

Enterprise Internet Routing



- Internet Service Providers connect to other ISPs and must use BGP for Internet routing
- Enterprises can use either static routes or BGP for their Internet connectivity
- Enabling BGP increases the load on both the routers and the administrators who need to support it

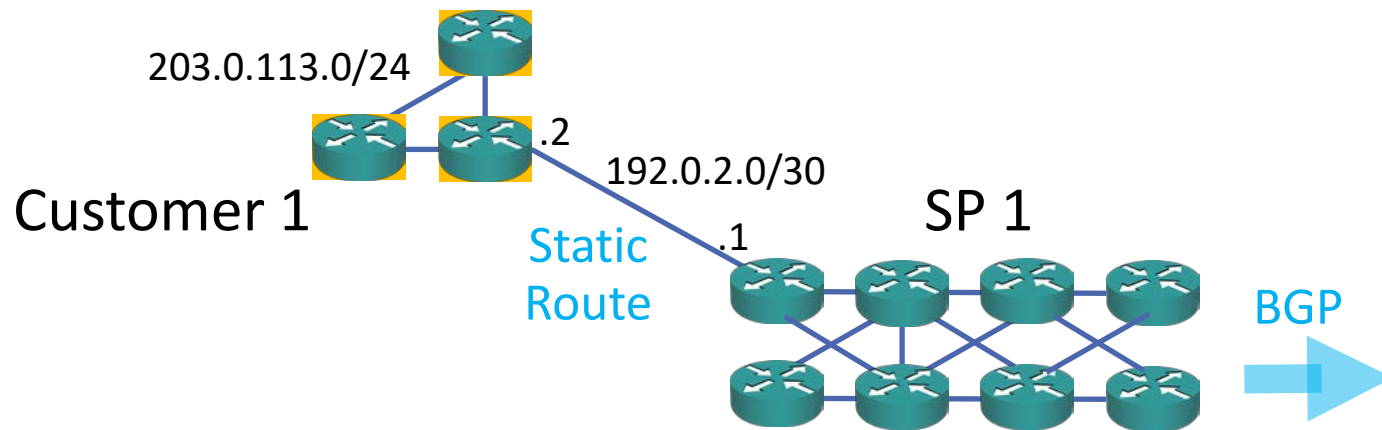
Enterprise Internet Routing



- There is only one path in and out for the customer so there is no need to use anything more complicated than a default static route

```
Cust1(config)# ip route 0.0.0.0 0.0.0.0 192.0.2.1
```

```
SP1(config)# ip route 203.0.113.0 255.255.255.0 192.0.2.2
```



Enterprise Internet Routing

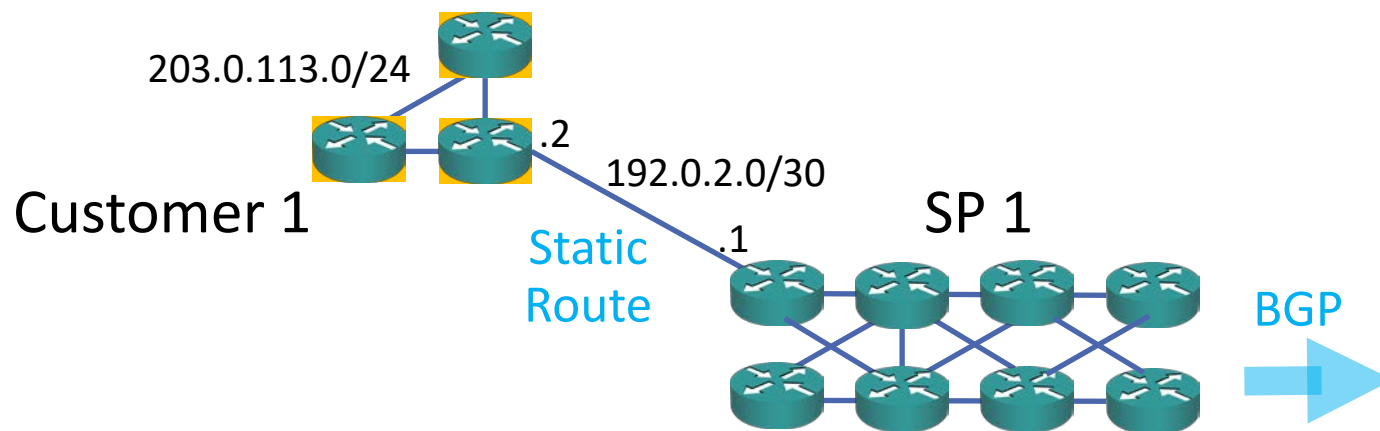


- The default static route can be injected into any IGP

```
Cust1(config)# ip route 0.0.0.0 0.0.0.0 192.0.2.1
```

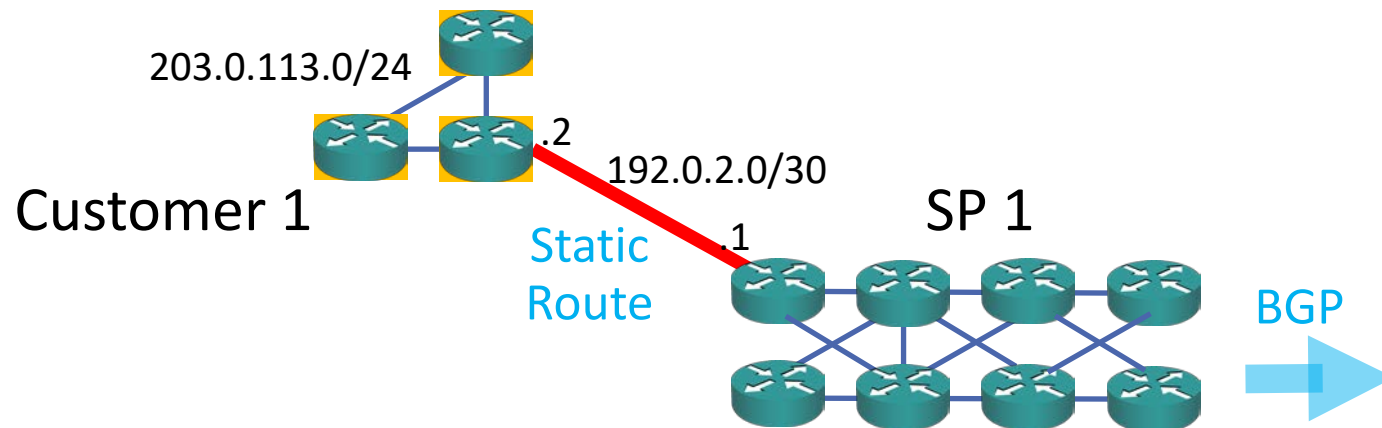
```
Cust1(router)#router ospf 1
```

```
Cust1(config-router)#default-information originate
```



Single Point of Failure - Link

- There is a single link between the customer and provider, this is a single point of failure
- This topology will sometimes be acceptable for small offices, but larger offices will want redundancy for their Internet connectivity



Active/Active Redundant Links

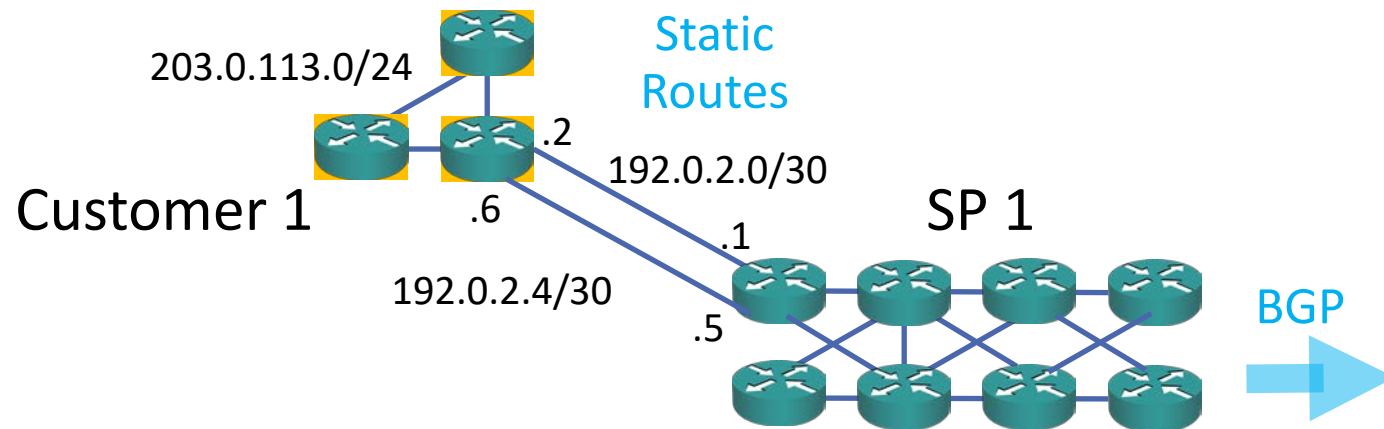


```
Cust1(config)# ip route 0.0.0.0 0.0.0.0 192.0.2.1
```

```
Cust1(config)# ip route 0.0.0.0 0.0.0.0 192.0.2.5
```

```
SP1(config)# ip route 203.0.113.0 255.255.255.0 192.0.2.2
```

```
SP1(config)# ip route 203.0.113.0 255.255.255.0 192.0.2.6
```



Active/Active Redundant Links



- Installing multiple active links provides redundancy and increased bandwidth
- All traffic to and from the customer travels via a single AS, so there is no need to configure BGP
- Equal cost load balancing will spread the traffic equally over both links
- This is suitable where all links have the same bandwidth and latency
- If a link fails all traffic will go over the surviving link

Backup Redundant Link

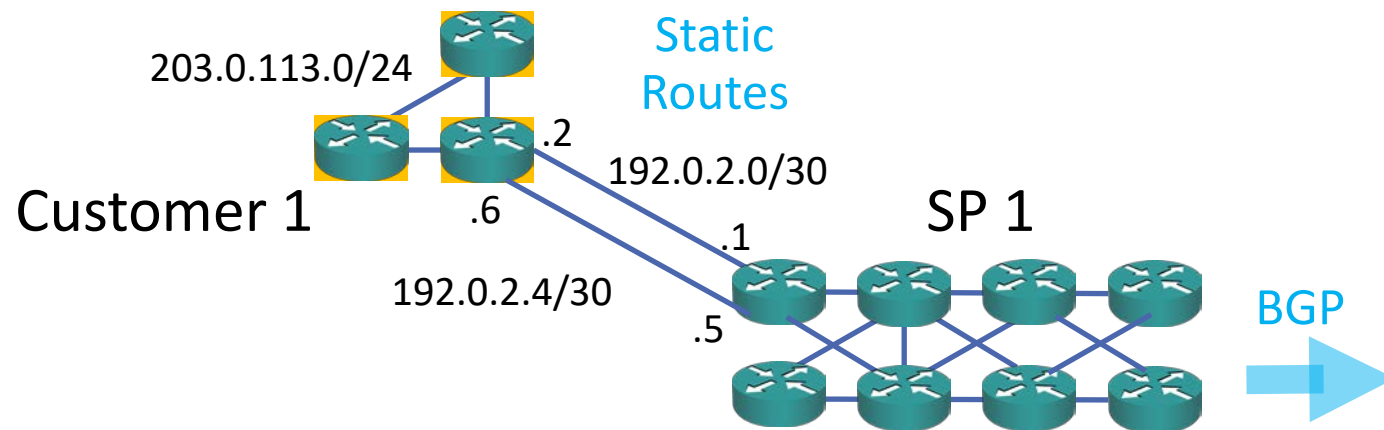


```
Cust1(config)# ip route 0.0.0.0 0.0.0.0 192.0.2.1
```

```
Cust1(config)# ip route 0.0.0.0 0.0.0.0 192.0.2.5 5
```

```
SP1(config)# ip route 203.0.113.0 255.255.255.0 192.0.2.2
```

```
SP1(config)# ip route 203.0.113.0 255.255.255.0 192.0.2.6 5
```



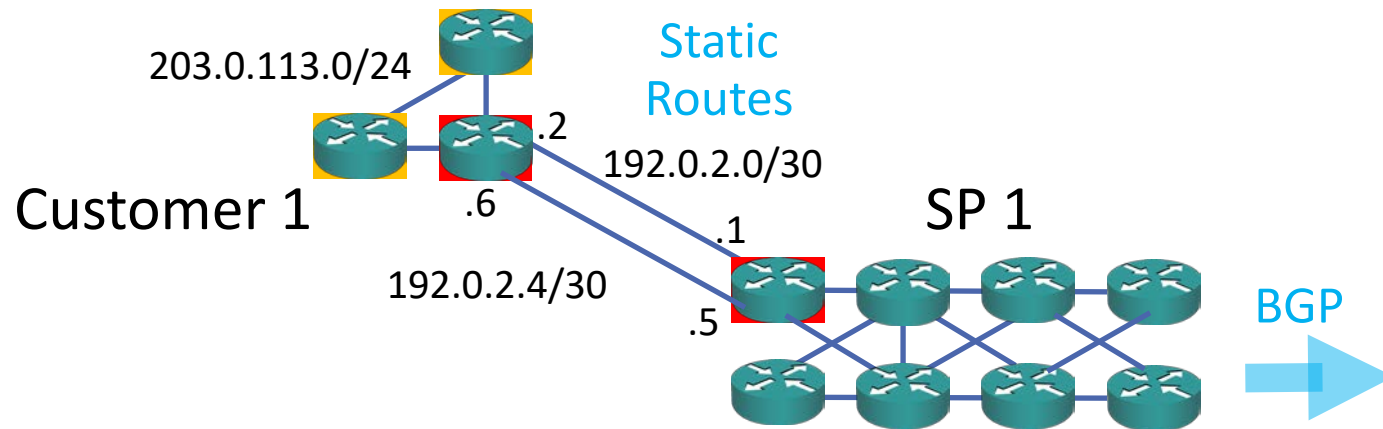
Backup Redundant Link



- All traffic to and from the customer travels via a single AS, so there is no need to configure BGP
- The lower bandwidth backup link is configured as a floating static route with a higher Administrative Distance. All traffic goes over the primary link when it is up
- If the primary link fails all traffic will fail over to the backup link
- This is suitable where the backup link has poorer bandwidth / latency
- Redundancy is provided, but not additional bandwidth

Single Point of Failure - Router

- There are single routers connecting the customer and provider, this is another single point of failure



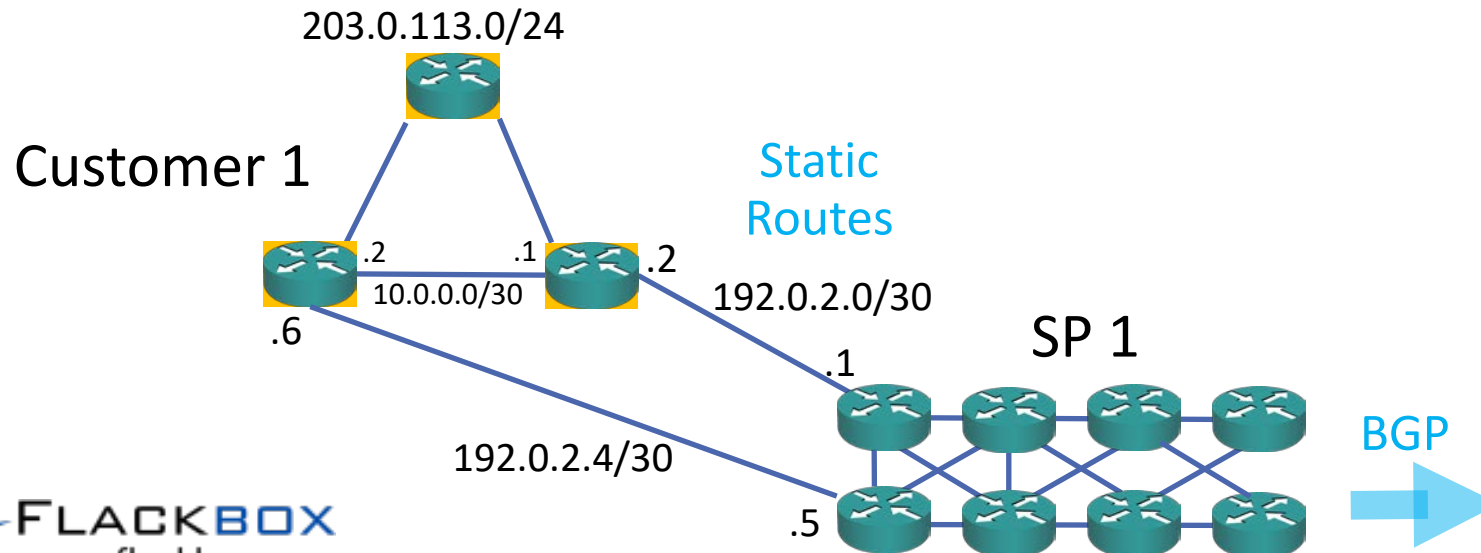
Multihoming – Active/Active Redundant Routers

```
Cust1A(config)# ip route 0.0.0.0 0.0.0.0 192.0.2.1
```

```
Cust1B(config)# ip route 0.0.0.0 0.0.0.0 192.0.2.5
```

```
SP1A(config)# ip route 203.0.113.0 255.255.255.0 192.0.2.2
```

```
SP1B(config)# ip route 203.0.113.0 255.255.255.0 192.0.2.6
```



Multihoming – Active/Active Redundant Routers

- All traffic to and from the customer travels via a single AS, so there is no need to configure BGP
- Equal cost load balancing will spread the traffic equally over both links
- If a link fails all traffic will go over the surviving link

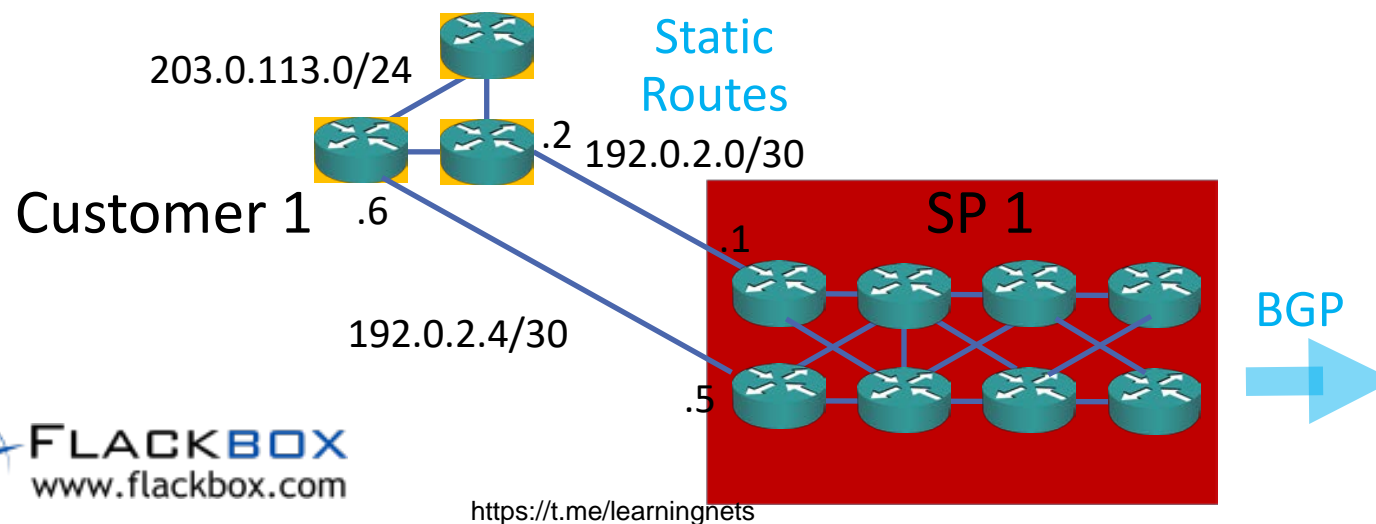
The Need for Enterprise BGP



- At this point we have eliminated all physical single points of failure for the connection between the customer and provider
- There was no need to implement BGP
- So you're probably thinking, when *would* a customer implement BGP?

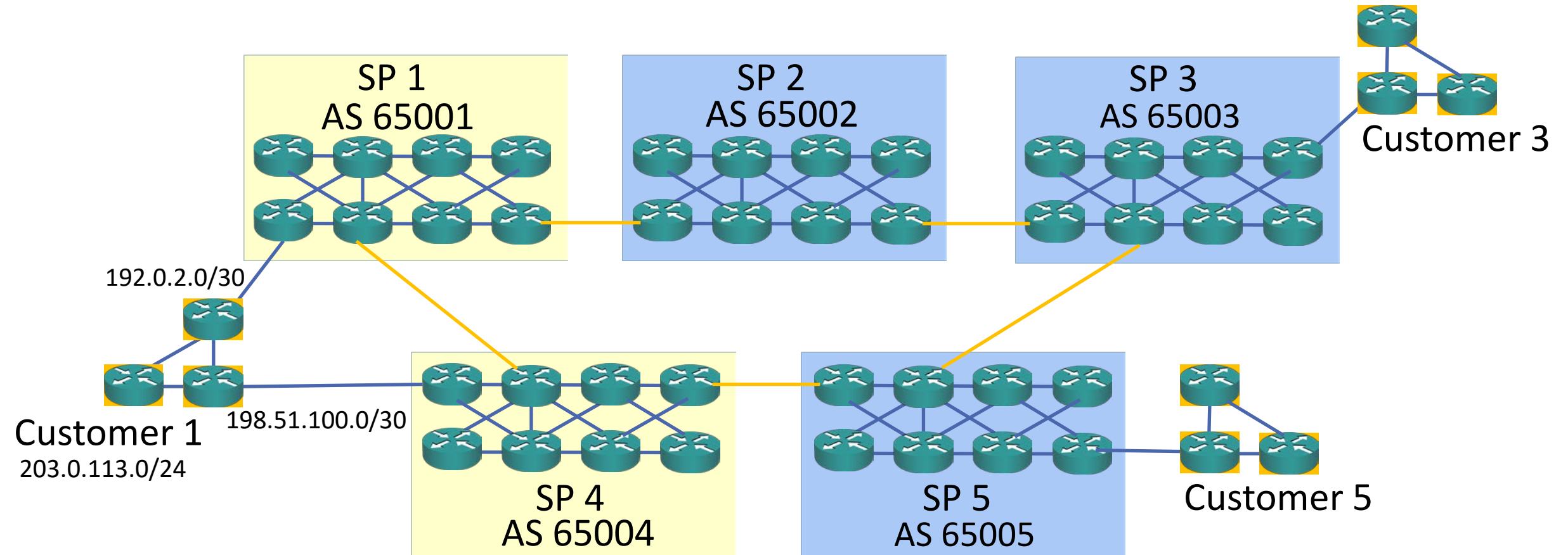
Single Point of Failure – Service Provider

- The Service Provider itself is a single point of failure
- They could have a physical or operational issue which drops their Internet connectivity
- This is not as likely as a link or router failure, but is still a consideration
- Some providers offer redundant physical Internet connectivity paths



Multihoming - Redundant Service Providers

- There is now no single point of failure for Customer 1



Static Routes or BGP



- At this point the customer has the choice of using either default static routes or BGP for their Internet routing
- The benefit of using static routes is that this method is the easiest to implement and support

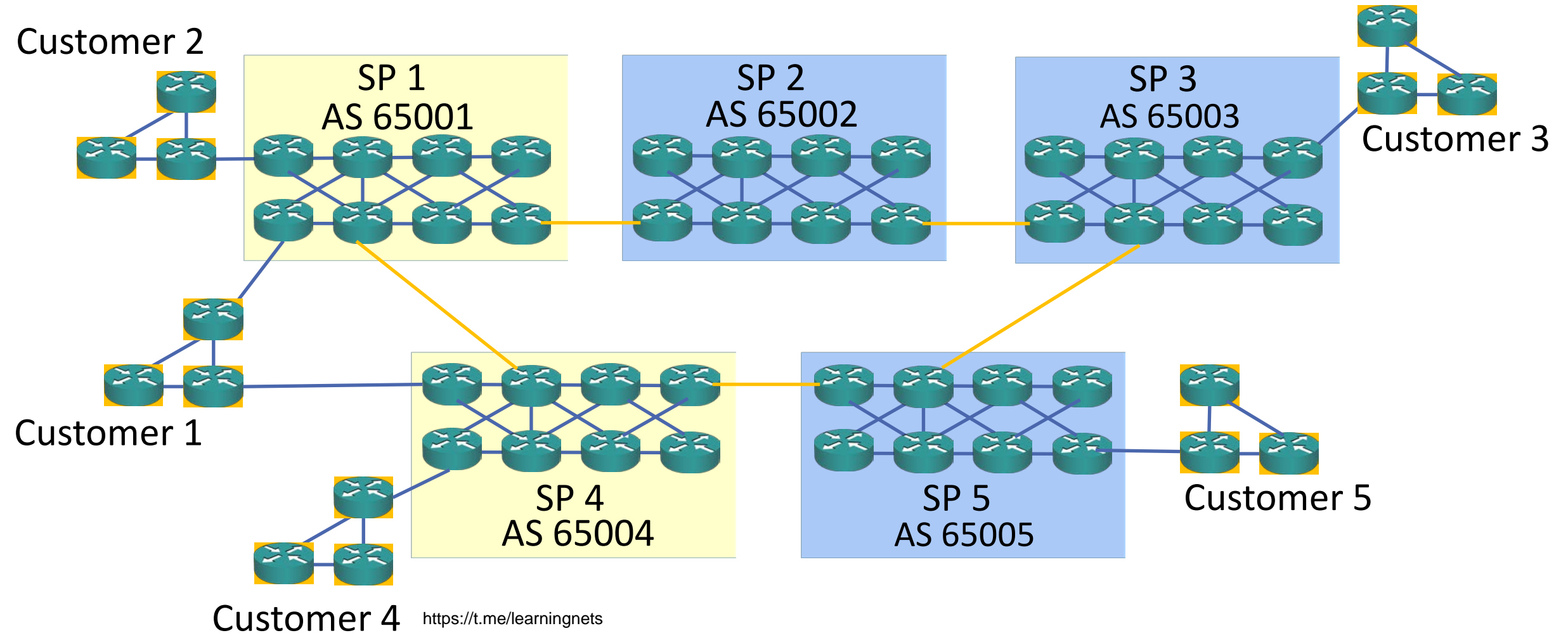
```
Cust1A(config)# ip route 0.0.0.0 0.0.0.0 192.0.2.1
```

```
Cust1B(config)# ip route 0.0.0.0 0.0.0.0 198.51.100.1
```

```
SP1(config)# ip route 203.0.113.0 255.255.255.0 192.0.2.2
```

```
SP4(config)# ip route 203.0.113.0 255.255.255.0 198.51.100.2
```

Static Routes Drawback – Suboptimal Routing



Enterprise BGP



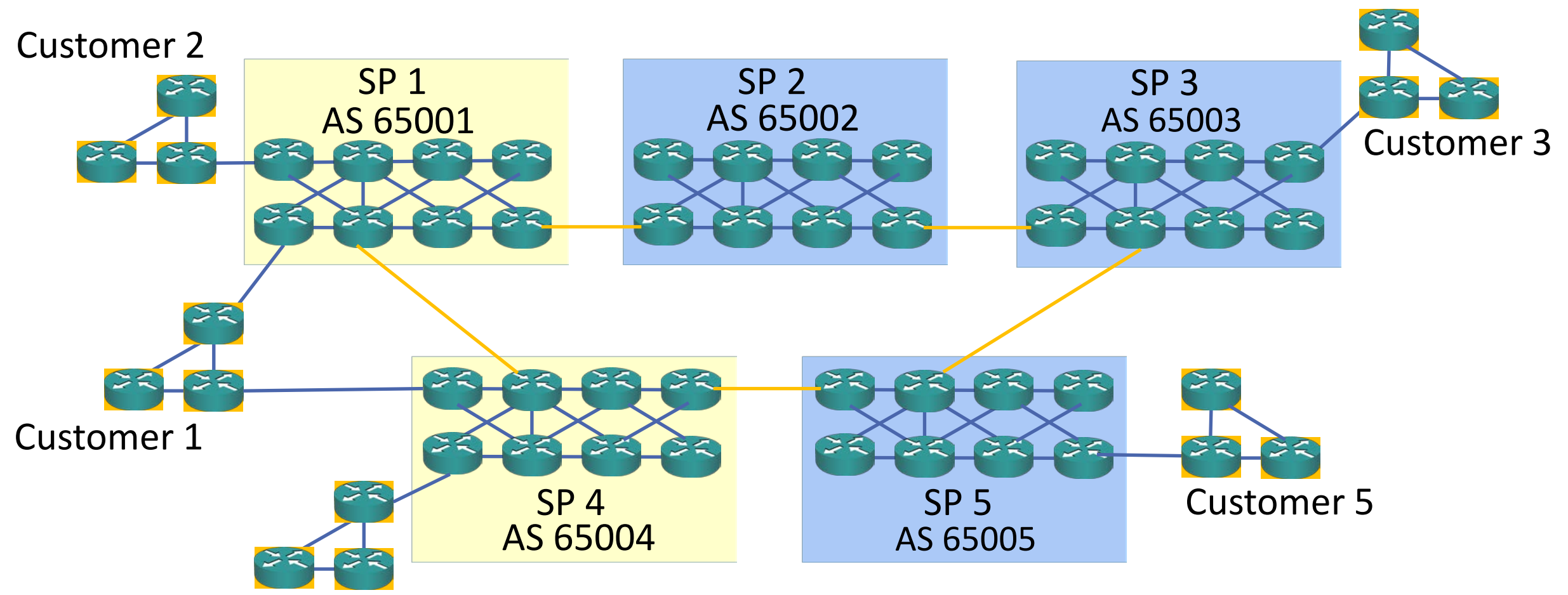
- The alternative method is to implement BGP between the customer and the service provider
- The customer should acquire their own BGP AS number and provider independent IP address space (their own public IP addresses)
- This enables optimal routing
- The drawback is there is increased load on the router and administrators

Enterprise BGP



- BGP only needs to be implemented on the enterprise's Internet edge routers which are connected to the ISPs
- Internal routers run an IGP and have a default route to the edge routers for Internet traffic
- All the enterprise's routers run their IGP. Only their Internet edge routers run BGP

Enterprise BGP – Optimal Routing



Enterprise BGP – Other Uses

- The previous examples focused on an enterprise using BGP for its Internet connectivity
- BGP is also commonly used for MPLS VPNs and for large extranets

