interior AS

IGP

EGP

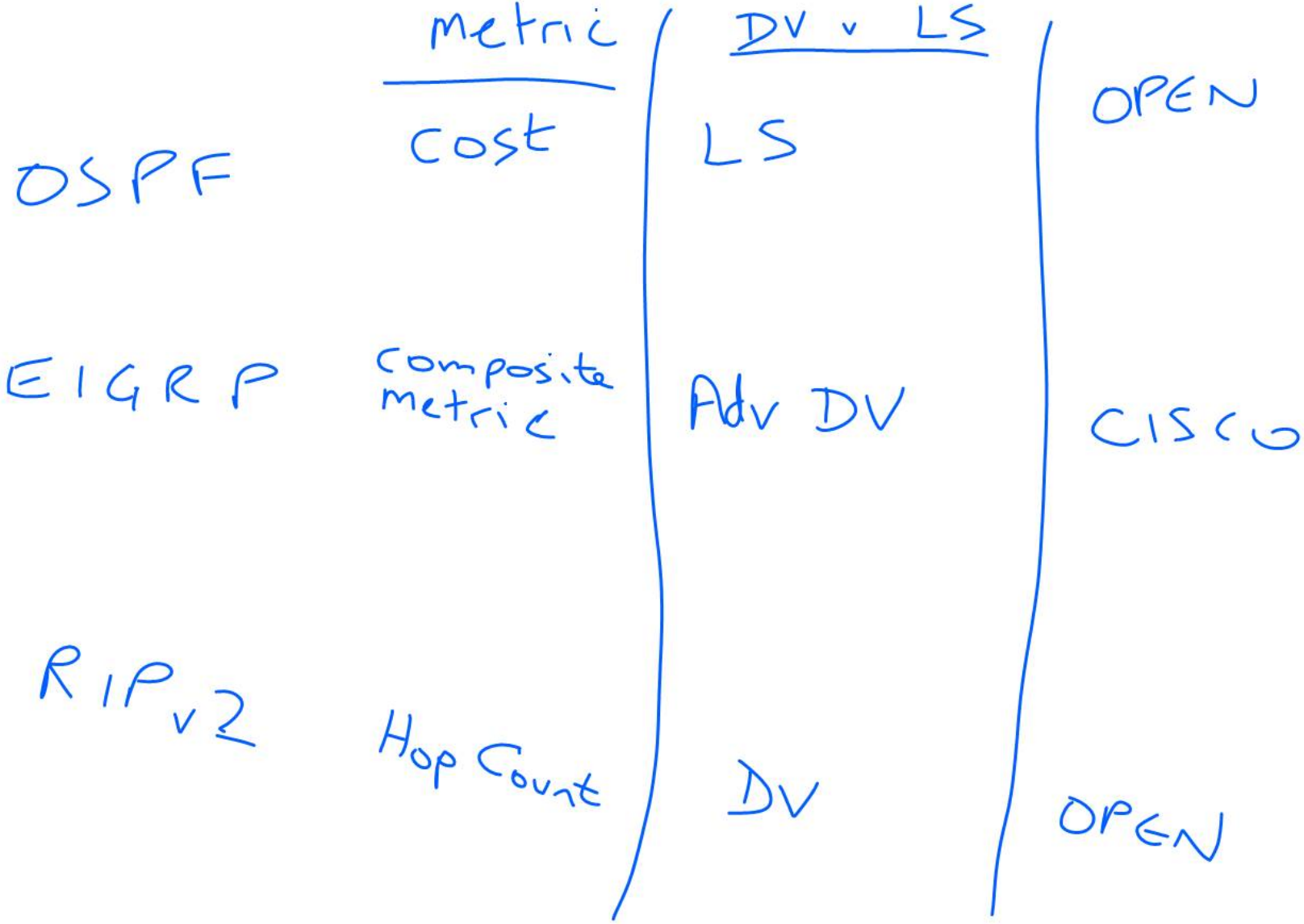
OSPF

EIGRP

RIPv2

IS-IS

BGP


metric
DV v LS
OSPF
cost
LS
OPEN
EIGRP
composite metric
Adv DV
CISCO
RIPv2
Hop Count
DV
OPEN

Link state v DV ANALOGY

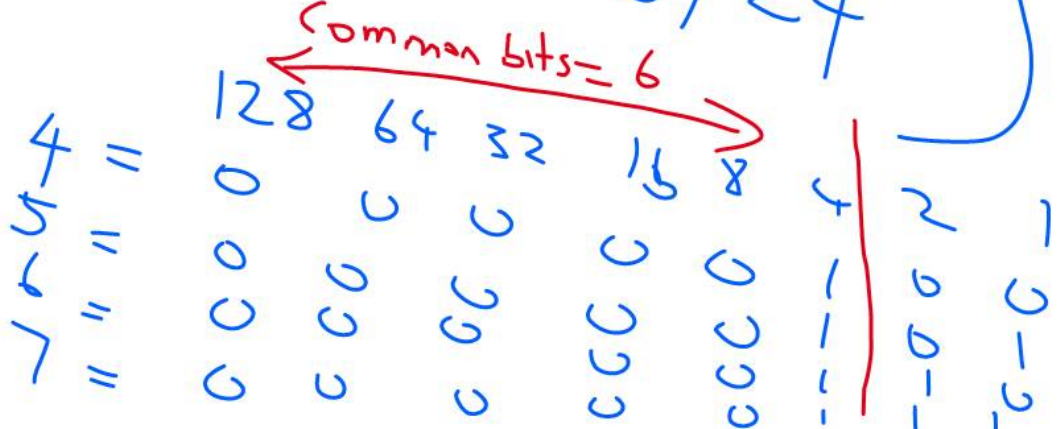
MAP SIGNPOST

Summarising the hard way

$8 + 8 + 6 = 22$ common bits

172.16.4.0/24
172.16.5.0/24
172.16.6.0/24
172.16.7.0/24

172.16.4.0/22



Summarizing easy way

N	Bits to left
2	1
4	2
8	3
16	4
32	5
⋮	

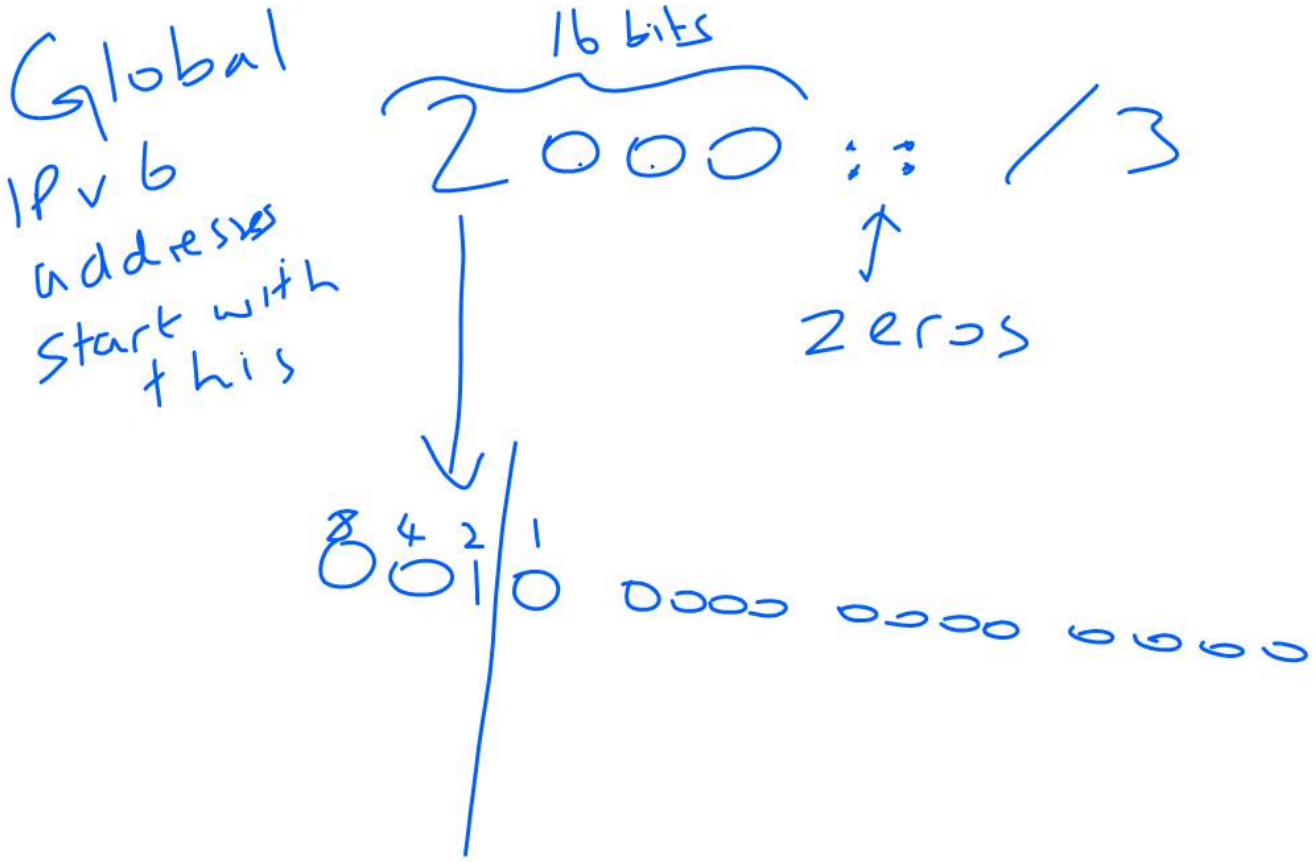
RIPv1 B/C 255.255.255.255,
No SUBNETMASK, FLSM

RIPv2 M/C 224.0.0.9 = RIPv2
VLSM

FIRST OCTET

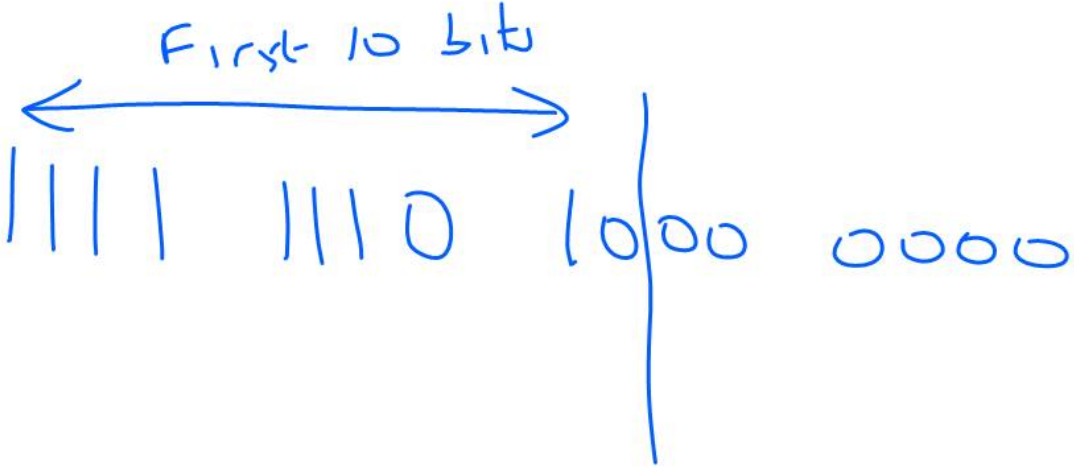
A 1-126
B 128-191
C 192-223
D 224-239
E 127.0.0.1.

class D multicast

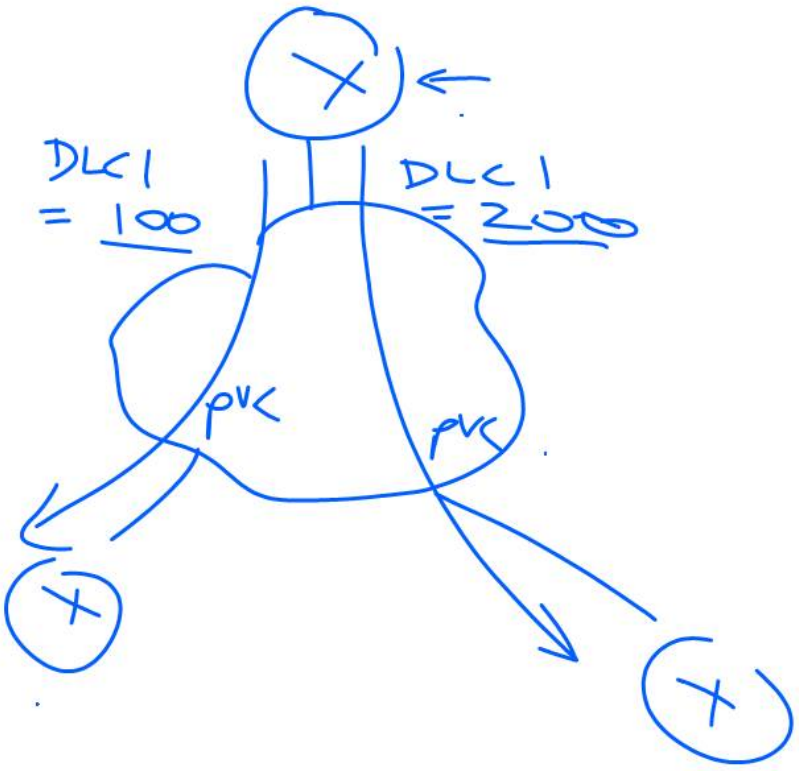

Global
IPv6
addresses
start with
this
16 bits
2000 :: /3
zeros
8 4 2 1
0010 0000 0000 0000

link local

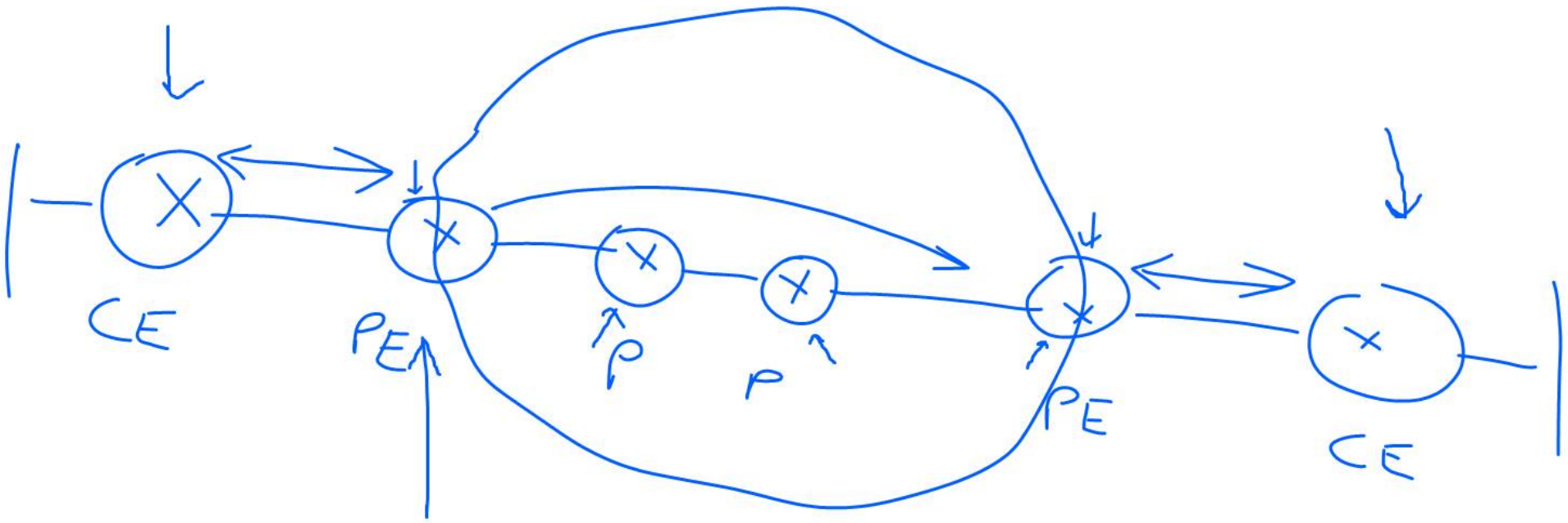
FE80::/10

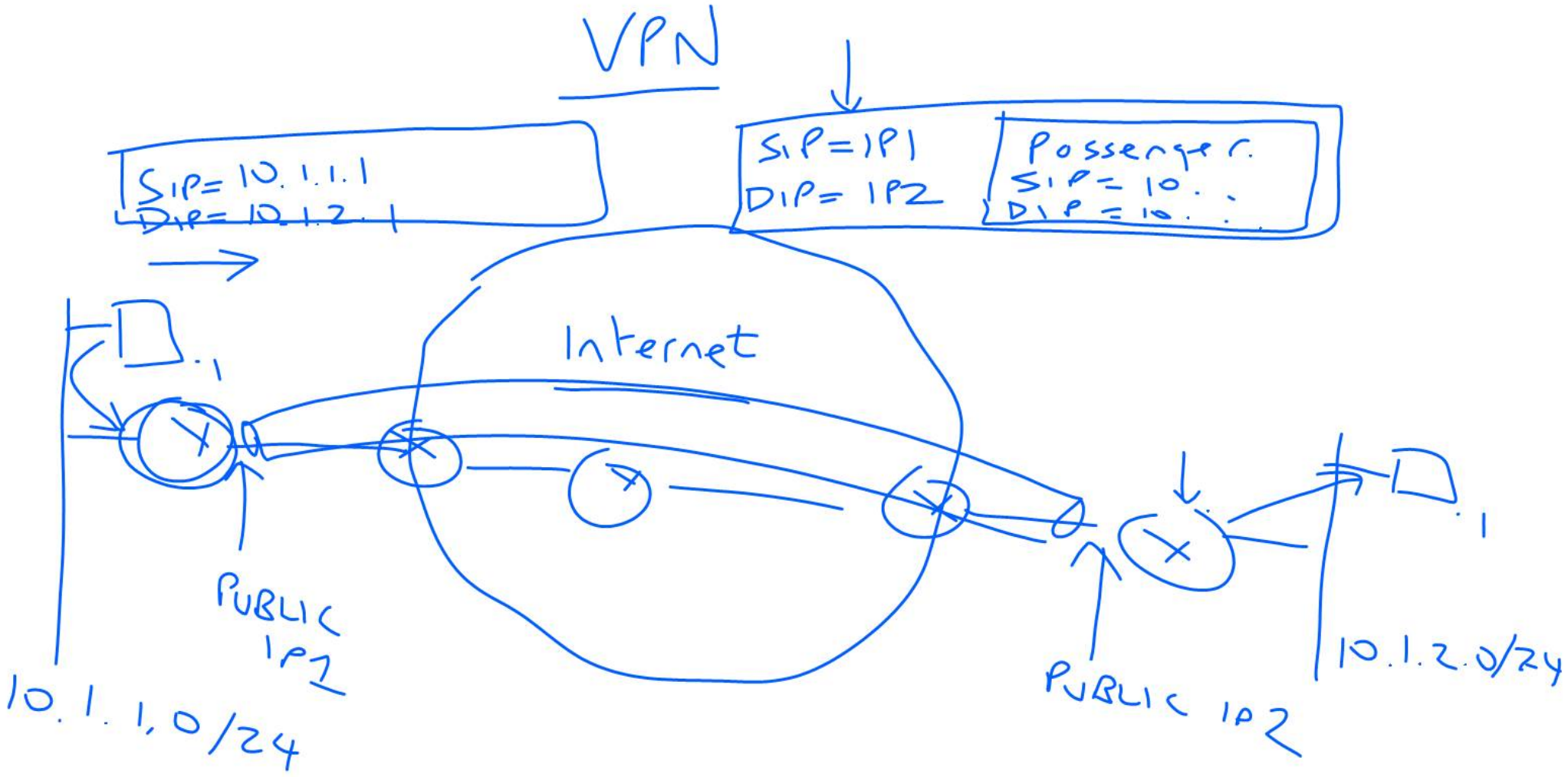


Frame



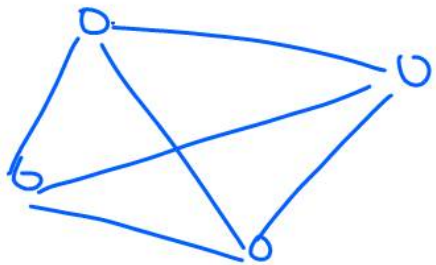
L3 MPLS VPN




VPN
SIP= 10.1.1.1
DIP= 10.1.2.1
SIP=IP1
DIP= IP2
Passenger
SIP= 10..
DIP= 10..
Internet
.1
PUBLIC IP1
10.1.1.0/24
PUBLIC IP2
.1
10.1.2.0/24

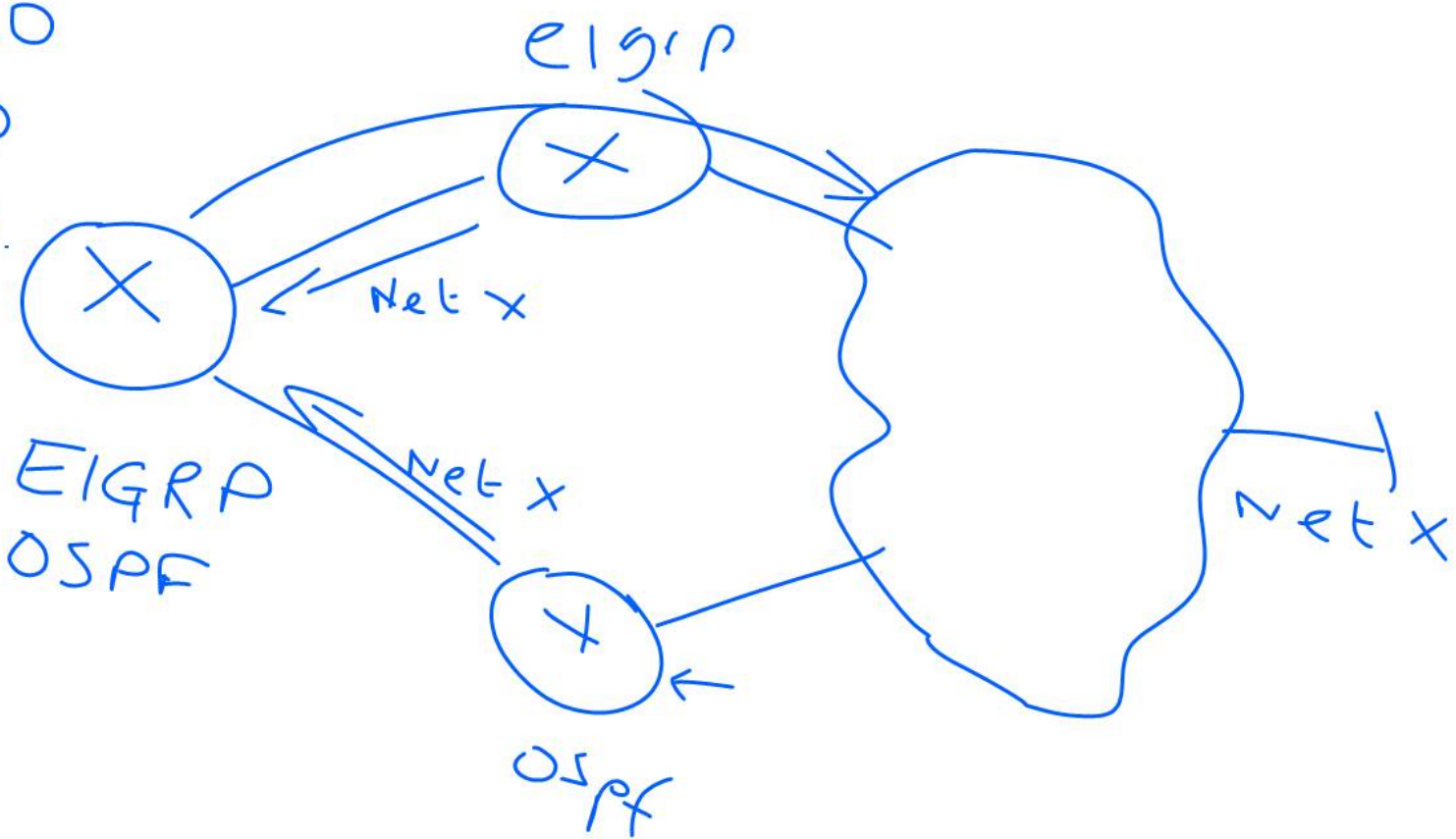
Full Mesh

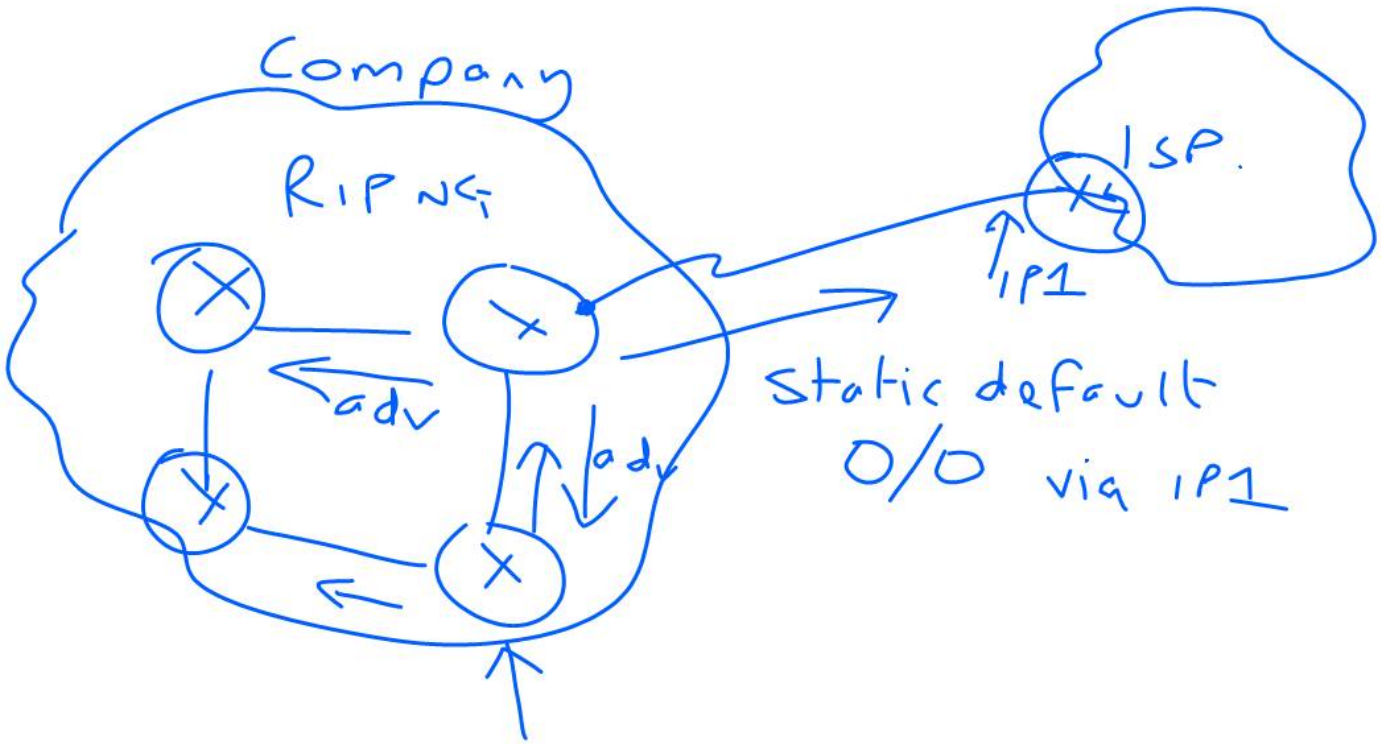
N nodes $\frac{N \times (N-1)}{2}$ eg $\frac{4 \times 3}{2} = 6$



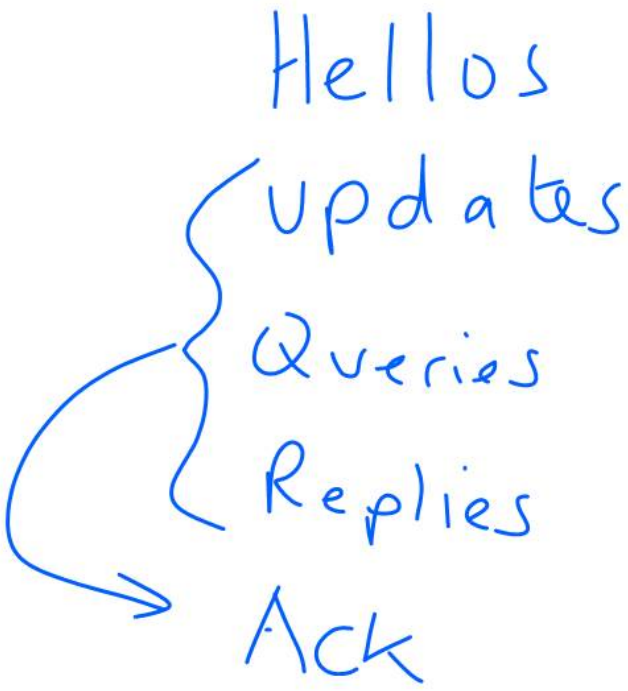
AD

RIPv2	120
EIGRP	90
OSPF	110
STATIC	1




Company
RIPNG
adv
adv
ISP.
IP1
static default
0/0 via IP1

OSPF message types



Analysing a /30

172.16.2.0 /30

172.16.2.0 255.255.255.252

1111111 11111111 11111111 111111 00

30 bits

H = 2 bits

HOSTS = $2^H - 2 = 2^2 - 2$

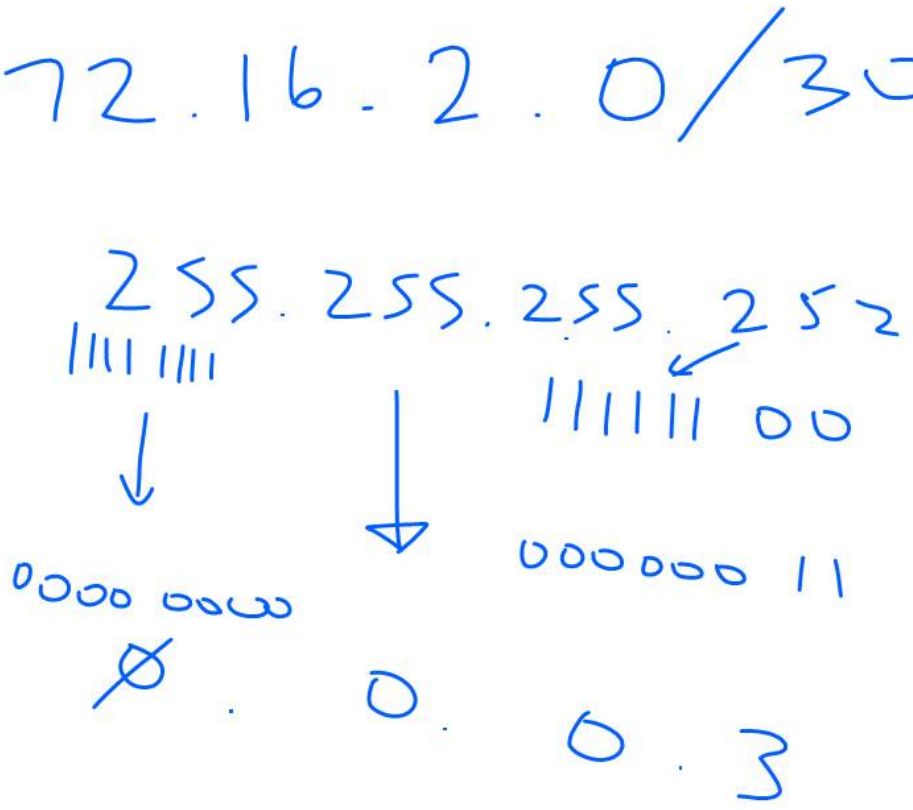
$= 4 - 2$

$= 2$

	HOSTS	BC
2.0	.1 - .2	.3
2.4	.5 - .6	.7
2.8		
2.12		
⋮		

/30 Similar to 0.0.0.3 wildcard

172.16.2.0/30



Router-id

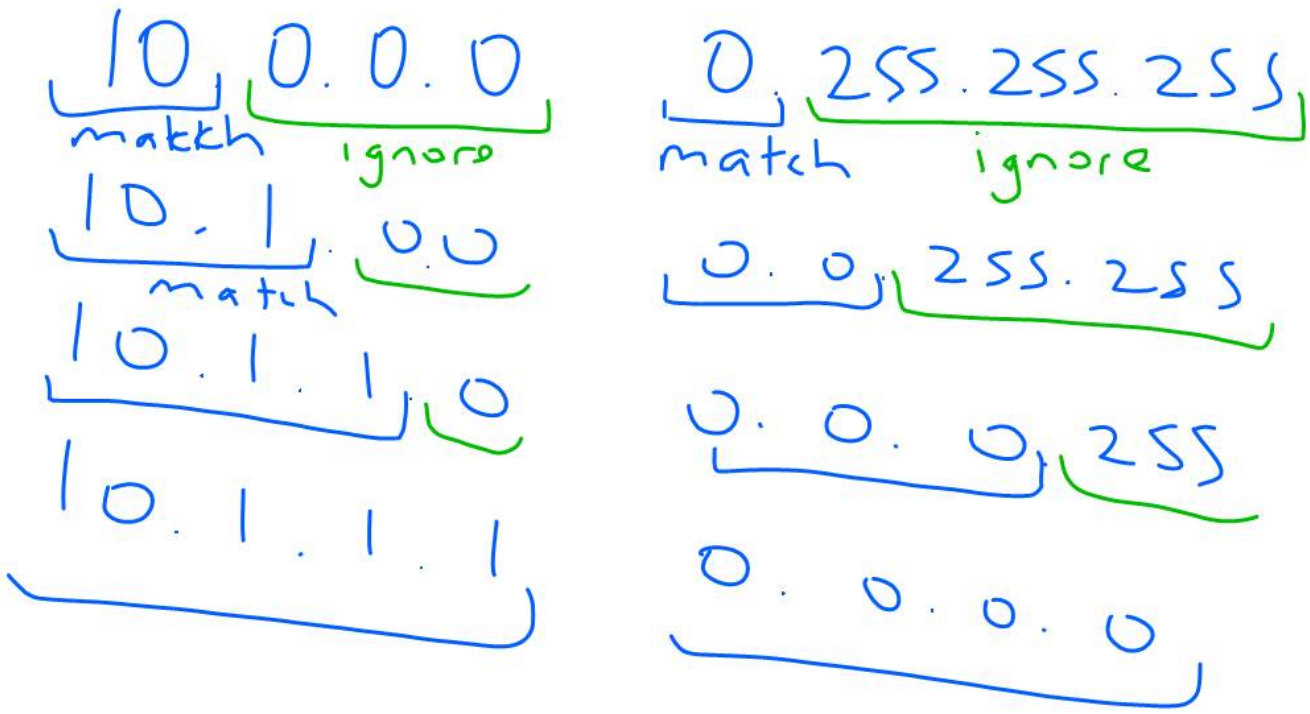
manual

highest loopback.

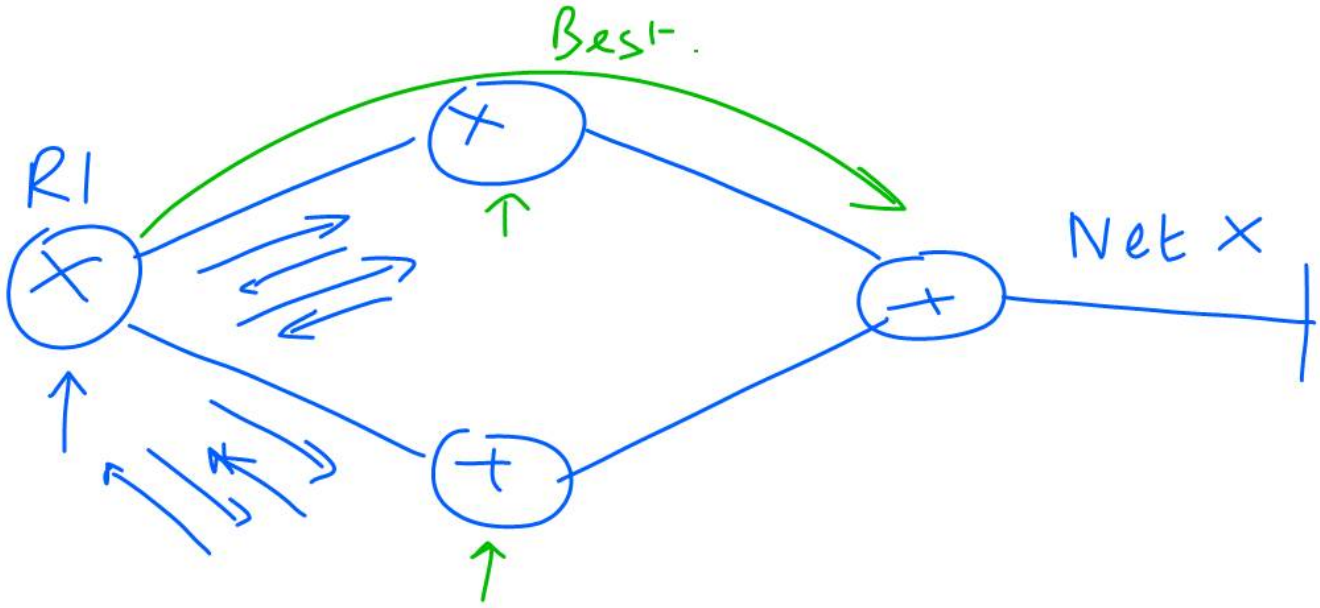
" ip on active int

preference

Wildcards


10.0.0.0
match
ignore
10.1.00
match
10.1.1.0
10.1.1.1
0.255.255.255
match
ignore
0.0.255.255
0.0.0.255
0.0.0.0

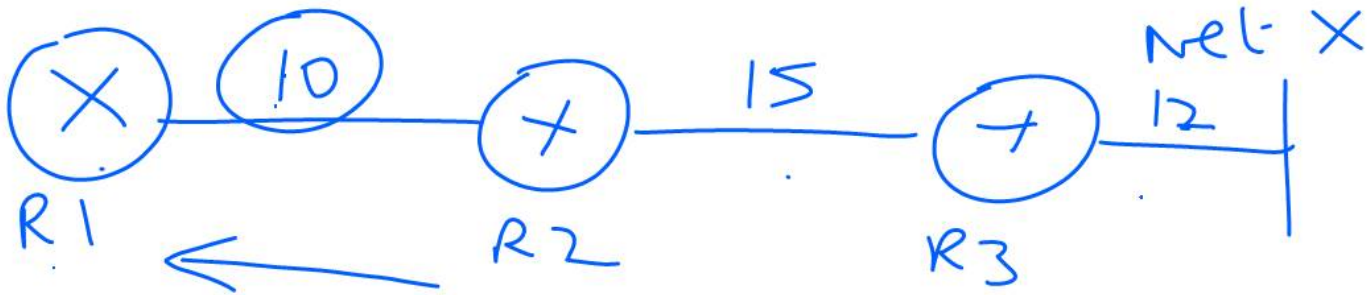
eigrp process



Swap Hellos

- Neighbor Table
  - exch routes
    - Topology Table
      - Successor
      - Feasible Succ
      - Other

→ Routing Table



R1

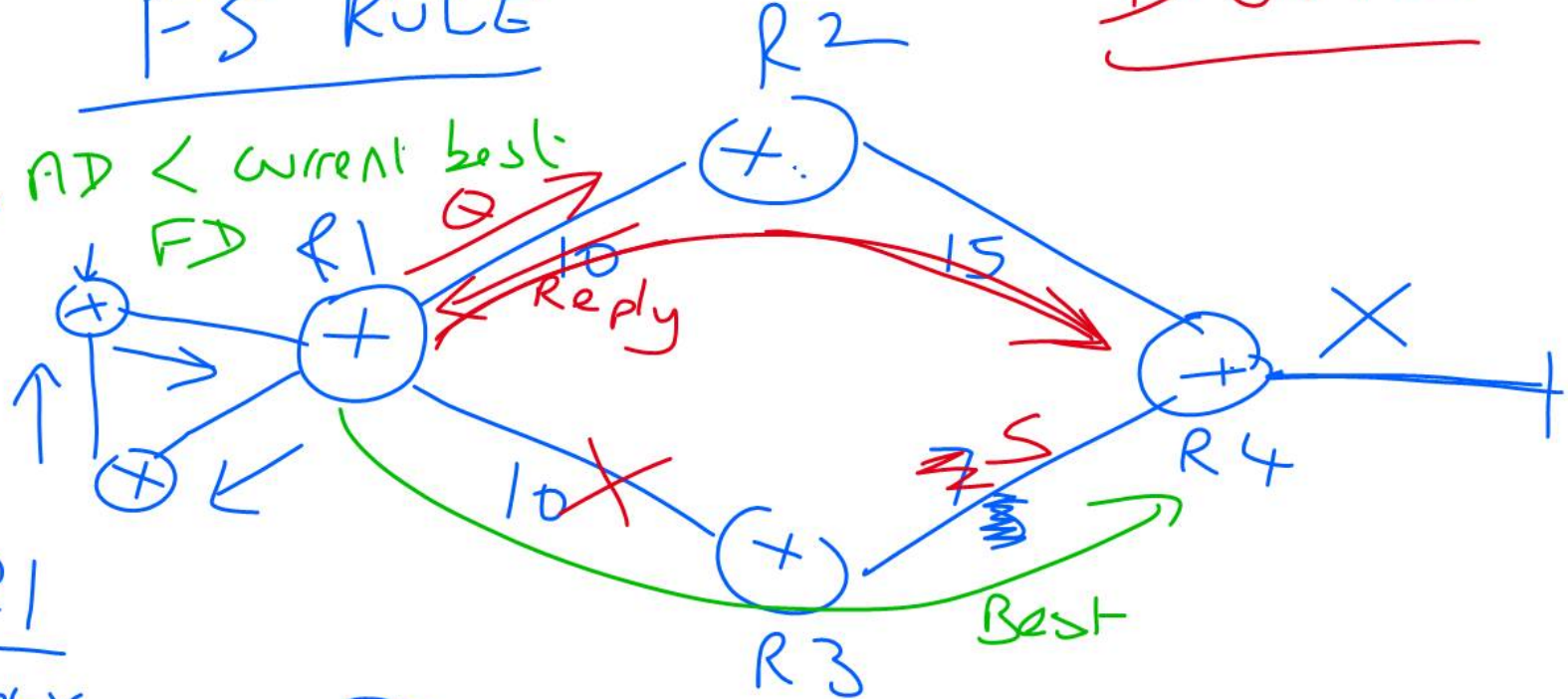
Net x via R2

FD	AD (RD)
37	27

DUAL

FS RULE

Next-hop AD < current best FD

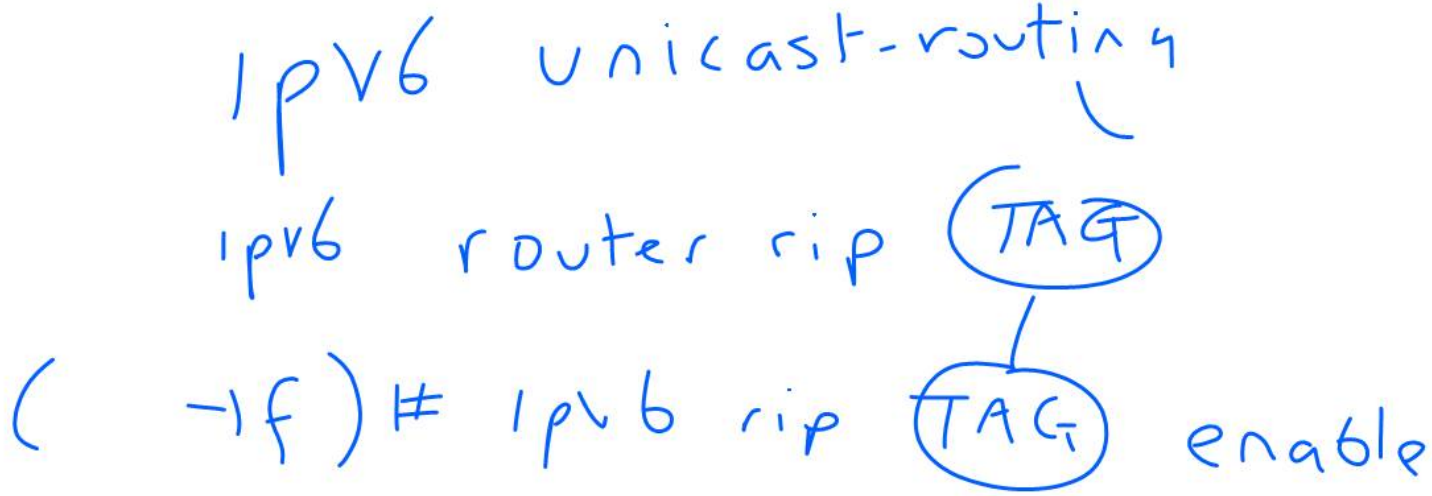


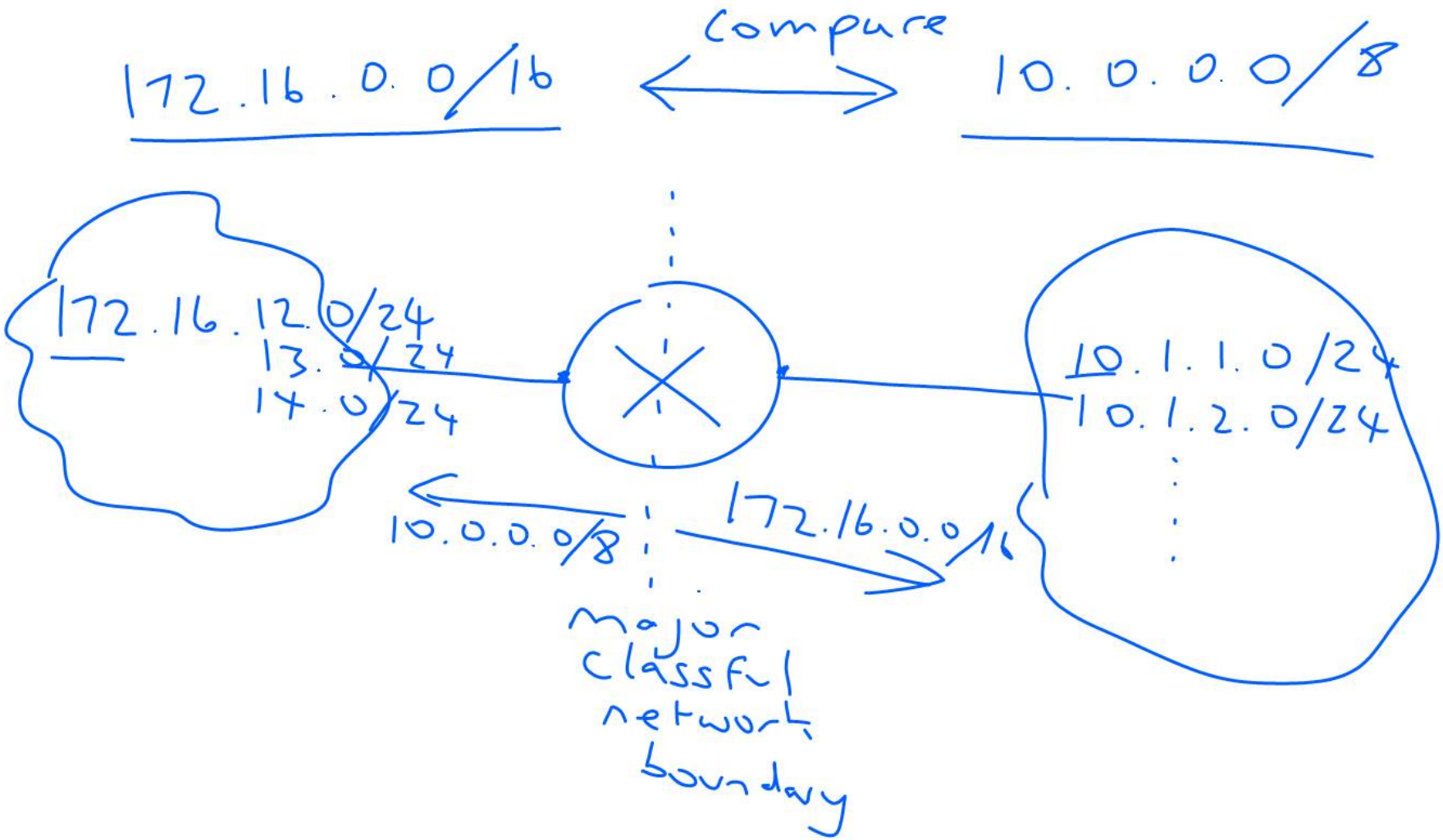
R1

Net-X	FD	AD
Via R2	25	15
Via R3	15	5

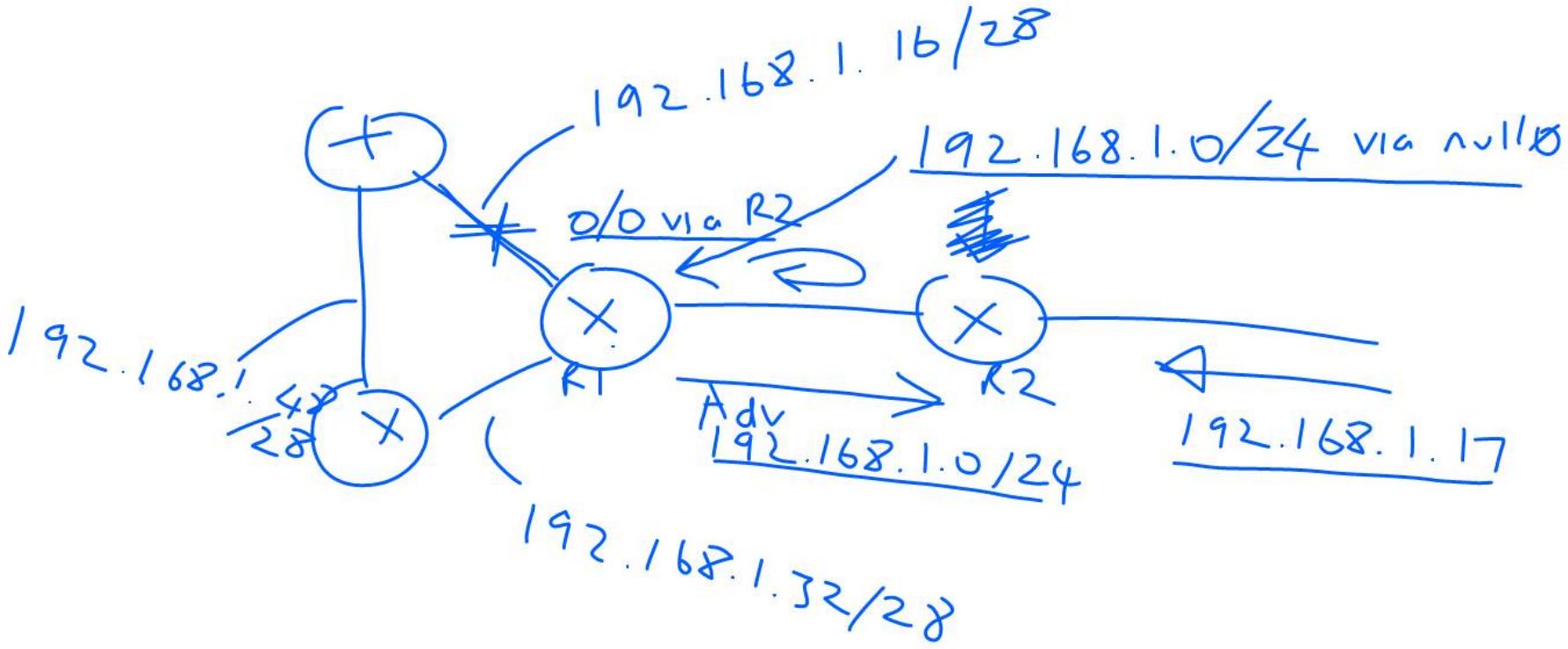
Feasible Successor.

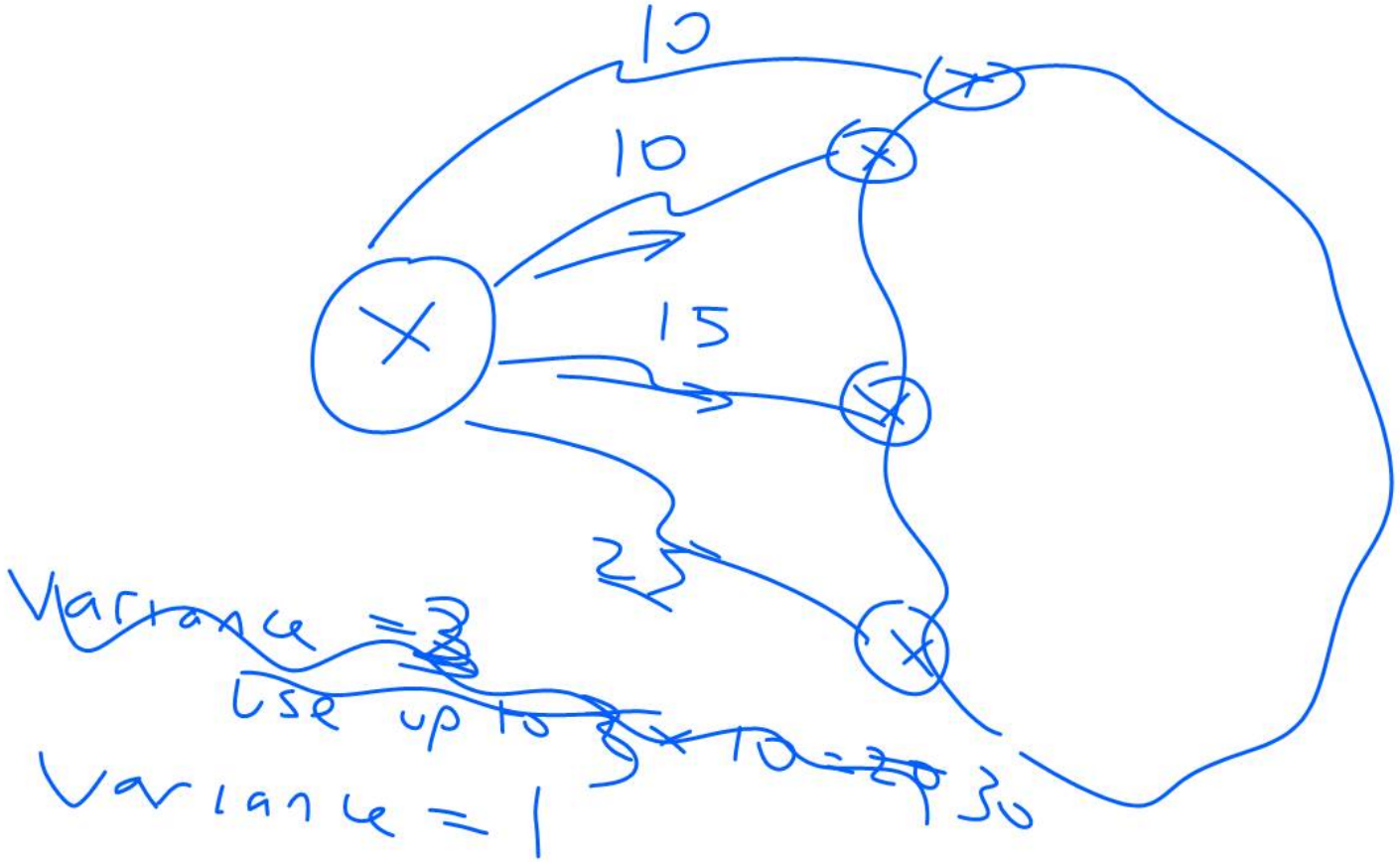
Successor.

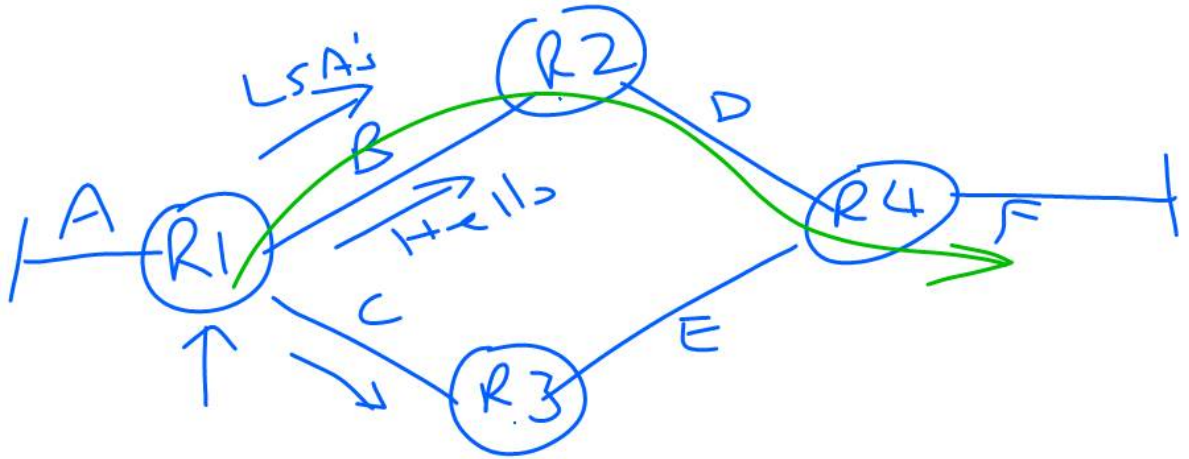

ipv6 unicast-routing
ipv6 router rip TAG
(config)# ipv6 rip TAG enable


compare
172.16.0.0/16
10.0.0.0/8
172.16.12.0/24
13.0/24
14.0/24
10.1.1.0/24
10.1.2.0/24
10.0.0.0/8
172.16.0.0/16
major
classful
network
boundary

Reason for route to Null0 on summarizing router




10
10
15
Variance =
use up to
10-20
30
Variance = 1

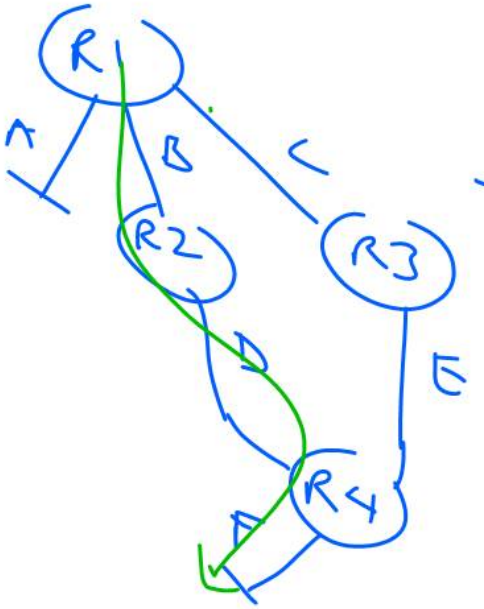


Neigh Table

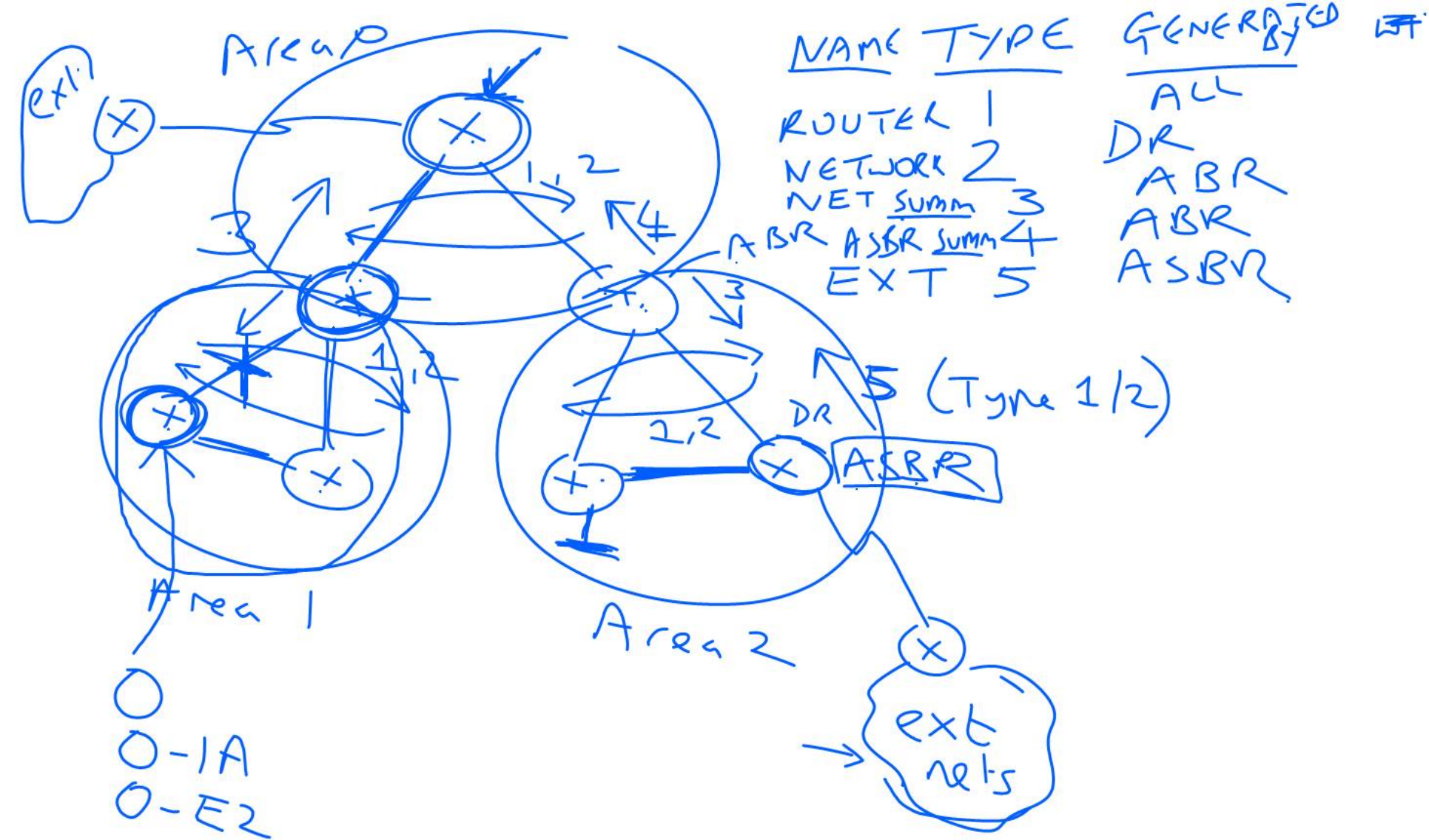
LSDB

R1 : A, B, C
R2 : B, D
R3 : C, E
R4, D, F

SPF



Routing Table


Area 0
exit
1,2
3
4
1,2
2,2
3
5 (Type 1/2)
DR
ASBR
Area 1
Area 2
ext nets
O
O-IA
O-E2
NAME TYPE GENERATED BY
ROUTER 1 ALL
NETWORK 2 DR
NET SUMM 3 ABR
ABR ASBR SUMM 4 ABR
EXT 5 ASBR

3) 2-way

2) INIT

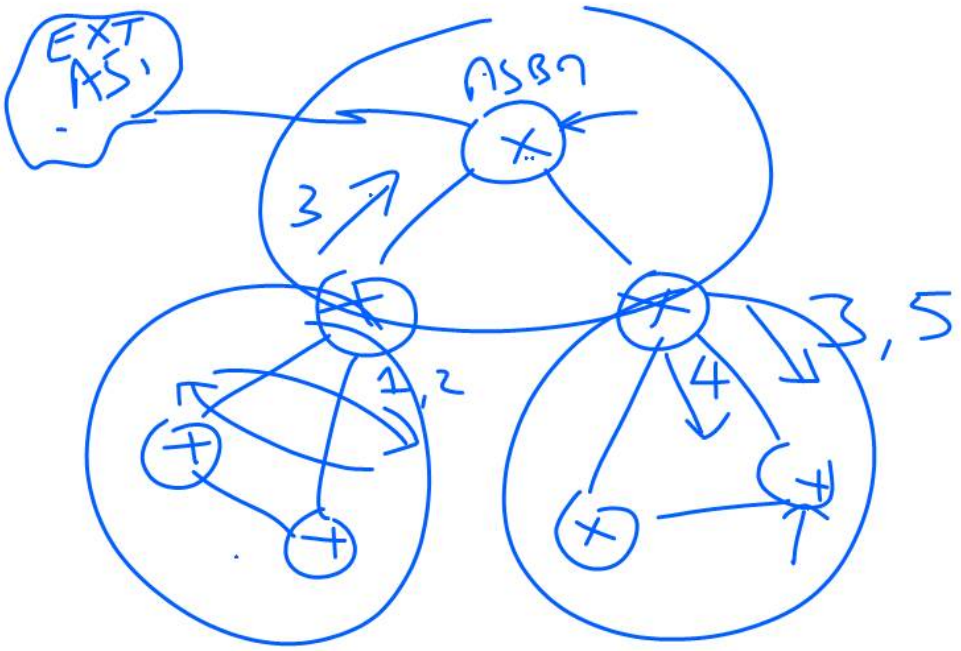
FULL

1) Down

5) Exchange

4) Ex-start

6) loading



Type

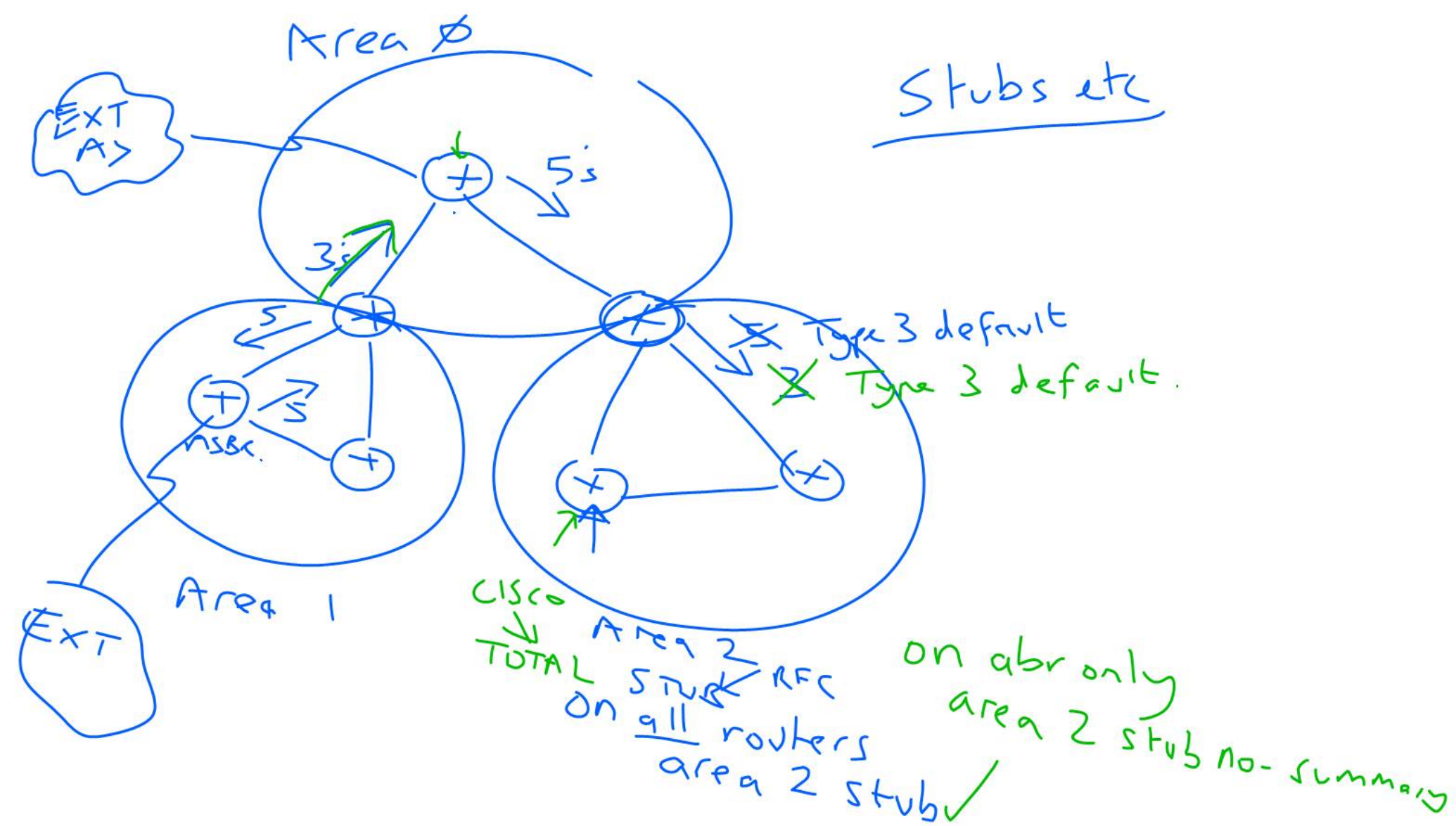
1	ROUTER	ALL
2	NETWORK	DR
3	NET SUMMARY	ABR
4	ASBR SUM	ABR
5	EXT	ASBR

manipulating costs

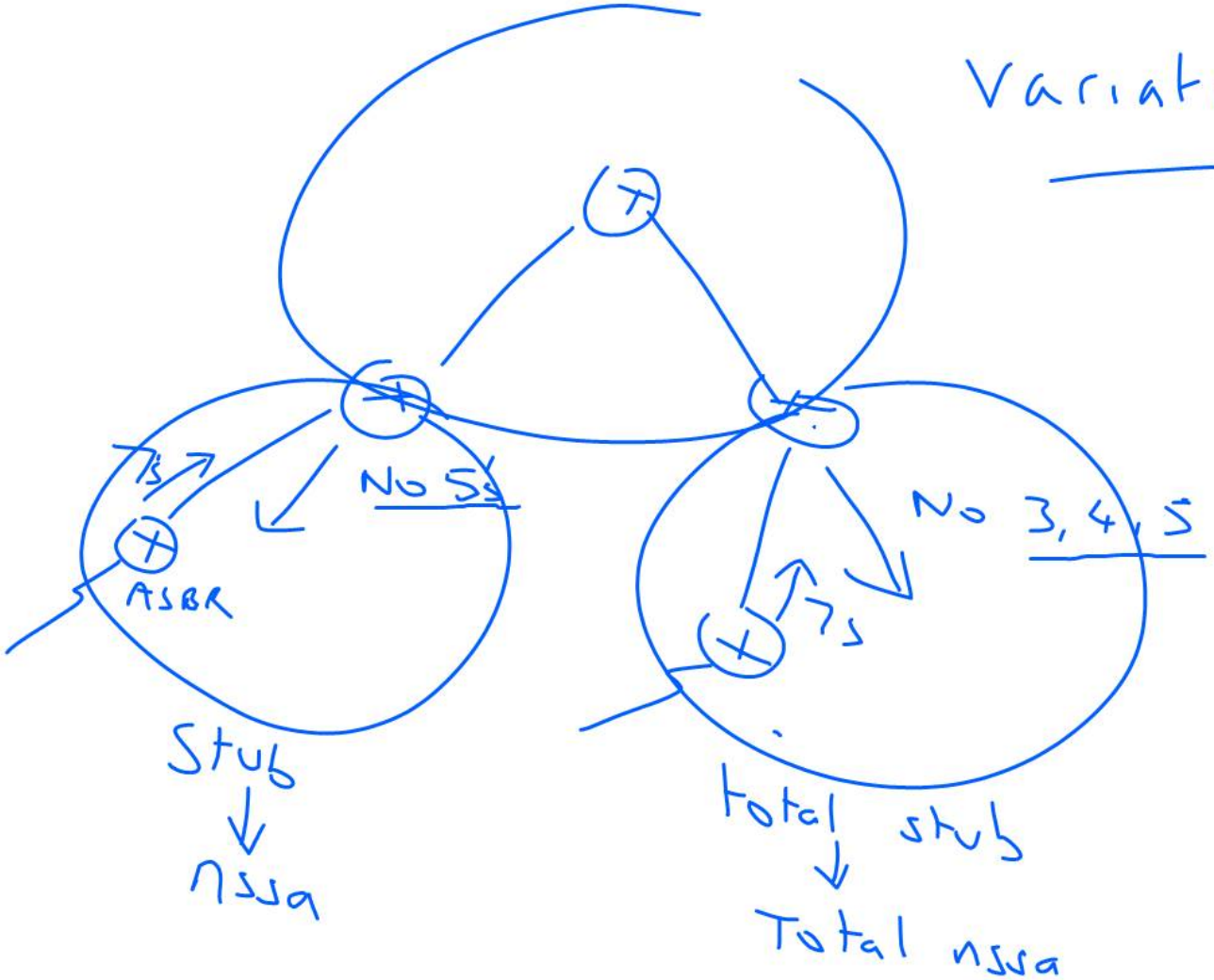
Ref b/w. ✓

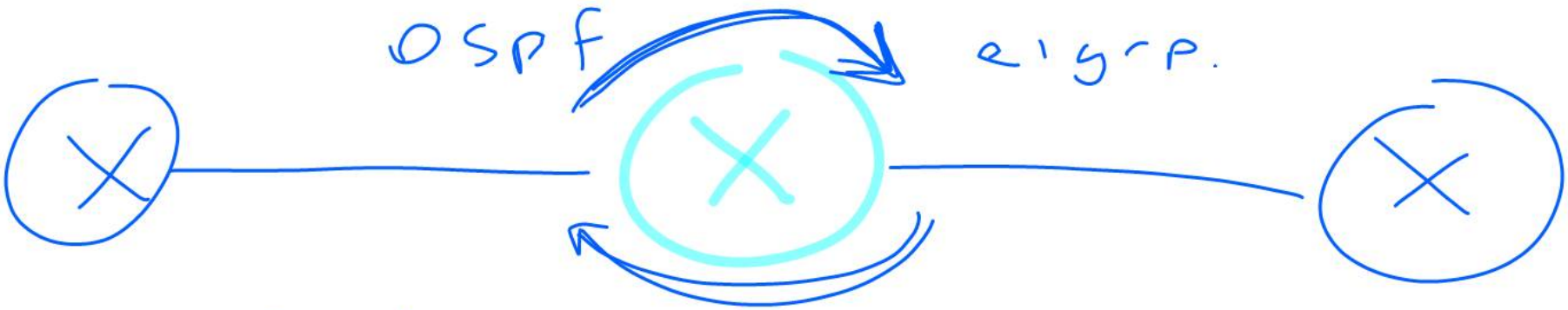
Cost of i/f ✓

bw of i/f ✓

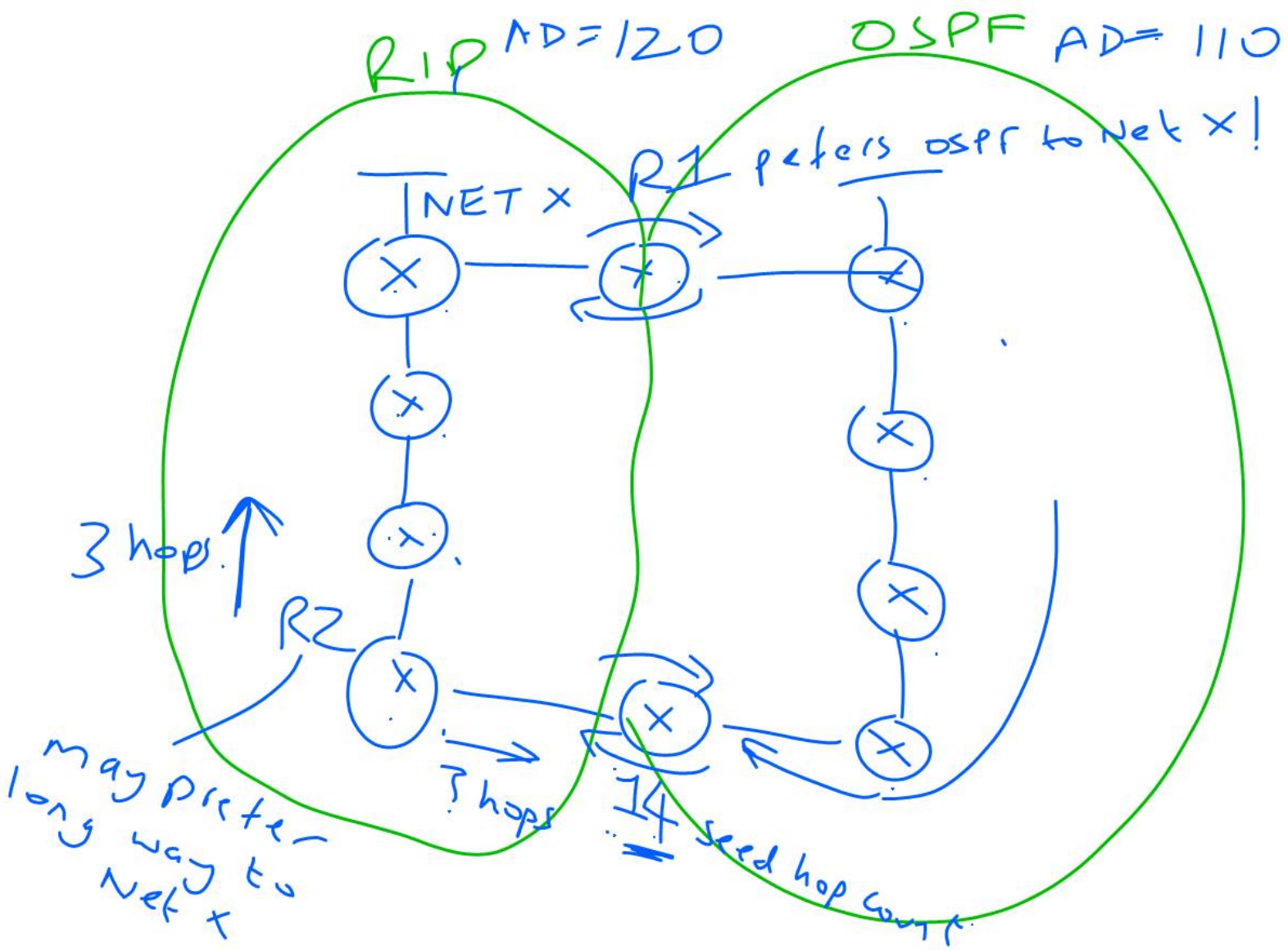

Area 0
EXT
A>
5s
3s
5
5
NSSA
Area 1
EXT
Type 3 default
Type 3 default.
Cisco
Area 2
TOTAL STUB
RFC
on all routers
area 2 stub
on abr only
area 2 stub no-summary
Stubs etc

Variations of a stub

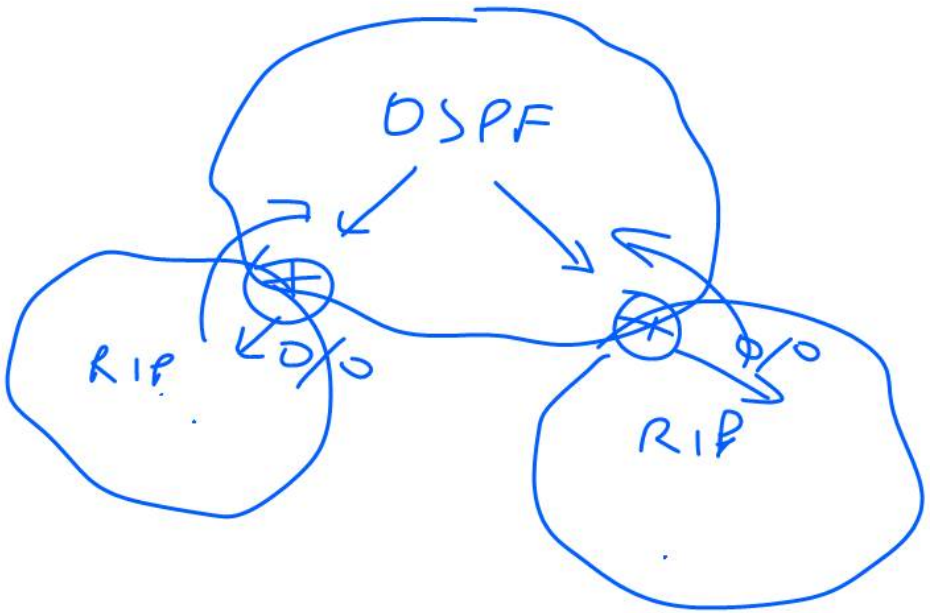





```
router eigrp 100
    redistribute ospf 1 .....
router ospf 1
    redist... eigrp 100 ....
```


RIP AD=120
OSPF AD= 110
R1 prefers ospf to Net X!
NET X
3 hops
R2
may prefer long way to Net X
7 hops
14
Send hop count

Better to redistribute 1 way



ip prefix-list MYPL permit 172.16.0.0/16

172.16.0.0/20 No

172.16.0.0/16 Yes

172.17.0.0/16 No

... prefix-list .... 172.16.0.0/16 le 24

172.16.1.0/24 ✓

172.16.16.0/20 ✓

172.16.1.16/28 No

172.17.1.0/24 No

permit 0.0.0.0/0 le 32
any !

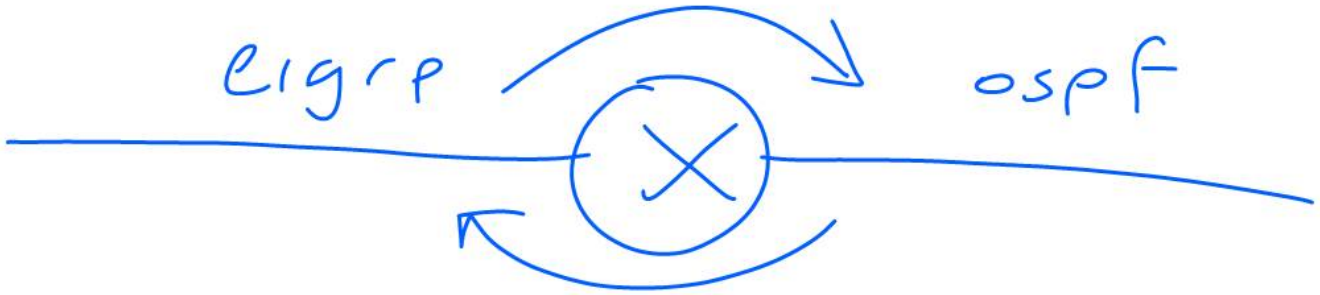
permit 0.0.0.0/0
default route

ABR

router ospf x
area 1 range <net> <mask>

ASBR

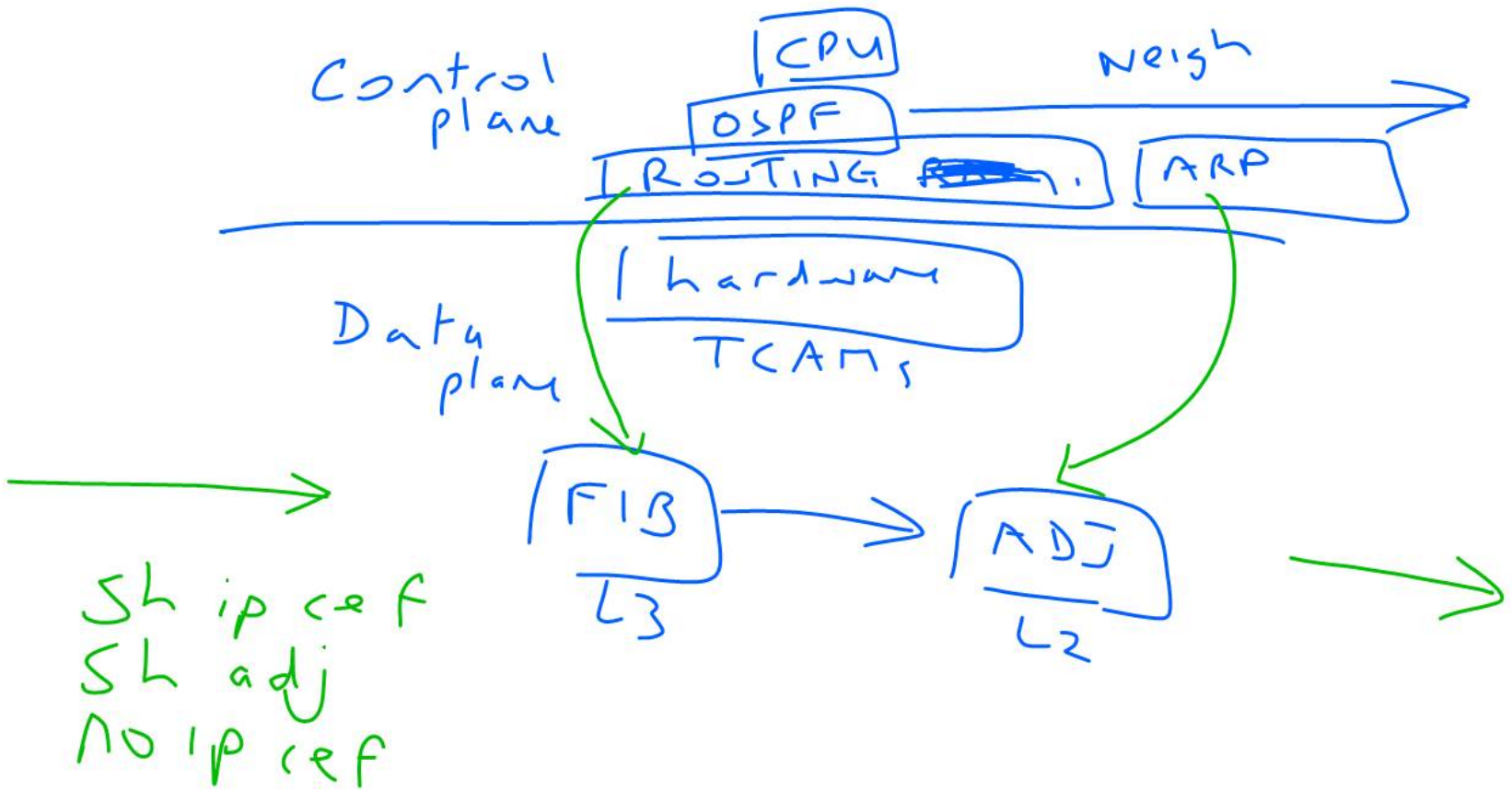
summary-address <net> <mask>

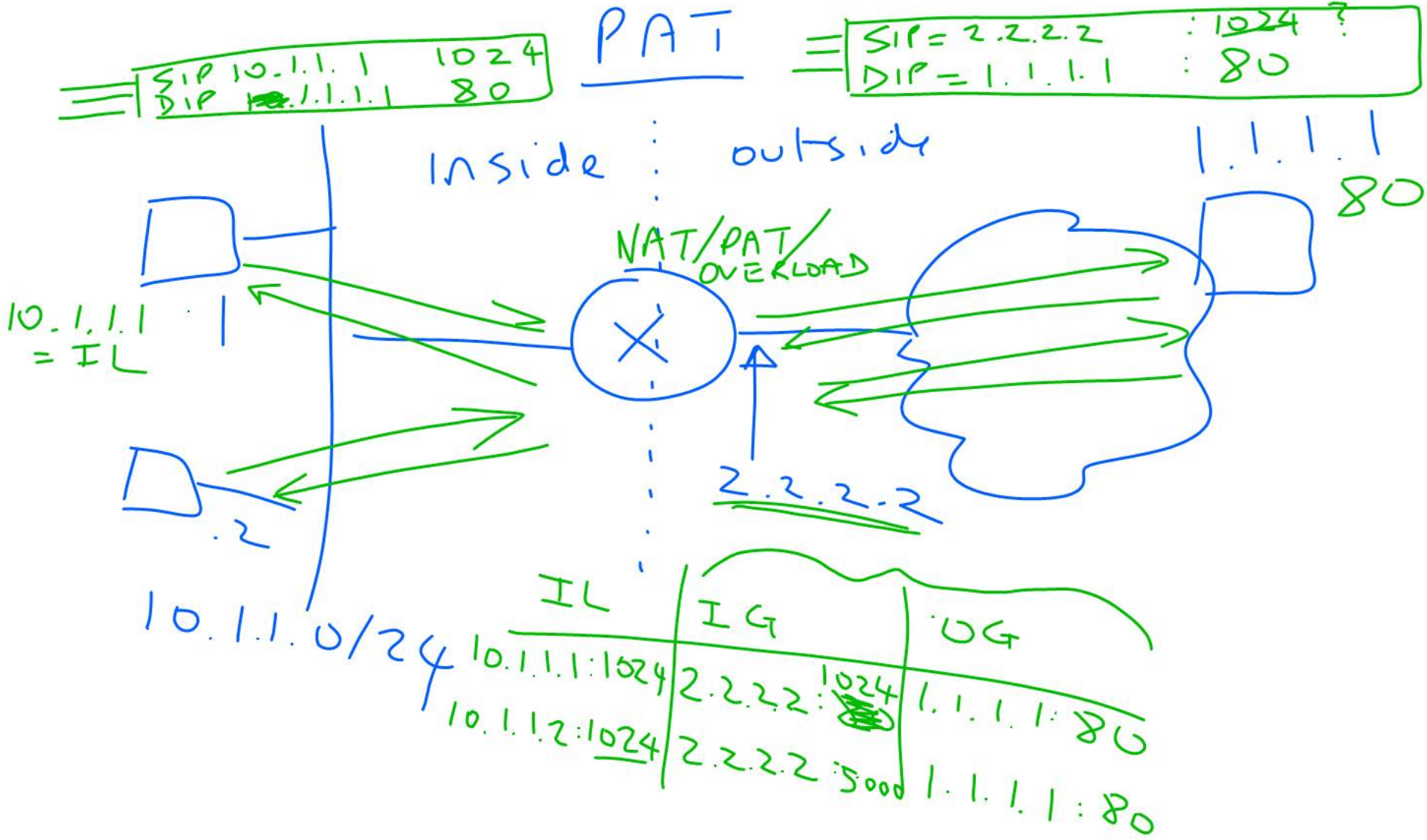



```
router ospf 1
    redist eigrp 100 metric 30 subnets

router eigrp 100
    redist ospf 1 1500 100 255 1 1500
```

CEF


Control plane
CPU
OSPF
ROUTING
ARP
Neigh
Data plane
hardware
TCAMs
FIB
L3
ADJ
L2
Sh ip cef
Sh adj
No ip cef


PAT
SIP 10.1.1.1 1024
DIP 1.1.1.1 80
SIP = 2.2.2.2 : 1024 ?
DIP = 1.1.1.1 : 80
inside
outside
1.1.1.1
80
NAT/PAT
OVERLOAD
10.1.1.1
= IL
.2
2.2.2.2
10.1.1.0/24
IL
IG
OG
10.1.1.1:1024
2.2.2.2:1024
1.1.1.1:80
10.1.1.2:1024
2.2.2.2:5000
1.1.1.1:80

Traditional NAT → INSIDE → ROUTING → NAT → OUTSIDE

← ROUTING ← NAT ←

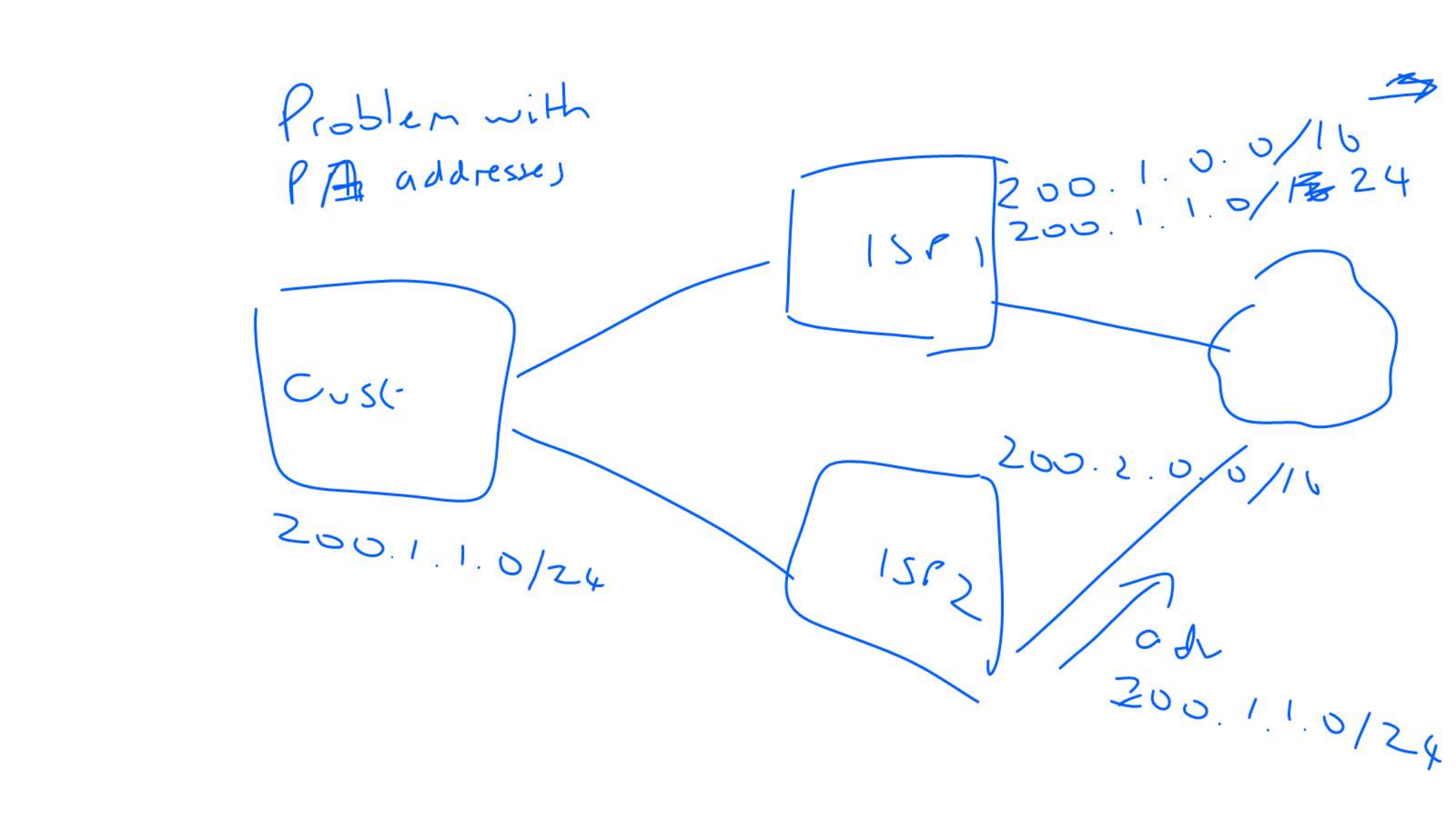
- breaks certain scenarios

~~NVI~~

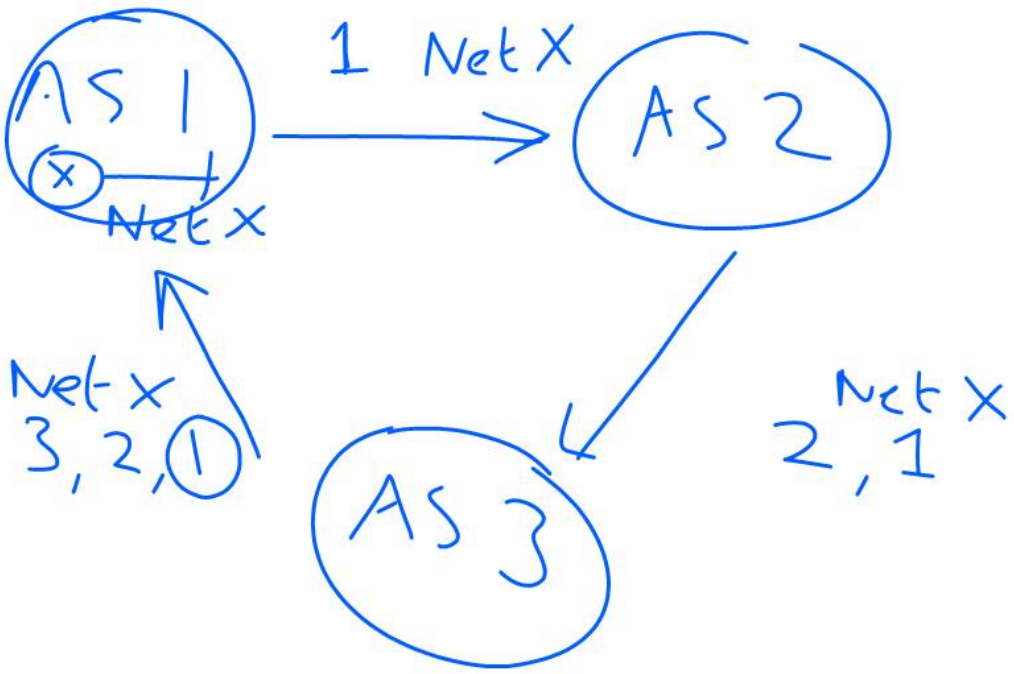
NVI NAT

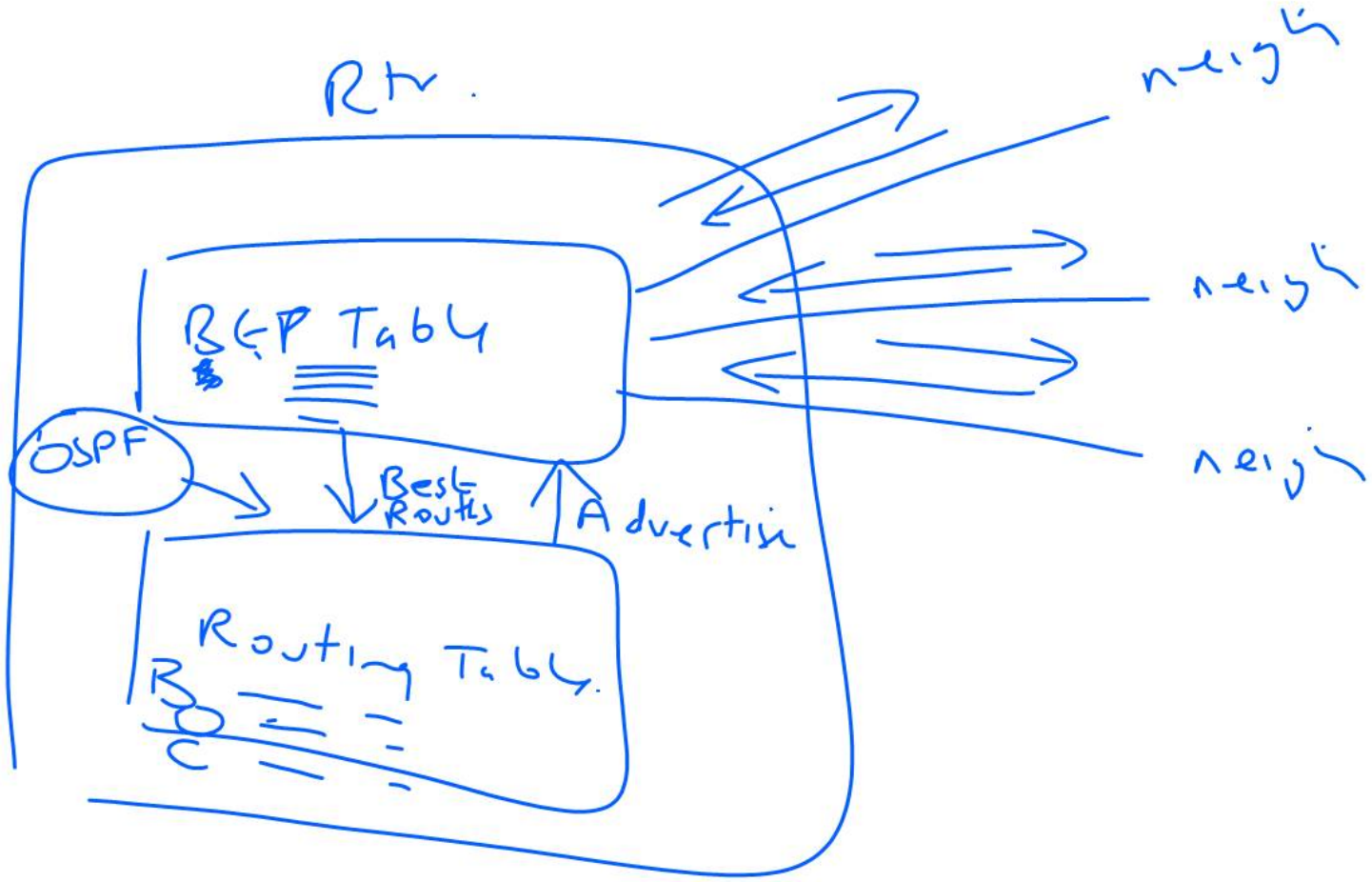
NVI → NAT → ROUTE

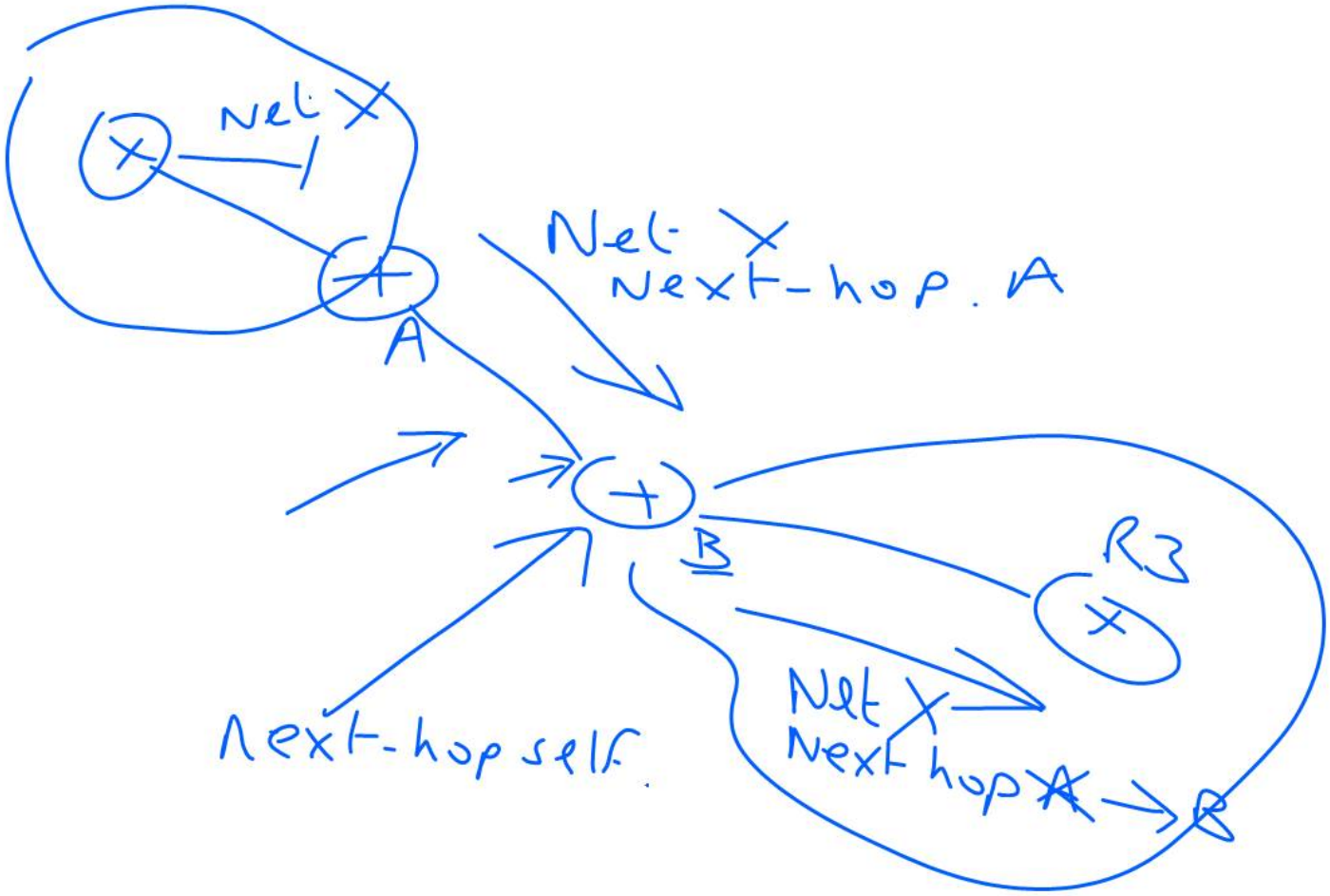
both directions same


Problem with
IP addresses
ISP1
200.1.0.0/16
200.1.1.0/24
Cust-
200.1.1.0/24
200.2.0.0/16
ISP2
or
200.1.1.0/24

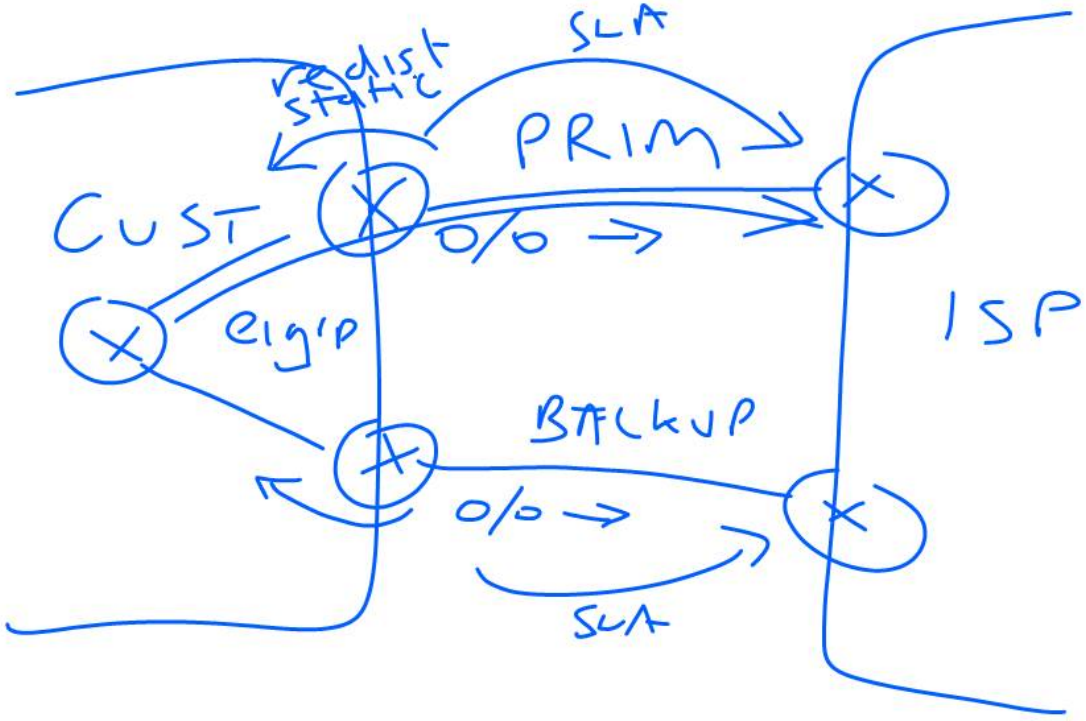
AS Path & Loops

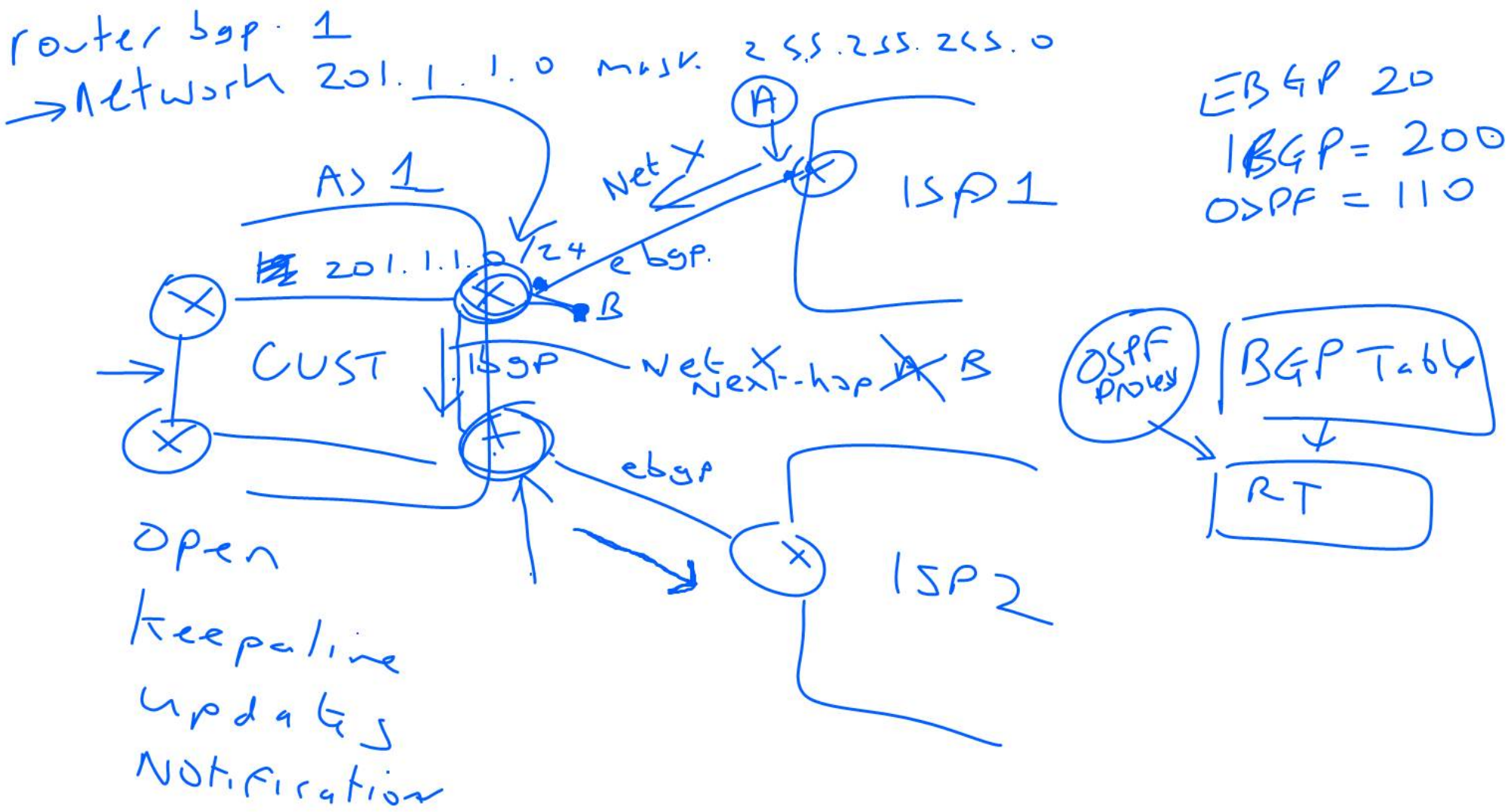



Rtr.
neigh
neigh
neigh
BGP Table
OSPF
Best Routes
Advertise
Routing Table
B
O
C


Net X
A
Net X
Next-hop A
B
R3
Net X
Next hop A
Next-hop self

W
L
A
M


SLA
static
dist
PRIM
CUST
o/o
eigrp
ISP
BACKUP
o/o
SLA


router bgp 1
network 201.1.1.0 mask 255.255.255.0
AS 1
Net X
A
ISP 1
201.1.1.0/24
ebgp
B
CUST
ISP
Net X Next-hop B
ebgp
ISP 2
Open
keepaline
Updates
Notification
EBGP 20
IBGP = 200
OSPF = 110
OSPF process
BGP Table
RT

W local to Rtr. Cisco. Highest: Ø.

L Local to AS. Def LP = 100: Highest

A Shortest

MED Ø. Lowest

Authentication