A router with higher router-ID will be the DR if OSPF Priority is not configured manually. → DR & BDR might change places. if want to be static: setup priority

PAPCO

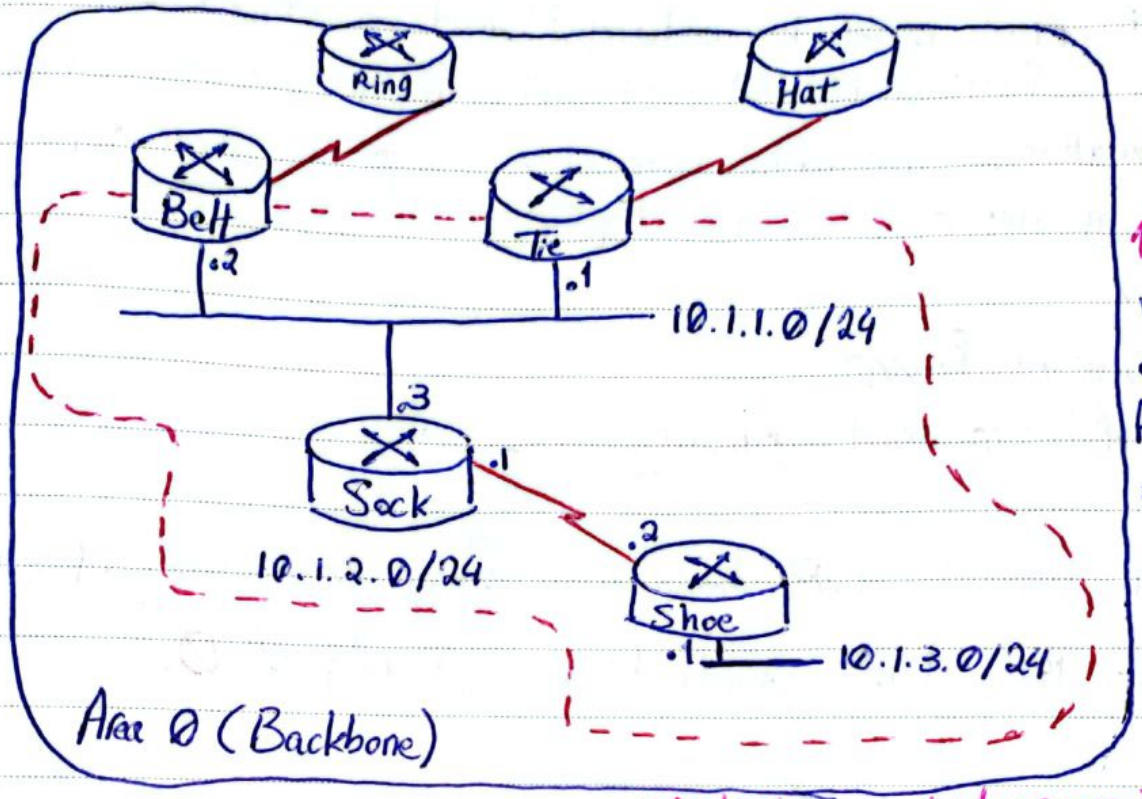
Cisco redundent = CSLU

Subject: Video 29 OSPF Base Configuration

Year. Month. Date. ( )

1982

OSPF should be tweaked based on network speed: 100Mb/1Gb/10Gb/40Gb



Objectives Are 6, On video

1. Configure all routers shown to operate in the backbone Area. Hard code router IDs so they do not easily change.

Shoe(Config)# router OSPF 1 → try to use only 1 process ID

Shoe(Config-router)# router-id 4.4.4.4 → Hard-Coded router ID

Shoe(Config-router)# network 10.1.3.0 0.0.0.255 Area 0 → This is OK But Not Cisco's Best Practice

Cisco's best practice requires 1 interface 10.1.3.1 0.0.0.0 Area 0 → More Specific = Better

Shoe(Config-router)# network 10.1.2.2 0.0.0.0 Area 0

Check Commands:
- Shoe(Config-router)# do show run | sec ospf
- Shoe(Config-router)# do show ip protocols
- Shoe# show ip ospf neighbor

Sock(Config)# router ospf 1

Sock(Config-router)# router-ID 3.3.3.3

Sock(Config-router)# network 10.1.2.1 0.0.0.0 Area 0

Sock(Config-router)# network 10.1.1.3 0.0.0.0 Area 0

After a new router-ID always Reboot / Clear ip OSPF process

PAPCO

Belt # debug ip ospf adj → Shows neighbors relationship taking place real time

Tie #

Video 30 DR Election

Subject:

Year. Month. Date. ( )

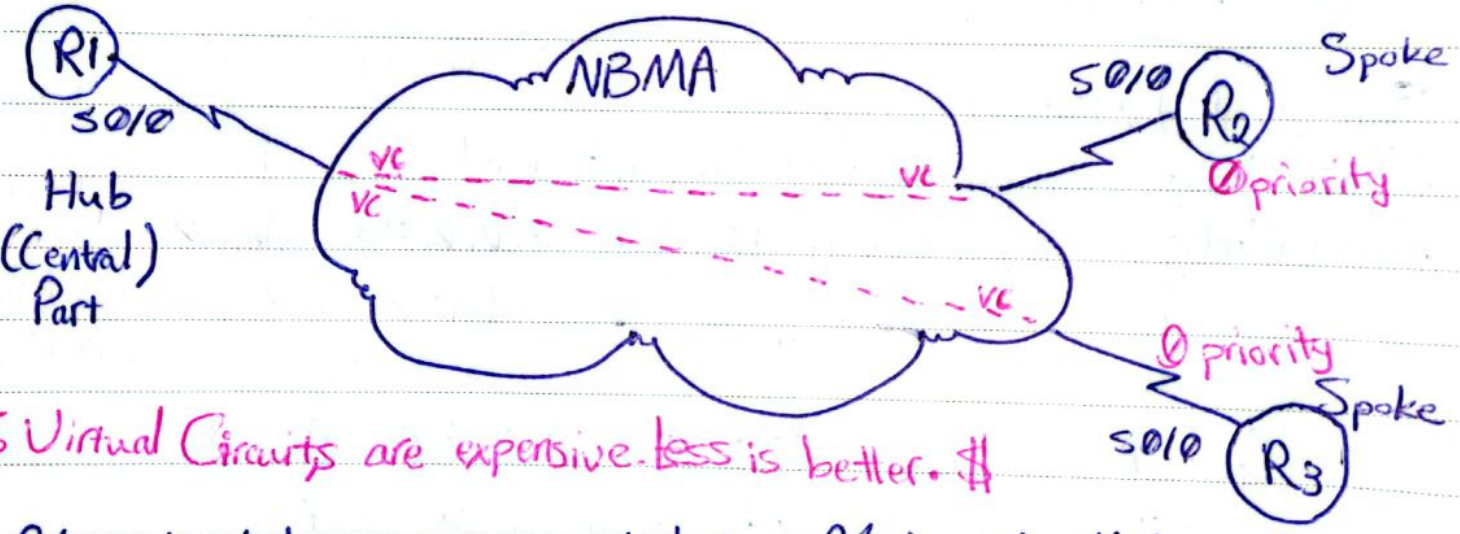
Network type → P2P → NO DR & BDR
→ Broadcast → DR & BDR

Shoe # show ip ospf interface Obj 2. Determine DR router. set "Tie" as DR

DR & BDR place might be exchanged based on which one is configured first or Booted First and in most topologies this doesn't matter. we can make sure DR stays the same by configuring its priority manually.

```
Tie # conf t
Tie(Config) # int fa 0/0
Tie(Config-if) # ip ospf priority 10.
```

IN NBMA networks, DR should never change, that's why all other router rather than HUB should have a priority of 0.



$ Virtual Circuits are expensive. less is better. $

R1 is the hub so it is essential that R1 have the Highest Priority be the DR
therefore spokes should have a 0 Priority.

P4PCO

Video 31 — Metric Adjustment

Subject:

Year: Month: Date:

Obj 3: Adj ospf metric for 10G links.

Rip uses hops as metric

Metric: Method that a routing protocol uses to pick the best route.

OSPF Metric = Cost = $\frac{100}{BW(Mbps)}$ → Bandwidth ← OSPF doesn't see decimals. (like 1.1 if less than 1 number)

more than 100 Mbps → cost = 1 → rounded to the next

OSPF doesn't recognize connections speed. cannot tell the difference the links with more than 100Mbps and that could be fixed manually.

= WAN LINKS = Serial interface = 1.544 Mbps

Sock # show ip route → shows bandwidth

Sock (Config) # int s1/0

Sock (Config-if) # ip ospf cost number ← customized cost

Shoe # show interfaces fa0/0

Shoe (config) # int fa 0/0

Shoe (Config-if) bandwidth 10000 Kbps

10 Mbps =

*GNS3 changes default bw.

It's better not to change cost manually, but much better to manually adjust the bandwidth (which doesn't mess up formula "rather than" custom cost

it's old, 1982

How to adjust the formula in order to be accurate in today's modern-speed networks?

Go on on every router and:

Belt (config) # router ospf 1

Belt (config-router) # auto-cost reference-bandwidth number

(Mbps) $\frac{100}{BW}$

P4PCO

Subject: Video 32 Passive Networks and Timer Configuration

Year: Month: Day:

Obj 4: Ensure "Shoe" does not form ospf neighbors on its LAN network

why? security, causes man in the middle attacks, also should use Auth.
How? by passifying interfaces "Router doesn't send hello messages" but it is still advertising to the other routers on right interfaces.

Shoe(Config)# router ospf 1
Shoe(Config-router)# passive-interface fastethernet 0/0

Check Command: Shoe# show ip ospf interface

RIP/OSPF/EIGRP

Second way — Cisco's preferd
First kill all Hellos on every interface
Then manually select our desired interface
} We can use this on Any routing Algo

Shoe(Config-router)# passive-interface default → Any Interface is Passive
then intentionally switch desirable interfaces back to Active:
Shoe(config-router)# no passive-interface s1/0

Obj 5: Adjust the hello timer on "sock" WAN interface to send Hello msgs 1/sec
Why more hellos? so ospf detects "failure" faster → faster recovery

Check Command: Sock# show ip ospf interface
default Hello timer = 10
" Dead " = 40

Sock(Config)# interface s1/0 ← going to the interface
Sock(Config-if)# ip ospf hello-interval 1 ← 1 sec hello timer
* Everything OSPF goes down → Hellos intos do have conflict
Dead timer = 4 sec
so the other router (Because it's a P2P connection) (→ All other routers)'s Hello timer should be changed as well.

Shoe(Config)# interface serial 1/0
Shoe(Config-if)# ip ospf hello interval 1 → neighbor reforms between Sock & Shoe

Objective Bonus: Create Loopback interfaces in such a way that router IDs (their names) are pingable from any router

P4PCO

Subject:

Year. Month. Date. ( )

Router-IDs: Shoe = 4.4.4.4 Belt = 2.2.2.2 Tie = 1.1.1.1
Sock = 3.3.3.3

is called a "hostmask" = only for 1 IP

Shoe (config) # interface loopback 0
Shoe (config-if) # ip address 4.4.4.4 255.255.255.255 → Not Pingable until Advertised
Shoe (config-if) # router ospf 1
Shoe (config-router) # network 4.4.4.4 0.0.0.0 Area 0

Check Command: Show ip route

PAPCO

Subject: Video 33 OSPF Troubleshooting, Single Area OSPF

Year. Month. Date. ( ) *A great watch *Same network as before

tie# Show ip route
Show ip ospf neighbor
Show ip protocols
Belt# Show ip ospf
Show ip protocols

DUP_RTR ID_NBR
↳ Duplicate Router ID
Router IDs should be unique in the whole entire System not only an Area.

* Belt# Show run | section ospf *
Belt# Conf t → Belt(Config)# router ospf 1 → Belt(Config-router)# router-id 2.2.2.2
the only problem that can happen to ospf in Real World Scenarios is
Sock # debug ip ospf adj → shows full details of ospf running [wrong config]
#u all → All debugs turns off.

* Hello timer is configured under the interface and it's very confusing to be troubleshooted. * Sock(Config)# int fa0/0 → Sock(Config-if)# no ip ospf Hello Interval

* We should be careful of lower level issues when trouble shooting.

There are Two types of encapsulations: Serial → HDLC / PPP → not compatible with each other
HDLC: Industry standard
Sock(Config)# int S1/0
Sock(config-if)# no encapsulation PPP

Subject: Video 34 OSPF Area Design and Terms

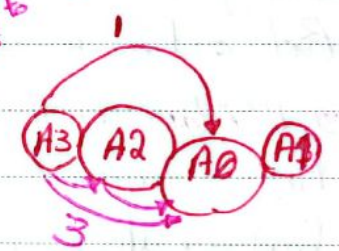
Year. Month. Date. ( )

* All routers in an area must have the same LINK STATE DB.
* Every Route, Every Change must be known.
* The larger the network, the more unruly the DB becomes.
* Area boundaries allow you to summarize (efficiently).

All areas must connect to Area 0
All routers in an Area have the same topology table.
Goal: Localize updates within an Area.
Requires a Hierarchical Design

"out side" "other networks" Frame-Relays Internet : not ospf parts of networks

ABR: Area Boarder routers (Between two Areas)
ASBR: Autonomous System boundry Router — Connects to



All the areas must connect to Area 0 (Directly) → 1. Must buy links for Distant Areas (####)
or 2. Redesign the ospf topology
or 3. Using a Virtual link (tunnel A3 through A2 to get to A0) → sth like VPNs

It thinks it is directly connected to A0
It is complex and messy not so good.

P4PCO

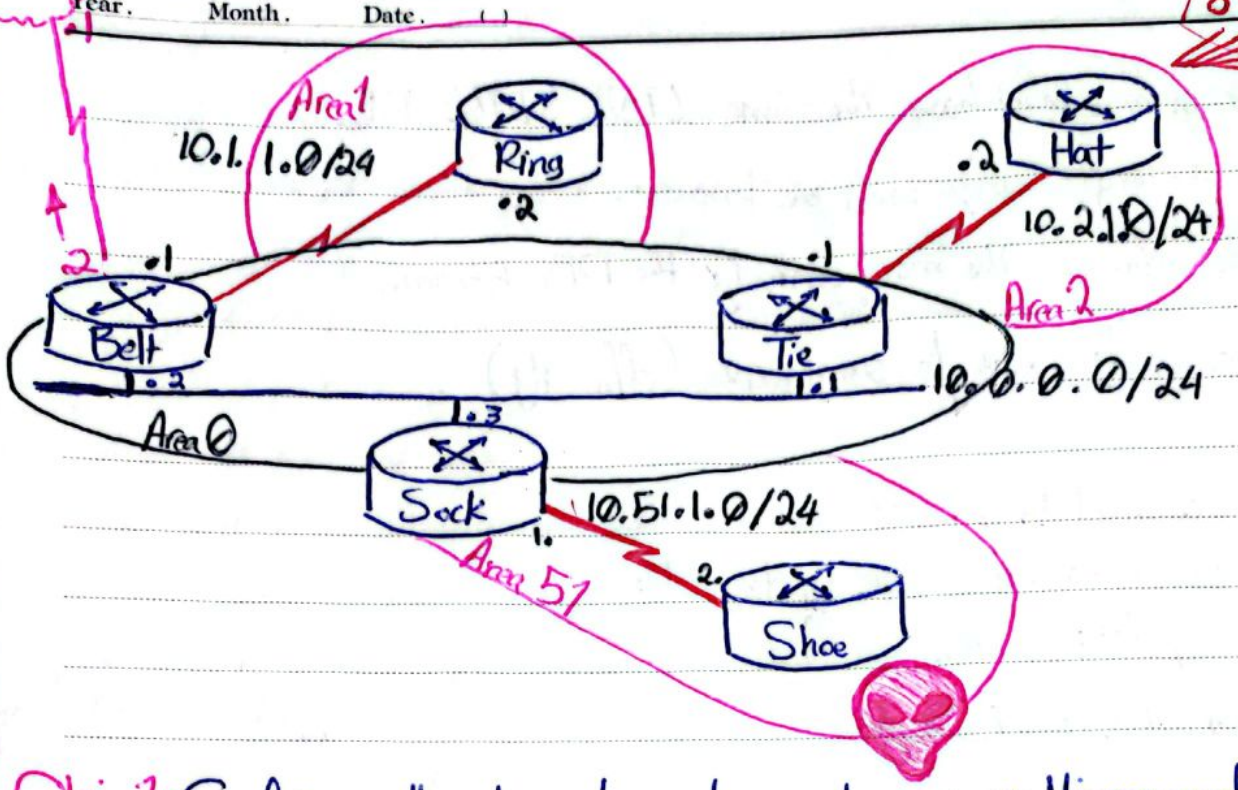
take a look at exam obj. in cisco website.

Obj 4 & 5 ISP

Subject, Video 35 Multiarea Configuration Live Lab

Year. Month. Date. ( )

loopbacks 0 2 3 4 5



Obj 1: Configure all routers shown to operate in a multiarea configuration. Tie, Belt and Sock will act as ABRs.

* Highest IP Address on the router becomes the router-ID if you don't set it or the Highest loopback. Loopback always beats the physical interfaces *

```
Belt(config)# router ospf 1
Belt(config-router)# network 10.0.0.2 0.0.0.0 Area 0
Belt(config-router)# network 10.1.1.1 0.0.0.0 Area 1
```

} ABR by assigning two or more Areas

Obj 2: Add 5 loopback interfaces to Ring, Hat, and Shoe. They should be contigous to exsisting Area subnets.

Ring(config)#

0,1,2,3,4

```
interface loopback 0
ip Address 10.1.0.1 255.255.255.0
ip ospf point to point
```

or 255

OSPF Recognizes loopback interfaces even if we use a correct subnet mask of Class C.

network

if that's a loopback, it will be advertised as a /32 network.

10.1.0.1
10.1.2.1
10.1.3.1
10.1.4.1

10.1.1.1 is WAN Link Do not use it

5 loopbacks on each Router

P4PCO

Show ip route ——→ IA = Inter Area route

Subject:

Year. Month. Date. ( )

(Include)

After creating all the loopback interfaces on Ring, It's time to advertise those links in the ospf advertisement.

Ring (Config) # router ospf 1

Ring (Config-router) # network 10.1.0.0 0.0.255.255 → doing all 5 loopback in 1 step. Be smart/be lazy.
↳ Area 1

These configurations should be done to Hat and Shoe as well.

what if we didn't put: ip ospf network point-to-point?

The interface which we removed being P2P then makes the subnet mask changes to /32 which means ospf recognizes it as Host rout.

if we turn the p2p command back on, it doesn't recognize it as a loopback.

cisco tuned ospf to know fake interfaces "loop backs" (stub host route). by using the command we virtually advertise it as a p2p link.

Video 36 OSPF Summary Routes not on the exam.

Subject: Year: Month:

Obj 3: Add an efficient summary route for area 1, 2, 51. Verify impact on the routing table of other routers.

EIGRP does summerization from under the interfaces, but ospf does it under router.

Belt(config)# router ospf 1 → Belt(Config-router)# area 1 range 10.1.0.0 255.255.0.0

=> Tie# Show ip route :

10.0.0.0/8 is variably subnetted

The only route ← 10.1.0.0/16 (all the router under this range are suppersed into 1)

All the other routers in the system know the area 1 by 10.1.0.0/16

All the Chaos in the area 1 (routes going up or down) contains inside area 1. Same should be done for other areas "their ABR"

This is not the efficent way to do summarization: we should use a custom subnet mask to be efficent. we cannot use any 10.1.0.0/16 anywhere else in our system with the easy method that we Just learned if Areas are growing we will face a big problem. because we summarize the entire 10.1.0.0 as being Area 1. That's wasteful and inefficend.

EFFICIENT:

Ranges we used in 10.1.0.0 in Binary Format

3 = changing bits

10.1.0.0
10.1.1.0
10.1.2.0
10.1.3.0
10.1.4.0
10.1.5.0

00000000
00000001
00000010
00000011
00000100
00000101

not changing bits

10.1. : 5 + 8 + 8 = 21

back to Subnetting ← 10.1.0.0/21

10.1.0.0

Binary: 8 bits . 8 bits . 5 bits ...

11111000

back to decimal ↓ 8

10.1.0.0 ~ 10.1.7.255
10.1.8.0 ~ 10.1.15.255
16.0 ~ 10.1.23.255
24.0
⋮

then we have a lot of subnets to grow as rooms

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Subject: Video 37

Year. Month. Date.

Obj 4: Add a loopback interface to Belt with the ip address 184.51.1.2/24 and a default route to 184.51.1.1. This will simulate an Internet Connection.

Obj 5: Have Belt advertise the default route to the other routers via OSPF. The route should exist even if Belt does not have a default route.

```
Belt(config)# interface loopback 5        → any number
Belt(Config-if)# ip address 184.51.1.2 255.255.255.0
Belt(Config)# ip route 0.0.0.0 0.0.0.0 184.51.1.1
```

Even if the interface goes down, whatever happens always use always. → loopback

Obj 5:

```
Belt(Config)# router ospf 1
Belt(Config-router)# default-information originate
```

**** always ****

Belt is now an "ASBR" and it is also an "ABR"
(→ connects to out side of system.)

under show ip routes on other router we can see this route is known as

E2 - OSPF external type 2

ospf

If we enable on a loopback interface and change network type to P2P, Does it Sends hello messages every 10 sec? Theoretically yes. Technically NO. cause loopback Do Not Really exist.

Subject: Video 38 EIGRP PROTOCOL REVIEW

Year. Month. Date. ( )

EIGRP is Cisco's answer to OSPF. The only downside of EIGRP is that it was proprietary "owned by cisco". then cisco opened it up as a RFC standard so that other vendors can adapt it.

Why EIGRP is better than OSPF ?

It's an Advanced Distance Vector routing protocol. * 1. back up routes (Fast Convergence DUAL)

EIGRP uses the hello protocol. it forms neighbor relationship. sends only partial updates (small update from its routing table) rather than sending the who routing table which RIP does. But we don't have to maintain the entire DB like Link State protocols." rather than what ospf does".

EIGRP instead maintains Backup Routes. Finds the best way to reach a destination and then creates Feasible successor routes. they move into primary position really fast when needed with DUAL protocol.

Fast Convergence Defused update Algo → much lighter than ospf's DIJKSTRA.

DUAL calculates what routes end up moving to routing table from topology table (OSPF called it link State Data Base)

2 * It has simple configuration. (OSPF only can do summarization on ABR/ASBR)

3 * Flexability in summarization: we can put a summary route wherever needed. every interface could be a potential summary port for EIGRP.

4 * Unequal cost load-balancing: adapting for best speed no matter what links/speed is use

5 * Combines best of distance vector and link state (limited Routing info, but backup paths)

EIGRP Tables and Terminalogy:

Neighbor Table ↔ not as restrictive as OSPF

Topology Table ↔ Closest table to "OSPF's LSDB" contains Successor No Delay Feasible successor

Routing Table ↔ There might be lots of feasible successor but only one of them is going to end up in the routing table. unless: 1. TWO EQUAL COST PATH 2. UNEQUAL LOAD BALANCING COST

PAPCO

Subject:
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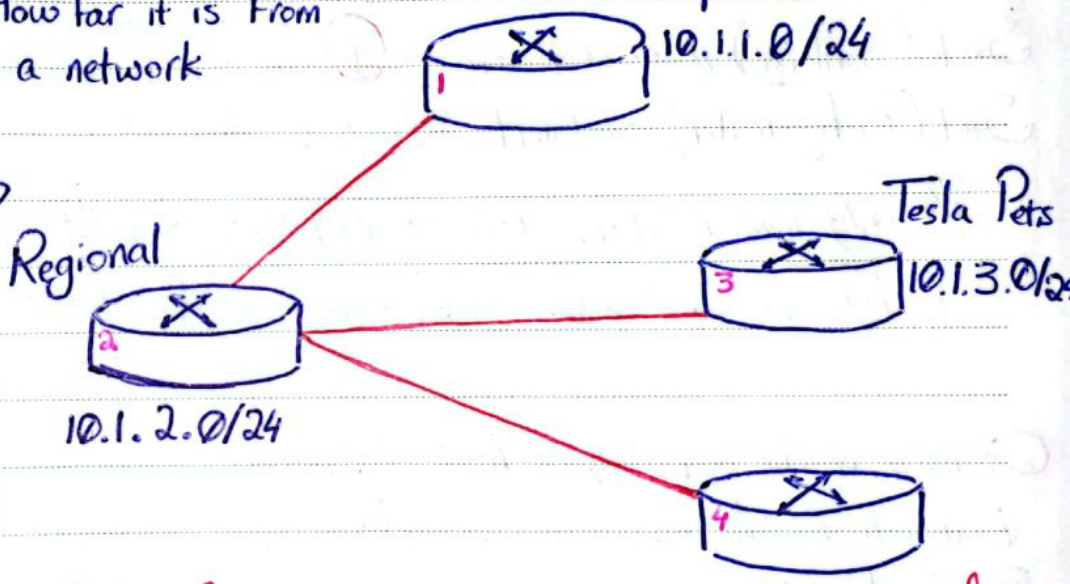
Must Watch Video

EIGRP's configuration is a piece of cake, But the terminology is hard and important.

EIGRP Tables and Terminology:

* Successor: in topology table is the primary route and goes into routing table.
* Feasible successor: are the backup routes and never go to routing table. Sends Query messages.
* Active Routes: Means router is actively trying to find a backup (Not OK)
* Passive Routes: Means all routes are working fine and it is Idleing. (OK)

* Feasible Distance: How far it is from your chosen router to get to a network
* Advertised Distance: How far the network is from the neighbor router that is telling us about that network.



RULE To be considered a feasible successor: The AD must be less than the FD of the successor.

This rule is for *loop prevention* mechanism.

Subject: Video 39 EIGRP Neighbors and metrics

Year. Month. Date. ( )

Much simpler than the OSPF

All communication is send to a single multicast address: 224.0.0.10

* Hello: Forms Relationships
* Update: sends updates
* Query: Asks about routes: only time it is being used is when a route goes down when a route goes down, router sends a query message to all neighbours asking for a backup way to that route. "Do you have a backup to that route?"
* Reply: Response to a query: It's mandatory to answer queries: Yes or No
* Ack: Acknowledges the Update, Query & Reply messages.

Just like ospf, EIGRP is its own protocol.

Sack(config)# router eigrp 1 → Autonomous System number. "THE GANG" Sign
must be exactly the same between the routers of a sys.
• Much more important than OSPF's process-i

Sack(config-router)# network 10.0.0.0 then optional wild card

The only time routers talk to each other directly is when they have an Update for each other. All other communication happen on Multicast.

Overview of the metric of EIGRP: The only metric ospf has is BW. → 10^9/BW

But EIGRP's metric takes all kinds of critiria:

Bandwidth (K1)
Delay (K3)
Reliability (K4, K5) → how constant and well connected the link is.
Loading (K2) → How much traffic is going on (Bandwidth only is link's full speed)
MTU → Maximum Transmision Unit: How big in size a packet can be?

Loading: How busy is the link.

NOT ON EXAM

Metric = (K1 * BW + ((K2 * BW)/(256 - Load)) + K3 * delay) * (K5/(reliability + K4))

BW = 10^7/BW (BW in Kbps)

Delay = Delay in micro Seconds

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other critiria = dynamic → makes router busy → NOT Default

Static Values = We configure
BW Delay

Nor ON EXAM

The only default critiria EIGRP uses are: K_1 & K_3

router n
router 1 days + ... + delay

Real "Default" Metric: 256 * (Slowest_BW + All_link_Delays)

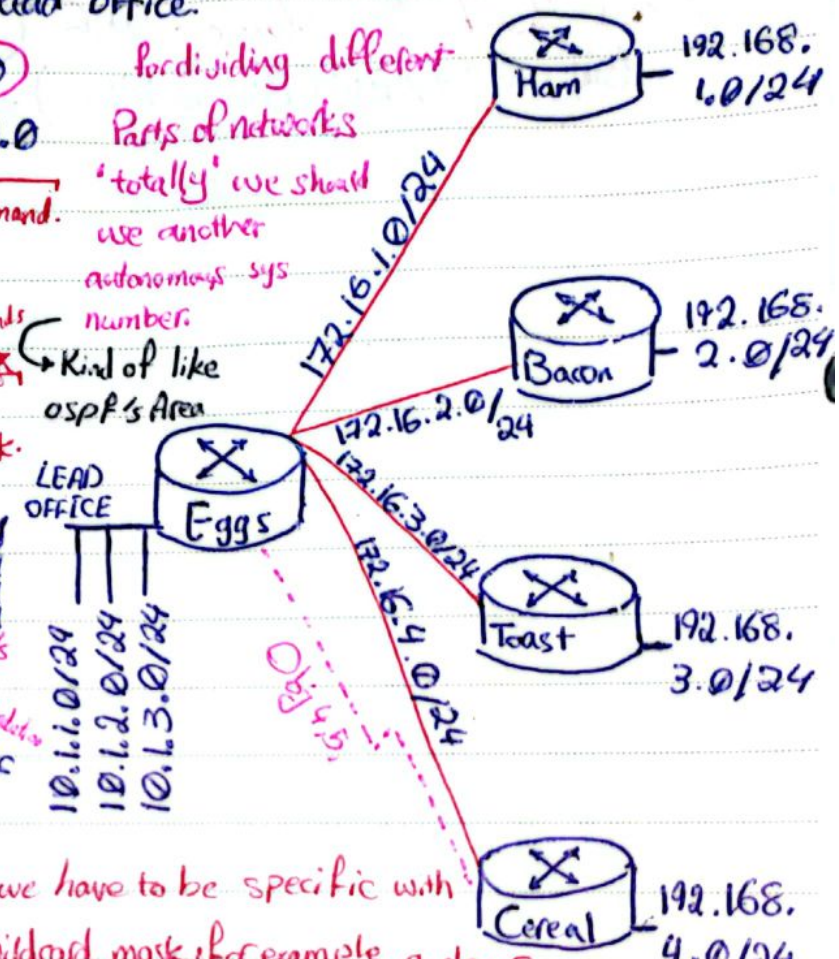
BW = 10^7 / BW (BW in Kbps), Delay = Delay in microseconds

Subject: Video 40 EIGRP Lab Base Configuration

Year. Month. Date. ( )

Obj 1: Configure EIGRP routing on all routers in autonomus sys 90. Use network-specific wildcard masks at the lead office.

REDs are Wan links.



Eggs(config)# router eigrp 90

Eggs(config-router)# network 10.0.0.0

↳ This is "Classfull" way of using the command. We didn't specify the wildcard. Not Recommaned.

for dividing different Parts of networks 'totally' we should use another autonomous sys number.

Cisco's recommends using IP and 0.0.0.0

↳ Kind of like ospf's Area

for specificy we should use wildcard mask.

Eggs(config-router)# network 172.16.1.0 0.0.0.0

:2.1
:3.1
:4.1

most specific wildcard mask used. Cisco's Recommendation

Check command: show ip eigrp neighbors

* do show run | section eigrp

when using willcard mask 0.0.0.0 we have to be specific with the ip, but when using any other wildcard mask: for example a class C Subnet, we do not need to be specific: NOT THE BEST PRACTICE

Network 172.16.1.0 0.0.0.255 ← not Best Solution.

This will include any router in the rounge to the network, that's ok but

Another useful Check cmd: Show ip EIGRP Interfaces: .nfos:

SRTT: source round trip timer: Delay forgetting to a neighbor & Back (Me) milliseconds

Hold Uptime (seconds): should be 10~15 seconds: if goes below 10 means we missed a Hello message. (every 5 seconds every hello) more than 15 means that neighbor is dead. => All were default values (seconds)

All for show ip eigrp neighbor cmd

↳ How long does it take to go to the other side so that router Adjust Hellos and Dead Timer appropriately.

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Subject: Video 41 EIGRP Lab Route Summarization.

Year. Month. Date. Only Auto-Summarization is an Exam subj.

Discontinuous = disconnected = separated = without contact

Obj 2: Verify the impact of auto-summarization then disable it.

Null 0 in "show ip route" cmd means garbage-can.

A summary with null 0 is used when packets are not specific enough (usually uses a lower subnet number, larger network and dumps it cause it is not specified enough in the routing table. helps not accidentally sending packets the wrong way). if the subnet does not exist → router dumps the packet

172.16.0.0/16

In this network these routes are null 0: 10.0.0.0/8

It's a protection Mechanism.

IF The packet is finding a more specific route, it goes that way.

* The more specific the Subnet Mask, the better the route. (aka Specifity Rule)

Auto summarization is not O.K. Cisco disabled it by default lately:

Eggs (Config-router) # no auto-summary → Not on exam from here forward:

Obj 3: Introduce a manual summary route at the Eggs.

The more Specific the route The better tasting your eggs.

Somehow like efficent summary in the OSPF.

Every router could act as a ABR in the EIGRP Protocol.

10.1.1.0
10.1.2.0
10.1.3.0

3th octed in binary →

00000001
00000010
00000011

← 6 Bits → ← 2 Bits →

where difference starts = 3th octed

8 bits . 8 bits . 6 bits ...

/22 subnet → First bit of these 6 bits:

11111100

Back to decimal

4

10.1.0.0 ~ 10.1.3.255
10.1.4.0 ~ 10.1.7.255
⋮

Eggs (Config) int s1/0

Eggs (Config-if) ip summary-address eigrp 90

10.1.0.0 255.255.252.0 ✓ it's Boom summarized

Check cmd: show ip route (on other routers) → Ham there is only one subnet for 10.1.0.0)

* for summerization in EIGRP we should go to every single interfaces and configuce summarization there. unlike OSPF.

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Video 42 EIGRP Lab Load Balancing

Subject:

Year. Month. Date. ( )

Hello packets work like sonar.

Obj 4: Add a secondary connection to the Cereal router and verify equal cost load balancing is working.

Cereal # show ip int brief
Cereal # conf t Cereal(config)# int s1/1
Cereal(Config-if) # no shut
Cereal(Config-if)# ip address 172.16.5.2 255.255.255.0

ICND1

Eggs # show ip interface brief
Eggs # conf t
Eggs(Config)# int s2/0
Eggs(config-if)# ip address 172.16.5.1 255.255.255.0
Eggs(config-if)# no shatdown

if we used a wild card mask of 0.0.0.255 or any network (rather than 1 Interface & IP) it would turn the EIGRP automatically on. Which is not recommended by Cisco.

Cereal # show ran | sec eigrp
Cereal # conf t
Cereal (Config) # router eigrp 90
Cereal (Config-router) # network 172.16.5.2
Eggs should be configured as well → 172.16.5.1

Obj 5: Modify the bandwidth on the secondary line to 1Mbps. adjust EIGRP to enable unequal cost load balancing. going to both side of connection

Eggs # Conf t eggs (Config) # int s2/0 eggs → s2/0 & Cereal → s1/1 to adjust the BW.
Eggs (Config-if) # Bandwidth 1000
Cereal (Config) # int s1/1 → Cereal (Config-if) # Bandwidth 1000

EIGRP Does not notice that the BW is changed, so let's restart or reset in 2 ways: Clear ip EIGRP neighbors / Clear ip route

Check CMD: Show ip route
Show ip EIGRP TOPOLOGY Shows

We should enable unequal load balancing:

Cereal (Config) # router EIGRP 90
Cereal (config-router) # variance (2)
Eggs (Config-router) # variance 2

→ It is going to multiply the metric of our best route
The lower the metric is, the better the route
Multiplier of the difference of the BW
even though there is a best route we include other routes (second best in this case) to the routing table

Metric variance Multiplier <<<< name

PAPCO
It's intelligent Switching to second route when really busy (much terratic)

This is totally unique to EIGRP

Subject: Video 43 EIGRP Lab Hello and Hold Down Timers

Year. Month. Date. ( )

Obj 6: Modify the hello/hold timers to Cereal so failover occurs in less than 5 seconds.

A little Confusing

Default hello/hold timers : Check cmds :

Cereal# Show ip EIGRP interfaces detail s 1/1

Cisco has 2 defaults → Hello intervals:
1. Sloco Networks
2. All other networks = 5 seconds
(NBMA) = 60s

the timers are working in countdown

that's why it's bouncing somewhere between 15 and 10

less than 10: Missed a Hello msg.

less than 0: Link is dead

*show ip EIGRP neighbor Check cmd

x3 = default Down Timers = 15 seconds

3 min = 180 sec Down Timers

EIGRP allows to have different Hello, / Hold, timers on each neighbor.

In OSPF all that should be the same between routers.

Dead Timer = Hold Timer = Down Timer = Hold Down Timer

Hold timer & Hello timer are interface based. and it's talking about that interface.

It's actually advertising those Hello/Hold timer to the other neighbor.

Cereal (config-if) # ip hello-interval eigrp 90 (1) → Seconds

Cereal (config-if) # ip hold-time eigrp 90 (3)

→ talking to eggs my hello timer is 1 second

The hold time Doesn't effect Cereal but the otherside of the connection: Eggs

and consider me dead if you haven't met me in 3 seconds.

Eggs#

Check CMD Show ip EIGRP NEIGHBORS : Hold uptime is 2 seconds ← what we settled

← what we see Cereal saying Hello every 1 seconds

EGGs (config-if) # ip hello-interval eigrp 90 1

Eggs (Config-if) # ip hold-time eigrp 90 3

P4PCO