IPV6

- ✓The working standard for the IPv6 protocol was published by the Internet Engineering Task Force (IETF) in 1998.
- ✓In 1997, IBM became the first commercial vendor to support IPv6 through its AIX 4.3 OS.
- ✓In 2004, Japan and Korea were acknowledged as having the first public deployments of IPv6.
- ✓The explosive growth in mobile devices including mobile phones, notebook computers, and wireless handheld devices has created a need for additional blocks of IP addresses.
- ✓IPv4 currently supports a maximum of approximately 4.3 billion unique IP addresses. IPv6 supports 340,282,366,920,938,463,463,374,607,431,768,211,456 .

340-Undecillion 282-decillion 366 nonillion 920-octillion 938-septillion 463-sextillion 463-quintillion 374-quadrillion 607-trillion 431 billion 768-million 211-thousand 456

- ✓Recent advancements in network technology including Network Address Translation (NAT) have temporarily lessened the urgency for new IP addresses, however, recent estimates indicate that IPv4 addresses could be exhausted as soon as 2012.

IPV6 Advantages

- ✓ Large address space
- ✓ Global reachable and flexibility - Access computer from anywhere
- ✓ Aggregation - summarization
- ✓ Multi-homing - multiple internet connection to same PC
- ✓ Auto configuration - DHCP
- ✓ Plug and Play
- ✓ Renumbering - assigning IP manually
- ✓ No need of NAT & PAT
- ✓ Header is much smaller than IPV4
- ✓ No broadcast traffic
- ✓ Unicast ,multicast and anycast
- ✓ Mobile IP – e.g. Roaming facility in sim (same ip can be used in two different places)
- ✓ IPSec native (default, Mandatory)

IPV6 ADDRESS

2031:0000:0000:013F:0000:0000:0000:0001

2031::13F:0:0:0:1

Use : : only once

2031:0:0:13F::1

1080:0000:0000:0000:0000:0034:0000:417A

1080:0:0:0:0:34:0:417A

1080::34:0:417A

2000 ::/3

0010 0000 0000 0000

Must not change first 3 bits

0011 1111 1111 1111

3 F F F

2000:: 3FFF::

FE80 ::/10

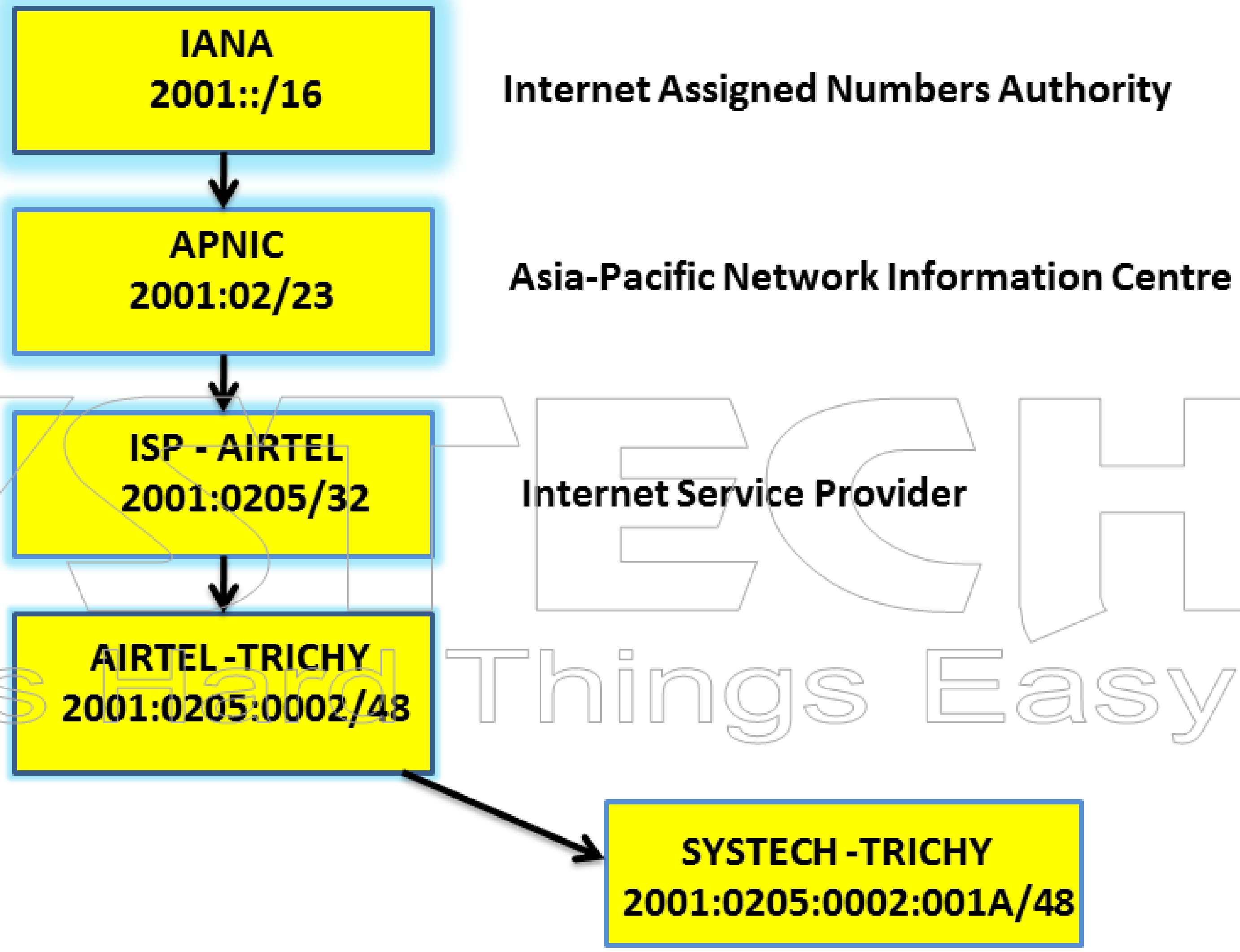
1111 1110 1000 0000

Must not change first 10 bits

1111 1110 1011 1111

F E B F

FE80:: .... FEBF::


IANA
2001::/16
Internet Assigned Numbers Authority
APNIC
2001:02/23
Asia-Pacific Network Information Centre
ISP - AIRTEL
2001:0205/32
Internet Service Provider
AIRTEL -TRICHY
2001:0205:0002/48
SYSTECH -TRICHY
2001:0205:0002:001A/48

64 BIT PREFIX

Padded bits

2001:0205:0002:001A	24 bit	FFFE 16 bit	24 bit

MAC ADDRESS 48 BIT

MAC ADDRESS : 00-1A-ZB-54-81-35

0000 0000 0

0000 0010 2

USE 1 AT 7th BIT

021A:ZBFF:FE54:8135

24 bit 16 bit 24 bit

SO IP IS PREFIX + MAC ADDRESS

2001:0205:0002:001A:021A:ZBFF:FE54:8135/128BIT

#ipv6 address 2001:205:2:1A/64 eui-64

IPV6 ADDRESS TYPES

- ✓**Unique local:** Its like ipv4 private address, its range is FD00::/8
- ✓**Link local:** Generated automatically for each interface
- ✓**Global unicast:** Its like public address, its address space is 2000::/3
- ✓**Unspecified:** Shows as ::/128 when host has no usable IPV6 address
- ✓**Loopback:** Same as 127.0.0.1 in IPV4, in IPV6 ::1/128
- ✓**Multicast:** Reserved space for this is FF:/8

IPV6 Static routing

RA

#int e0/0
#ipv6 add 2001:1::1/64
#no sh
#int s0/2
#ipv6 add 2001:2::1/64
#no sh
#exit
#ipv6 unicast-routing
#ipv6 route 2001:3::/64 2001:2::2

RB

#int e0/0
#ipv6 add 2001:3::1/64
#no sh
#int s0/1
#ipv6 add 2001:2::2/64
#no sh
#exit
#ipv6 unicast-routing
#ipv6 route 2001:1::/64 2001:2::1

#sh ipv6 route

IPV6 RIPNG (Next Generation)

RIP V2 (IPV4)		RIPNG (IPV6)
UDP port	520	521
Auto-Summary	Possible	Unavailable
Multicast address	224.0.0.9	FF02::9

RA & RB

```
#ipv6 unicast-routing
#ipv6 router  rip systech
#exit
#int e0
#ipv6 rip systech enable
#exit
#int s0
#ipv6 rip systech enable
#exit
#sh ipv6  route
```

IPV6 EIGRP

	EIGRP (IPV4)	EIGRP (IPV6)
Protocol header	88	88
Auto-Summary	Possible	Unavailable
Multicast address	224.0.0.10	FF02::10

RA&RB

#ipv6 unicast-routing
#ipv6 router eigrp 10
#no sh
#router –id 10.10.10.10
#exit
#int e0
#ipv6 eigrp 10
#exit
#int s0
#ipv6 eigrp 10
#exit

#sh ipv6 route
#sh ipv6 eigrp neighbour
#sh ipv6 eigrp topology

IPV6 OSPF

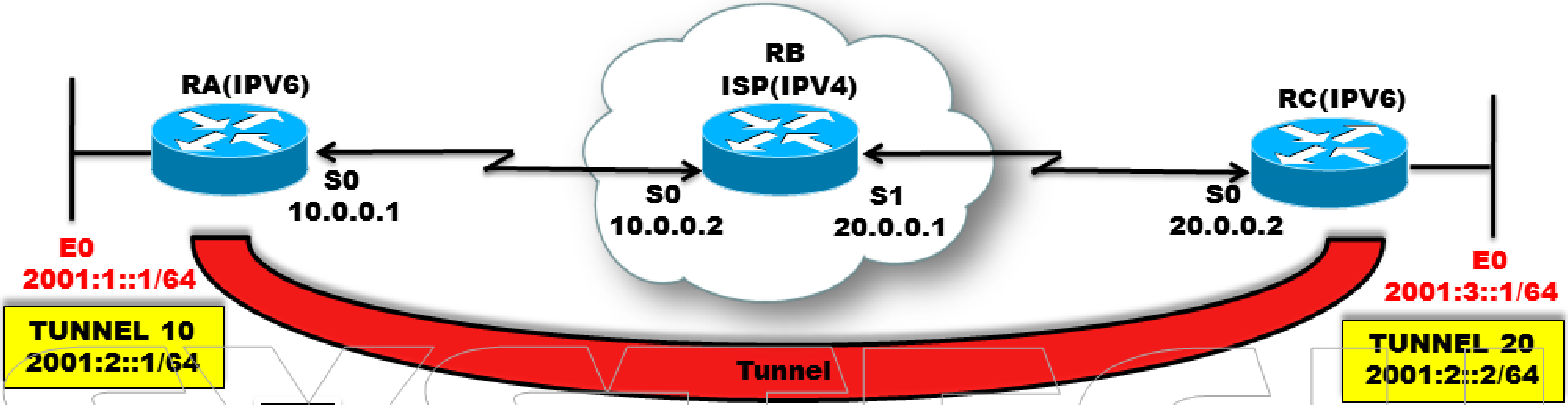
OSPF (IPV4)		OSPF (IPV6)
Multicast all OSPF	**224.0.0.5**	**FF02::5**
Multicast DR/BDR	224.0.0.6	FF02::6

RA&RB

```
#ipv6 unicast-routing
#ipv6 router  ospf 10
#router –id 10.10.10.10
#exit
#int e0
#ipv6 ospf 10 area 0
#exit
#int s0
#ipv6 ospf 10 area 0
#exit
```

```
#sh ipv6  route
#sh ipv6 ospf neighbour
#sh ipv6 ospf database
```

IPV6 tunnel



RA

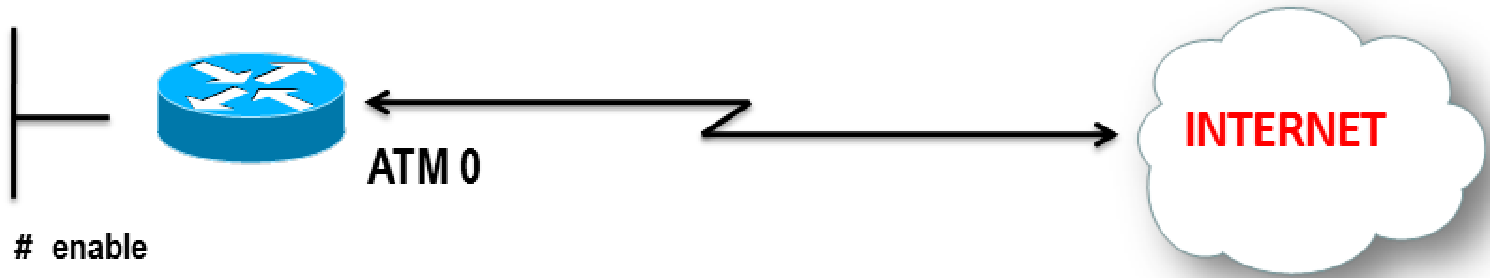
```
# interface tunnel 10
# ipv6 add 2001:2::1/64
# tunnel source s0
# tunnel  destination 20.0.0.2
# tunnel mode ipv6ip
# exit
# ipv6 unicast-routing
# ipv6 route 2001:3::/64 2001:2::2
# ip route 20.0.0.0 255.0.0.0  10.0.0.2
```

RC

```
# interface tunnel 20
# ipv6 add 2001:2::2/64
# tunnel source s0
# tunnel  destination 10.0.0.1
# tunnel mode ipv6ip
# exit
# ipv6 unicast-routing
# ipv6 route 2001:1::/64 2001:2::1
# ip route 10.0.0.0 255.0.0.0  20.0.0.1
```

#sh ipv6 ip route

ADSL Router configuration



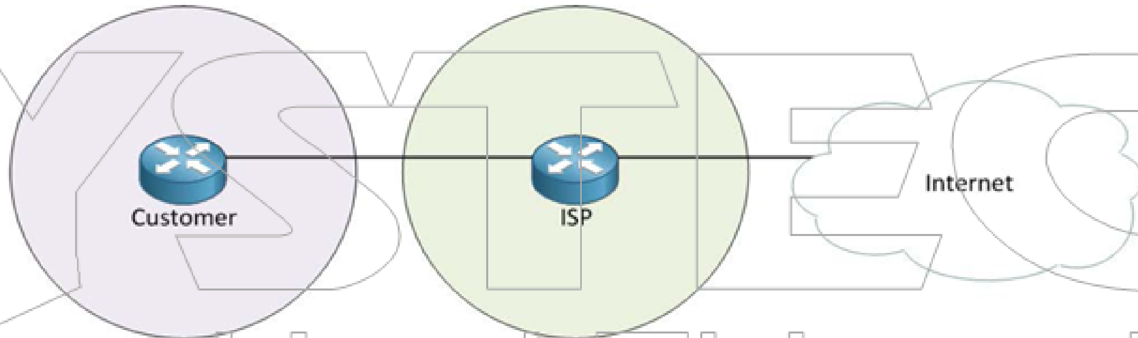

```
# enable
#int e0/0
#ip address 10.0.0.1 255.0.0.0
# no sh
#interface atm 0/0
#no sh
#pvc 0/35
#pppoe-client dial-pool-number 1
#exit
#interface dialer 0
# ip address negotiated
#ip mtu 1492
#encapsulation ppp
#dialer pool 1
#ppp pap sent-username***password***
#ppp chap hostname****
#ppp chap password****
```

```
#ip route 0.0.0.0 0.0.0.0 dialer 0
#access-list 1 permit any
#ip nat inside source list 1 interface dialer 0 overload
#interface e0/0
#ip nat inside
#exit
#interface dialer 0
#ip nat outside
#ip dns server
#interface dialer 0
#ppp ipcp dns request accept
#shutdown
#no shutdown
```

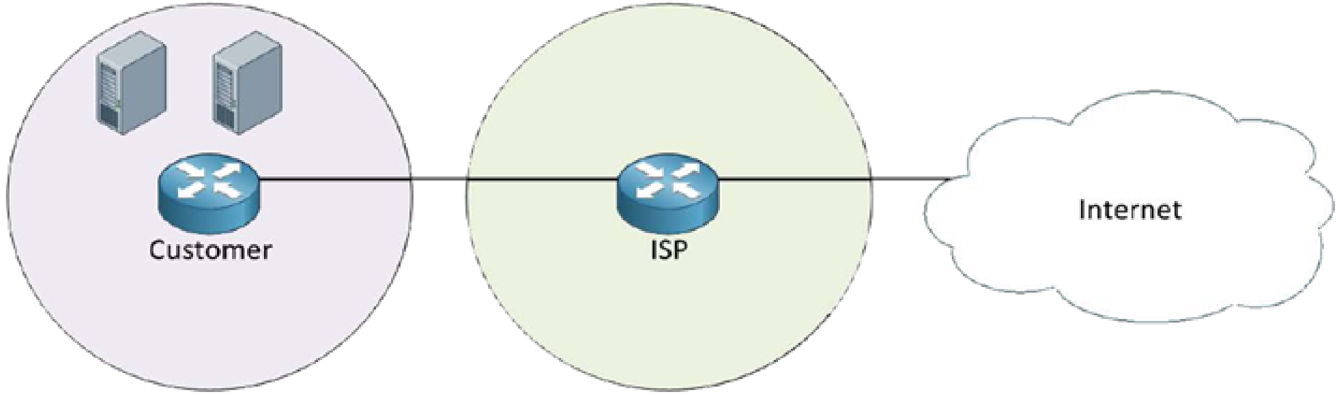
- Machine IP : 10.0.0.2 255.0.0.0
- Gateway IP : 10.0.0.1
- DNS SERVER: 10.0.0.1

BGP (Border Gateway Protocol)

- ✓BGP is the only protocol we currently use on internet
- ✓RIP,OSPF & EIGRP are different from BGP as they find shortest path to the destination, but in internet we don't care as much to find shortest path, being able to manipulate traffic paths is more important

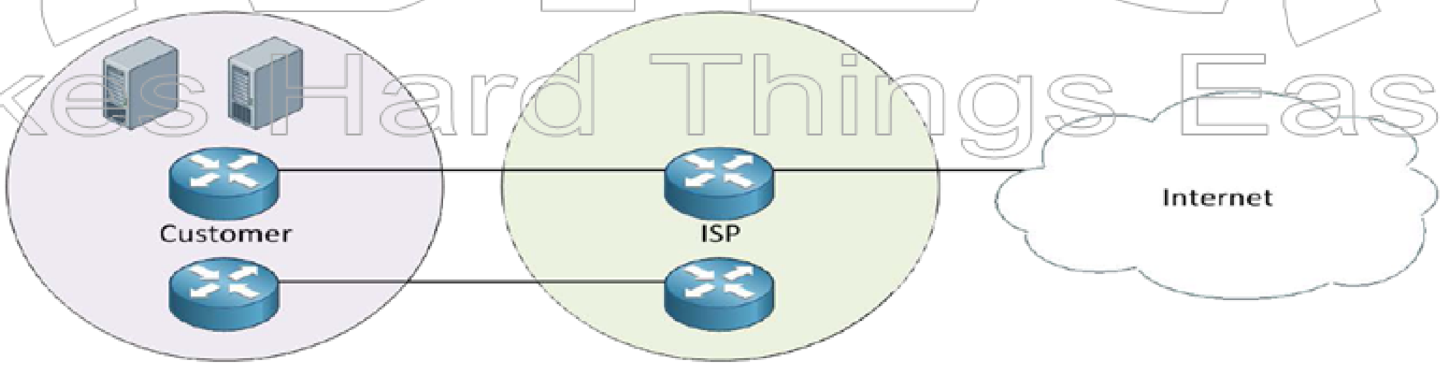


- ✓In the picture above we have a customer network connected to ISP
- ✓ISP will give a Static ip address
- ✓We will use NAT/PAT to translate our internal private address to single public IP address
- ✓This scenario is OK when we have only clients that need Internet access
- ✓In our customer router we will configure default route pointing to the ISP router

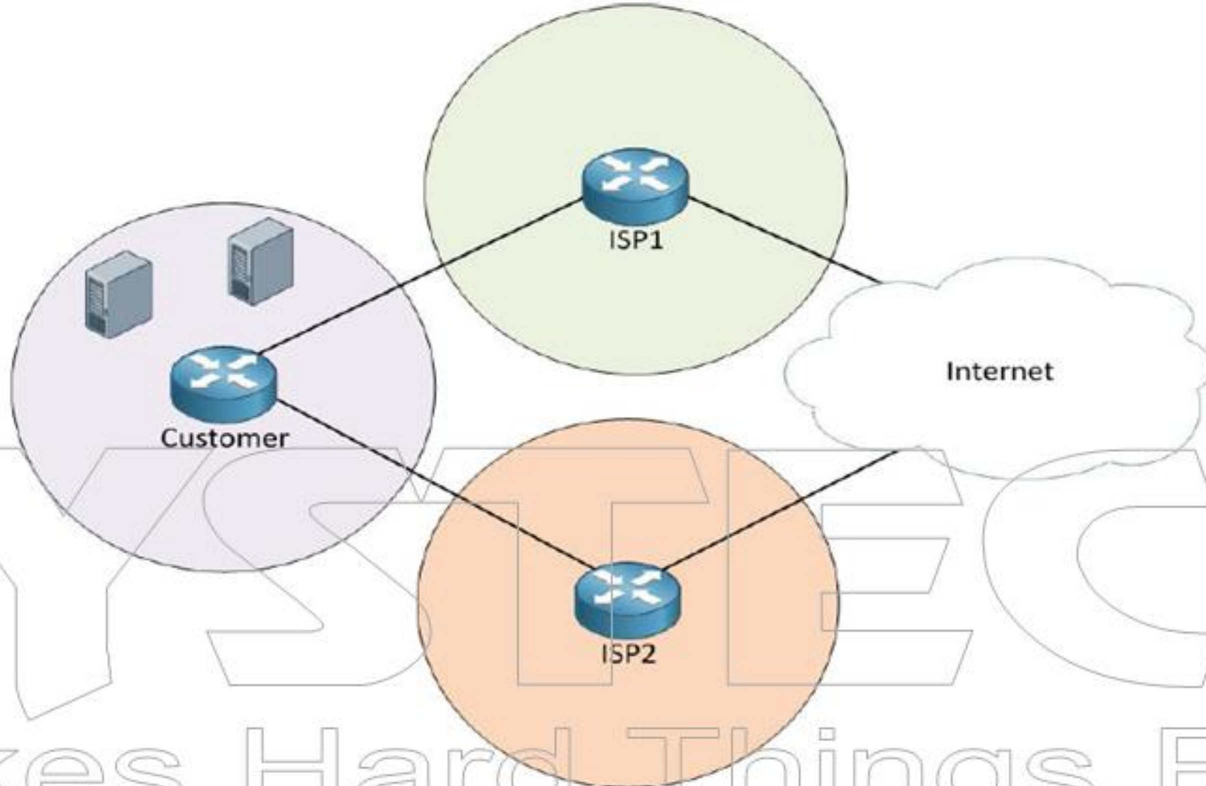


✓In the picture above we have a customer network with couple of servers that need to be reachable from internet

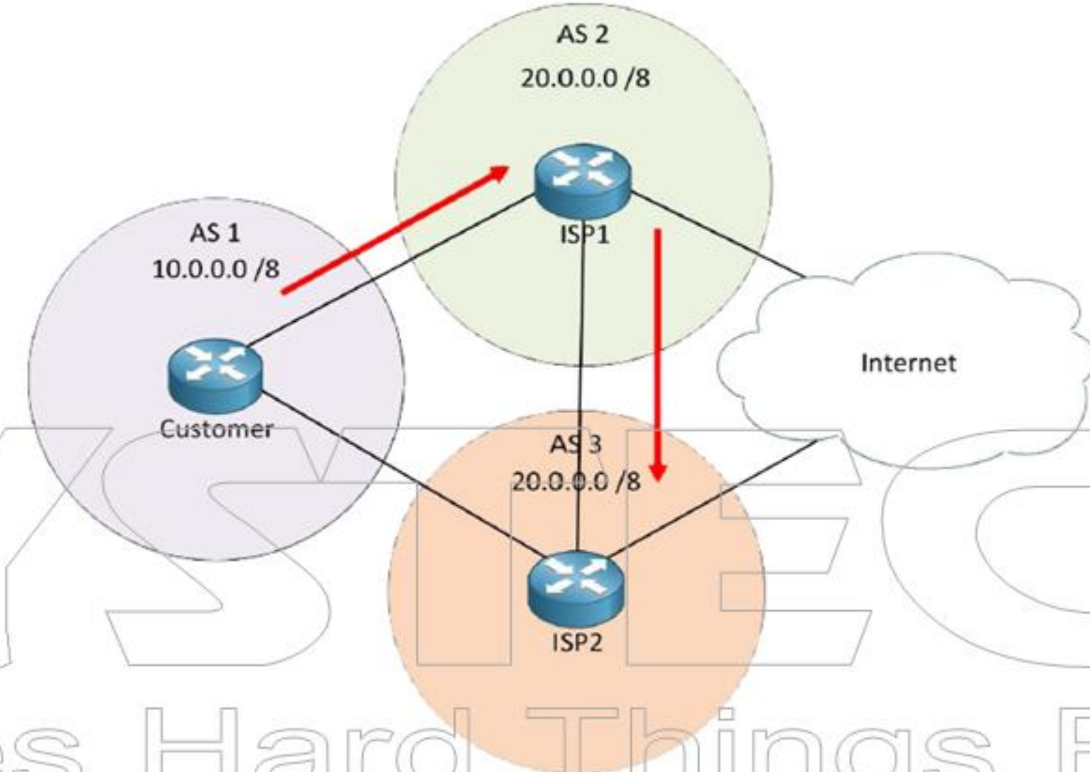
✓We could use port forwarding by using a single static IP address or else we can buy more public IP addresses from ISP



✓When we use Redundancy , we can use one link as primary link & another as backup link



- ✓In the scenario above we have 2 different ISPs and we are not going to use public IP address from any ISP but we will get some public IP address space of our own from IANA (www.iana.org)
- ✓We have to advertise this public IP address to both ISPs using BGP routing protocol

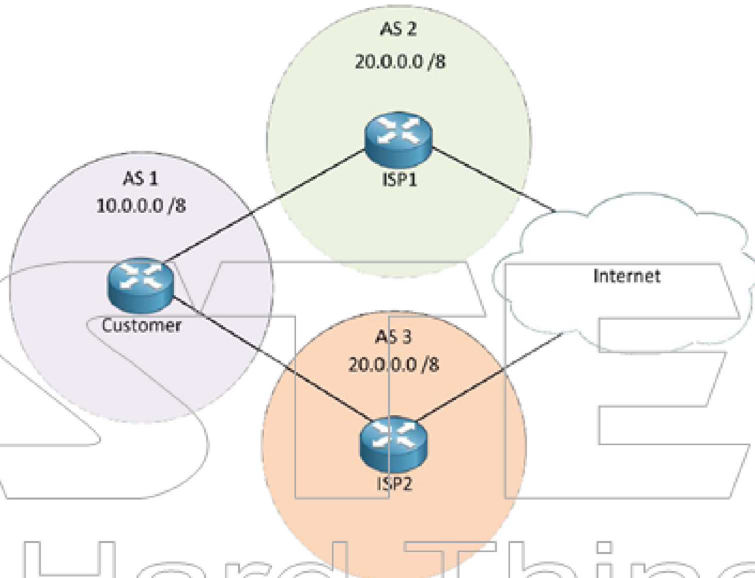


- ✓If our customer network receive a default route from both ISPs
- ✓We have chosen ISP1 to send all our traffic
- ✓The problem is whenever we send traffic ment for ISP2 it's going to be sent to ISP1 and then to ISP2

✓BGP has two flavors

✓ External BGP (between autonomous systems) AD:20 Internal BGP: (within the autonomous system) AD:200

✓External BGP is to exchange routing information between the different autonomous systems



✓Our customer network has AS1 and public IP and it is connected to two different ISPs

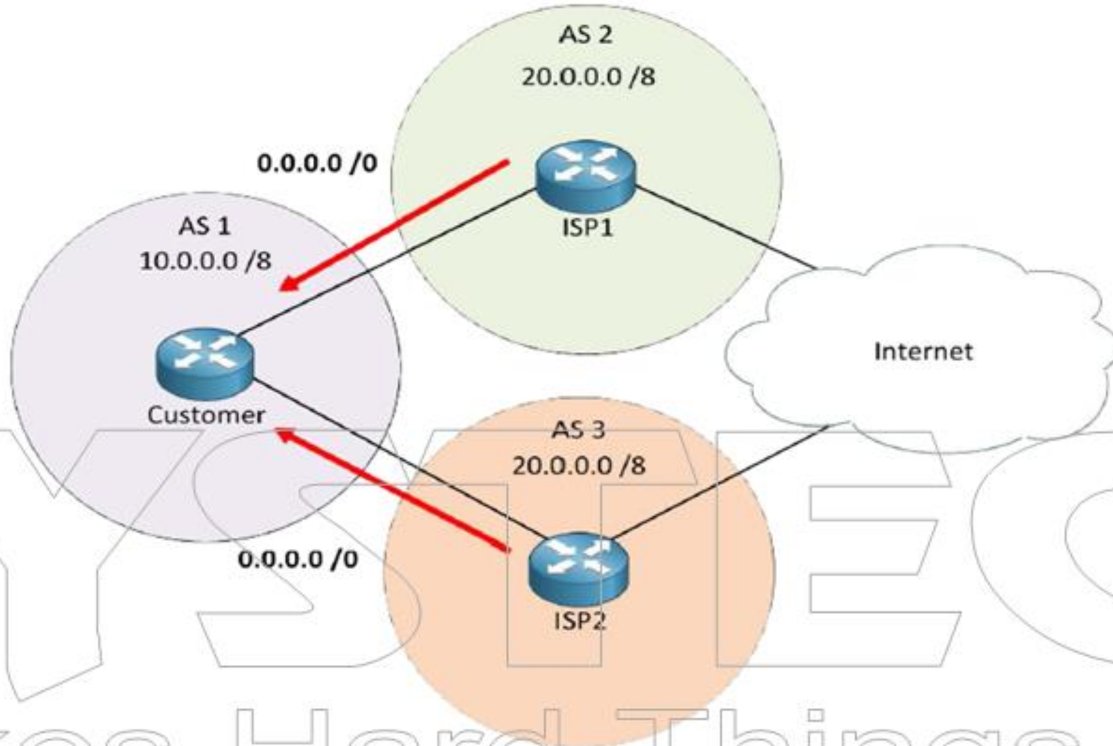
✓We can reach internet through both ISPs

✓What are the ISPs going to advertise to the customer network through BGP?

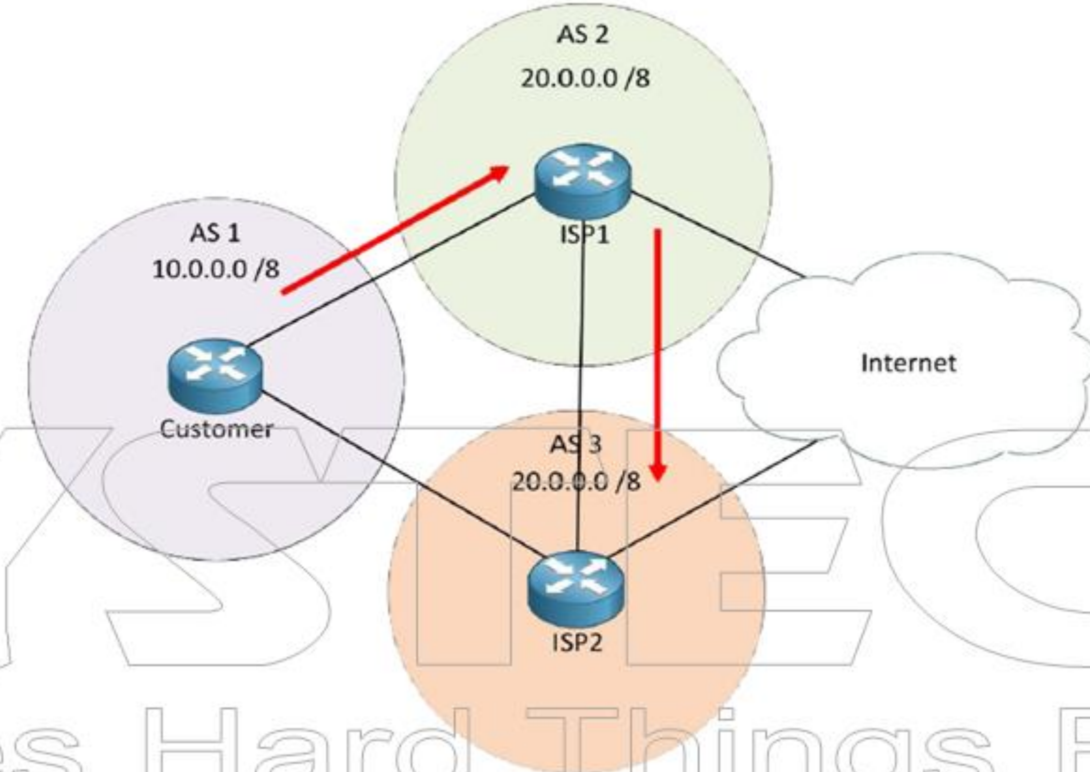
•They will advertise only default route

•They will advertise a default route and a partial routing table

•They will advertise a full internet routing table



- ✓ **Receiving default route requires the fewest resources on our routers since we have a single entry to reach any external network**
- ✓ **The customer router will advertise its 10.0.0.0/8 network to both ISPs**
- ✓ **The customer network doesn't know what is behind ISP1 & ISP2**
- ✓ **If we only have default routes then all traffic will be send to one of the ISPs**



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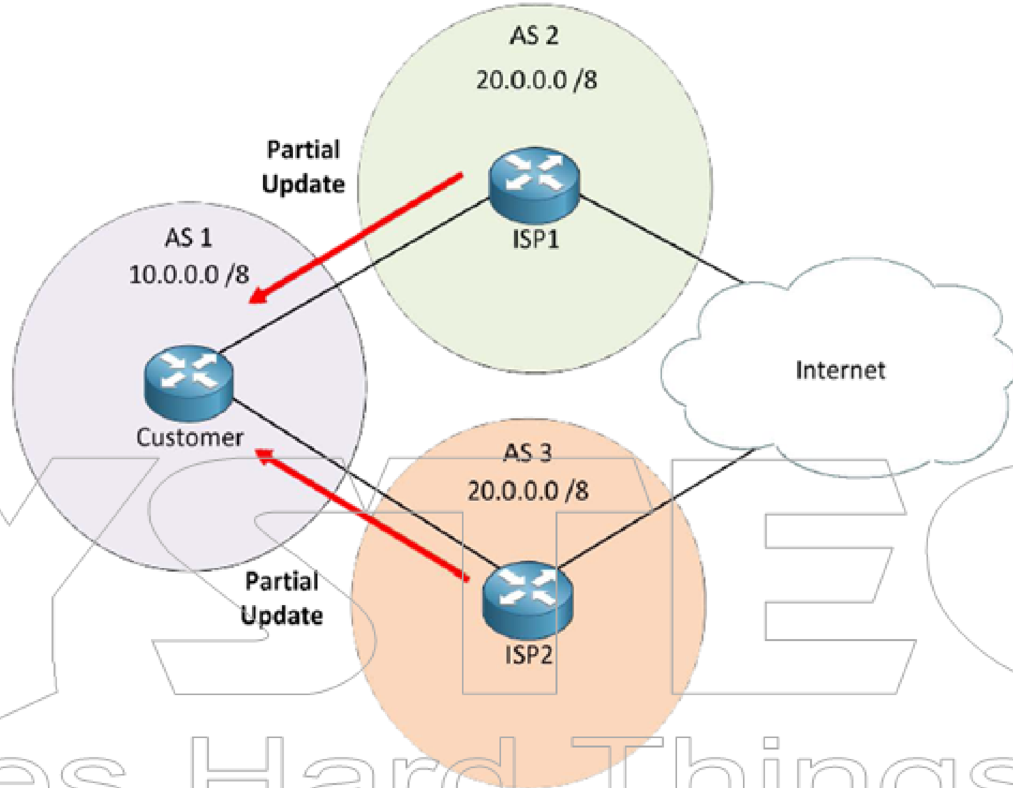
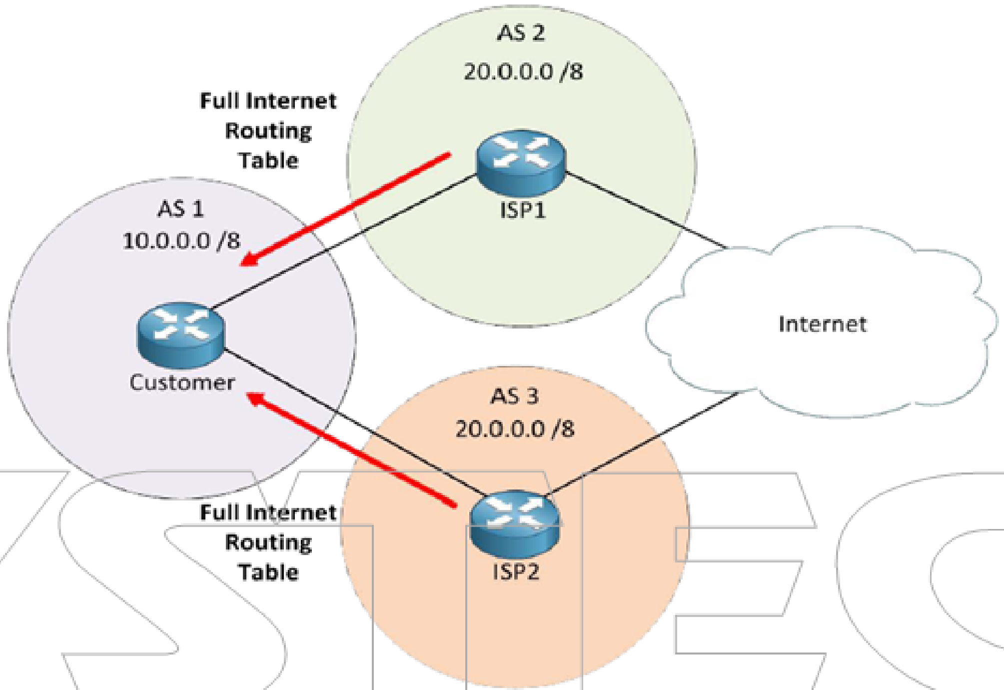
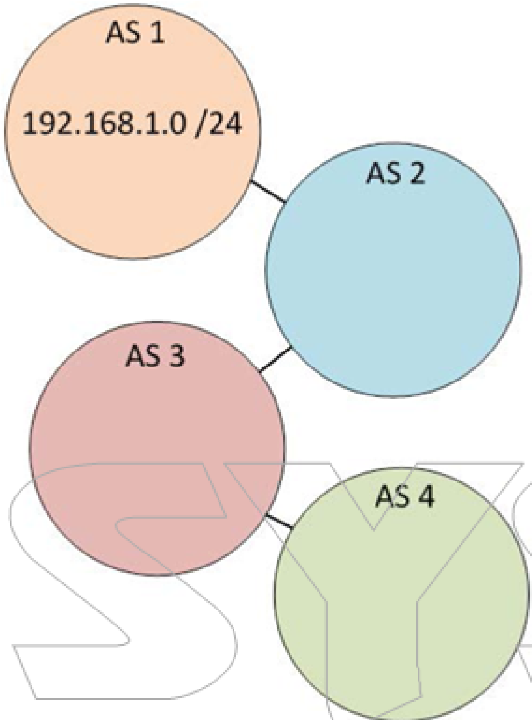


- ✓ we can also receive partial routing table from ISP along with default route
- ✓ The partial update might include all the IP address space that the ISPs have assigned to their customers
- ✓ More routing information means we can make better routing decisions
- ✓ Its better than having only default route



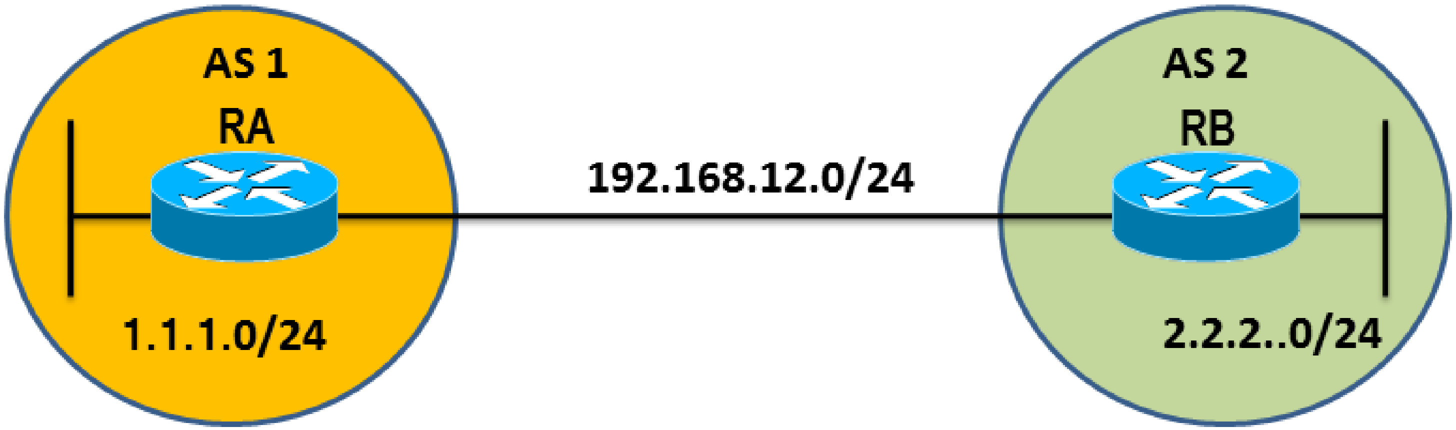
- ✓ we can also receive full internet routing table from both ISPs
- ✓ This requires more resources but we will be able to make the best routing decisions
- ✓ BGP guarantees loop-free routing information
- ✓ BGP is completely different than IGPs
- ✓ BGP is a path-vector routing protocol
- ✓ BGP uses BGP attributes instead of metrics



- ✓ Why BGP is called as path-vector routing protocols?
- ✓ In AS1 we have 192.168.1.0/24 network and it is advertised to AS 2,As 3 & AS 4
- ✓ If we look at BGP router in AS 4 we will see 192.168.1.0 network but it also stores the full path (AS 3,AS 2 and AS 1)
- ✓ This is different than any IGP (RIP,OSPF,EIGRP),they only show the next-hop IP addres
- ✓ Each AS will only advertise the best path to our AS
- ✓ If the best path fails then it will learn the second best path

```
route-views.optus.net.au>show ip bgp
BGP table version is 158954662, local router ID is 203.202.125.6
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*  1.0.4.0/22       202.160.242.71                         0 7473 6453 38809 38809 56203 56203 56203 i
```



RA

#router bgp 1
#neighbor 192.168.12.2 remote-as 2
#neighbor 192.168.12.2 password systech
#network 1.1.1.0 mask 255.255.255.0

RB

#router bgp 2
#neighbor 192.168.12.1 remote-as 1
#neighbor 192.168.12.1 password systech
#network 2.2.2.0 mask 255.255.255.0

#sh ip bgp summary
#sh ip bgp
#sh ip route