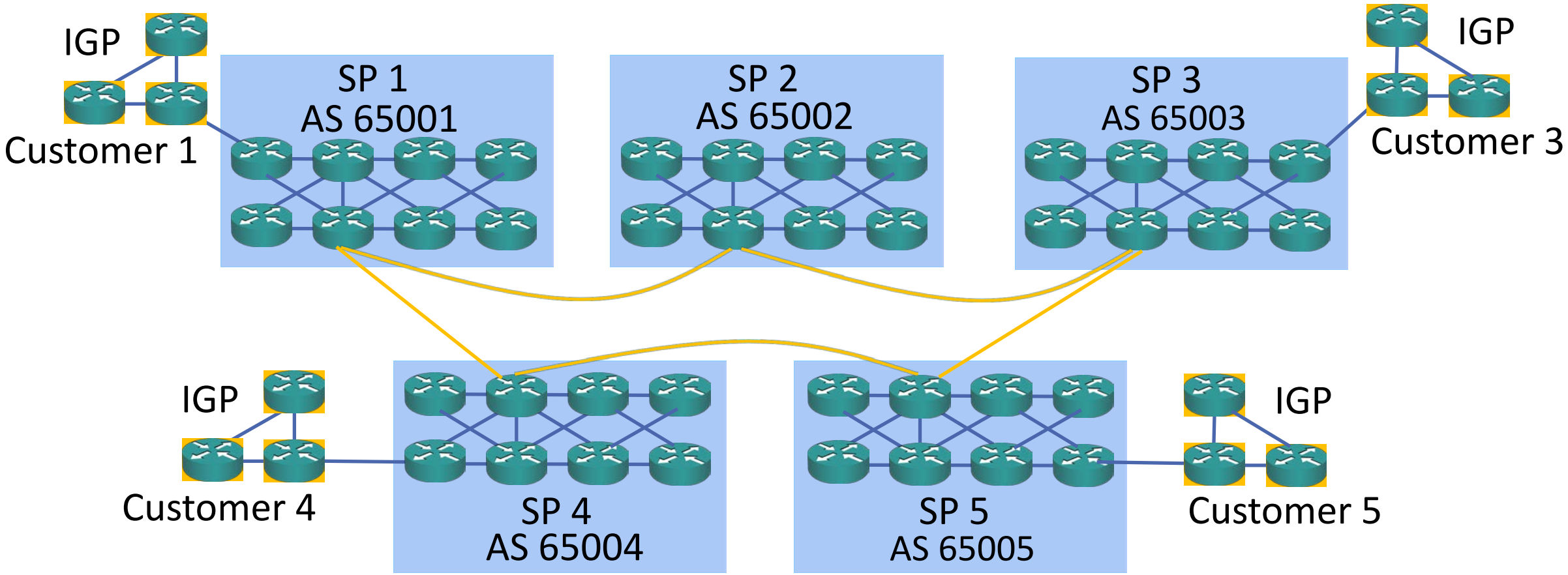
Connectivity Between Providers

- The Service Providers have a unique BGP AS number

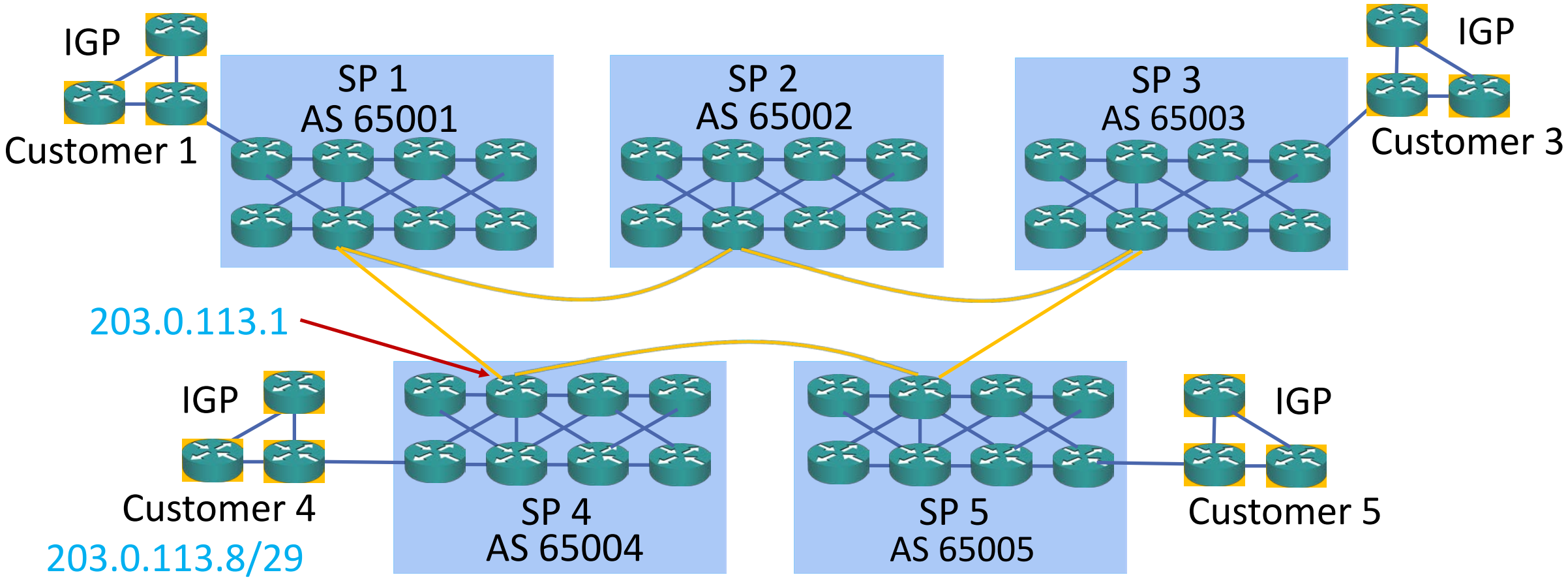


Border Gateway Protocol (BGP)

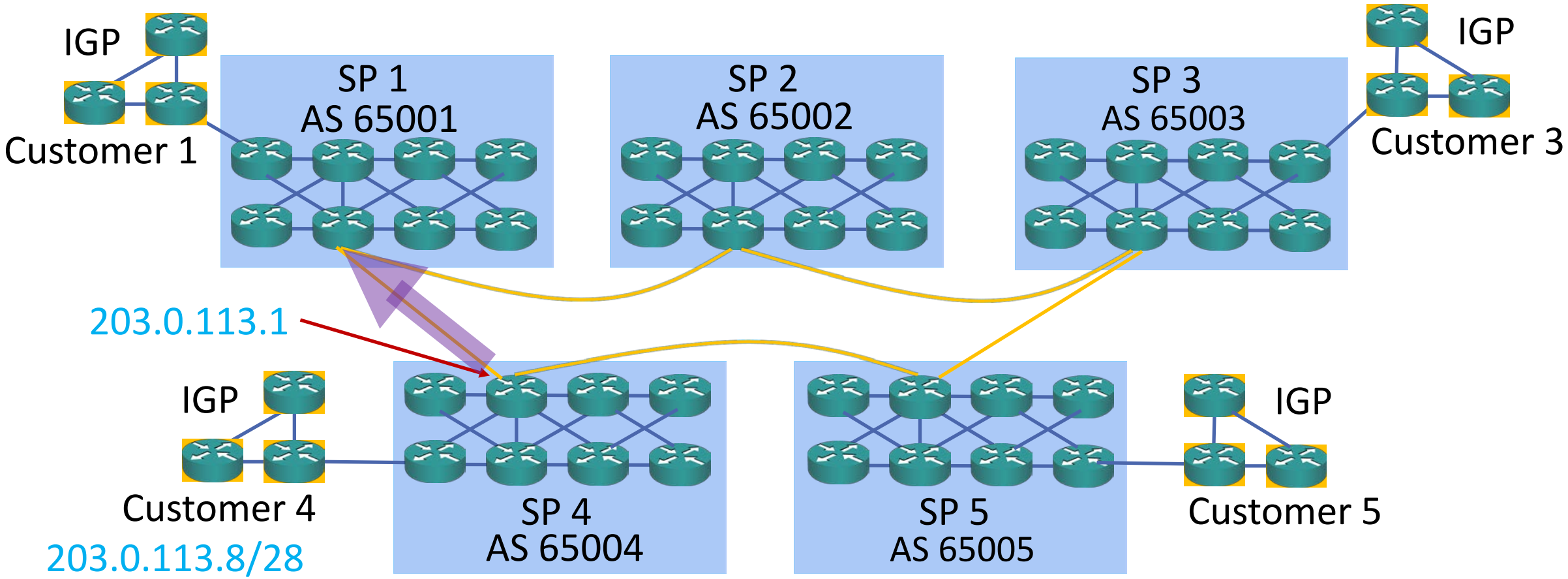
- BGP is a Path Vector routing protocol and by default makes routing decisions in a similar fashion to RIP, but rather than choosing the path with the shortest physical hop count, it chooses the path with the shortest AS path
- BGP routers are not aware of the individual physical hops traffic takes as it traverses another AS
- They see an overall AS as an individual hop. This makes the solution much more scalable

BGP Example

- Traffic from Customer 3 to Customer 4



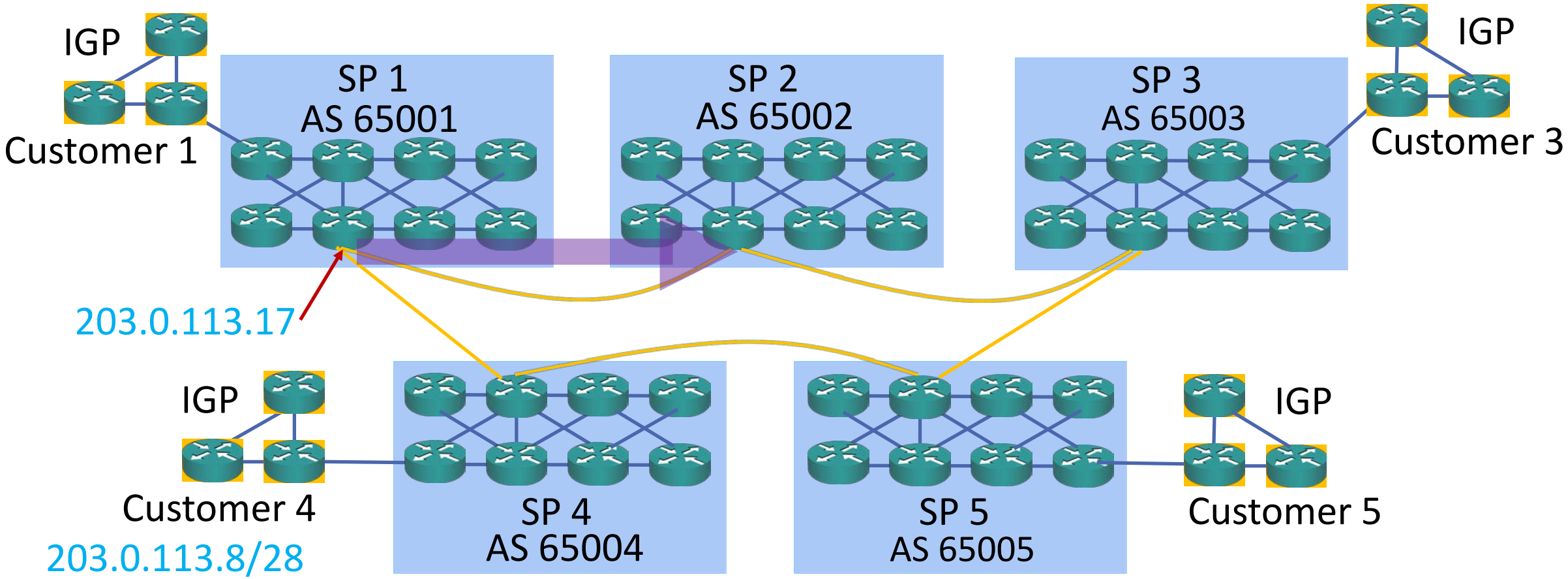
BGP Example


IGP
Customer 1
SP 1
AS 65001
SP 2
AS 65002
SP 3
AS 65003
IGP
Customer 3
203.0.113.1
IGP
Customer 4
203.0.113.8/28
SP 4
AS 65004
SP 5
AS 65005
IGP
Customer 5

BGP Example

- SP4 advertises 203.0.113.8/28 to SP1
- It advertises it with an AS Path of 65004 and its IP address on the link to SP1 (203.0.113.1) as the next hop address

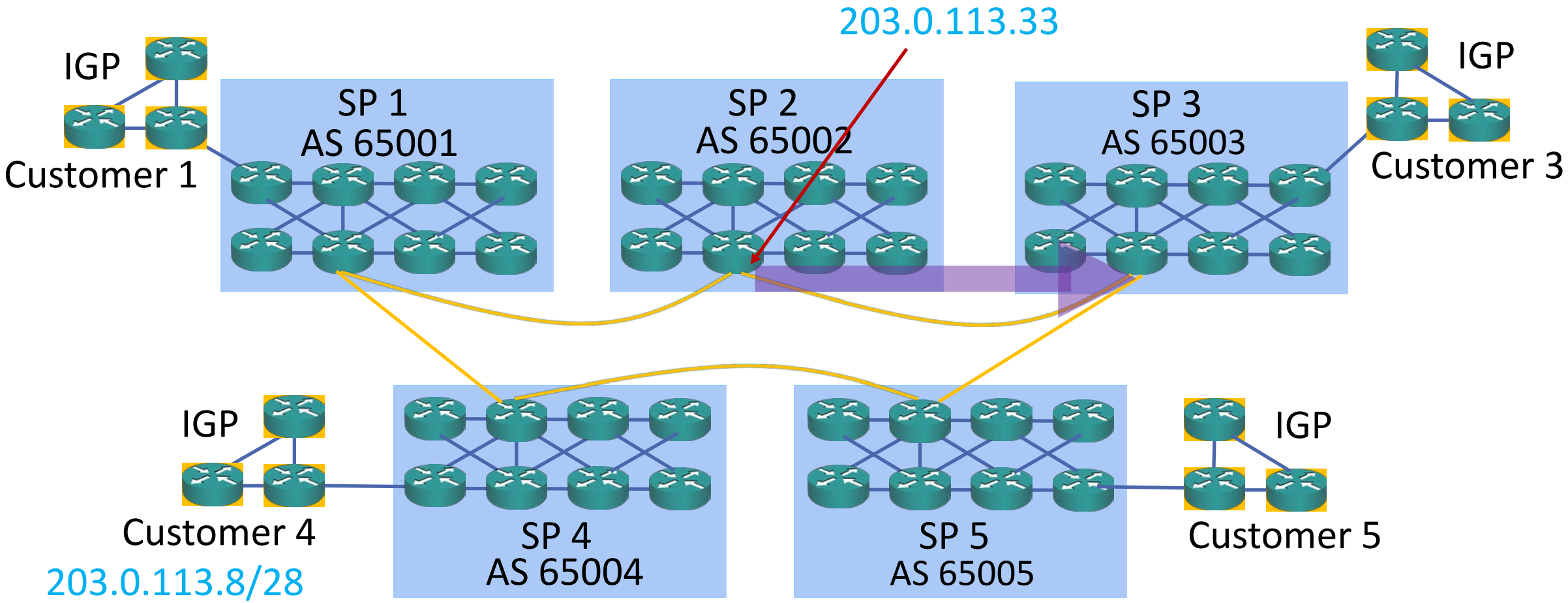
BGP Example


IGP
Customer 1
SP 1
AS 65001
SP 2
AS 65002
SP 3
AS 65003
IGP
Customer 3
203.0.113.17
IGP
Customer 4
203.0.113.8/28
SP 4
AS 65004
SP 5
AS 65005
IGP
Customer 5

BGP Example

- SP1 inserts the information into its routing table and then passes the information on to SP2, prepending its own AS number at the start of the AS path
- It advertises 203.0.113.8/28 with an AS Path of 65001 65004, and its IP address on the link to SP2 (203.0.113.17) as the next hop

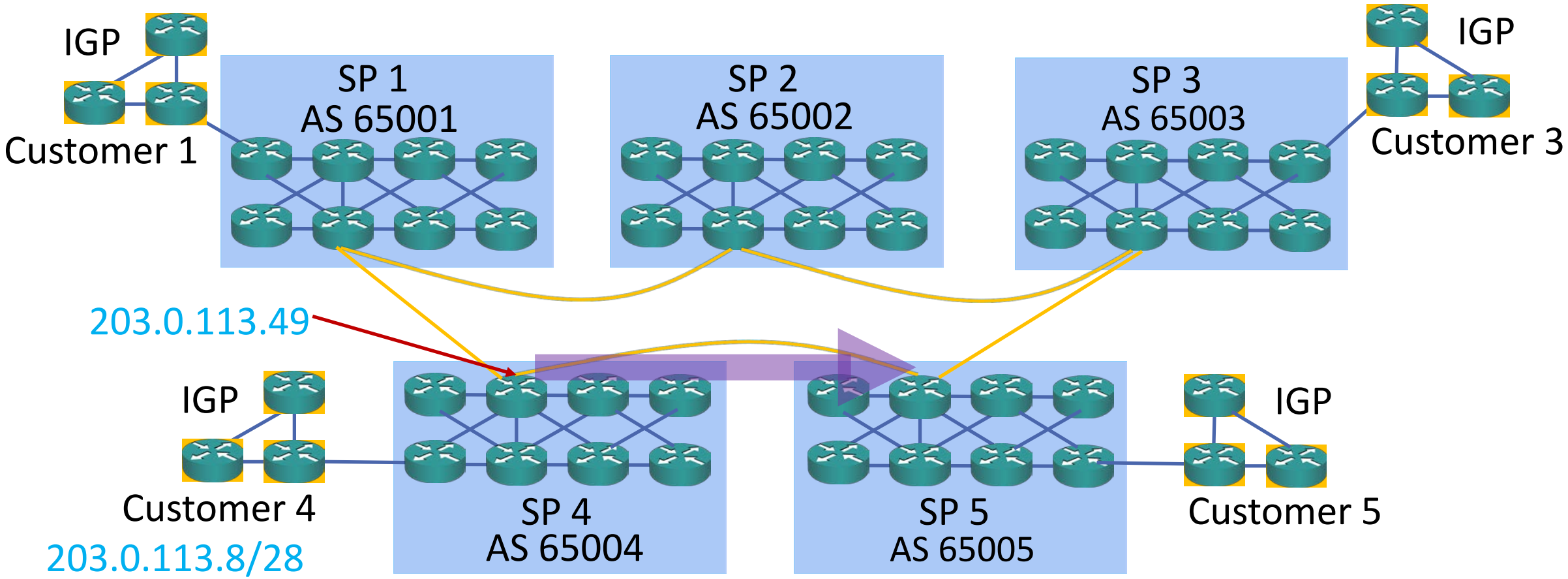
BGP Example


203.0.113.33
IGP
Customer 1
SP 1
AS 65001
SP 2
AS 65002
SP 3
AS 65003
IGP
Customer 3
IGP
Customer 4
203.0.113.8/28
SP 4
AS 65004
SP 5
AS 65005
IGP
Customer 5

BGP Example

- SP2 inserts the information into its routing table and then passes the information on to SP3, prepending its own AS number at the start of the AS path
- It advertises 203.0.113.8/28 with an AS Path of 65002 65001 65004, and its IP address on the link to SP3 (203.0.113.33) as the next hop

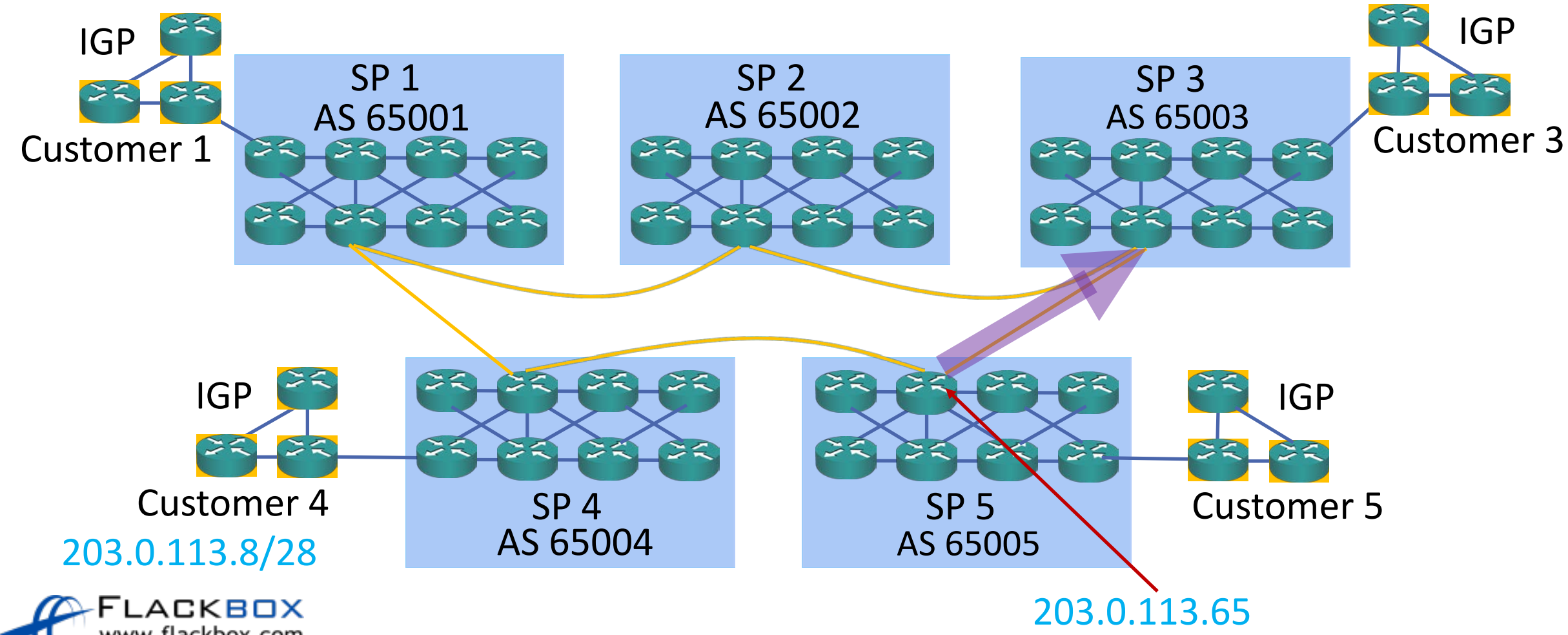
BGP Example


IGP
Customer 1
SP 1
AS 65001
SP 2
AS 65002
SP 3
AS 65003
IGP
Customer 3
203.0.113.49
IGP
Customer 4
203.0.113.8/28
SP 4
AS 65004
SP 5
AS 65005
IGP
Customer 5

BGP Example

- SP4 also advertises 203.0.113.8/28 to SP5
- It advertises an AS Path of 65004 and its IP address on the link to SP5 (203.0.113.49) as the next hop address

BGP Example



BGP Example

- SP5 inserts the information into its routing table and then passes the information on to SP3, prepending its own AS number at the start of the AS path
- It advertises 203.0.113.8/28 with an AS Path of 65005 65004, and its IP address on the link to SP3 (203.0.113.65) as the next hop

BGP Example

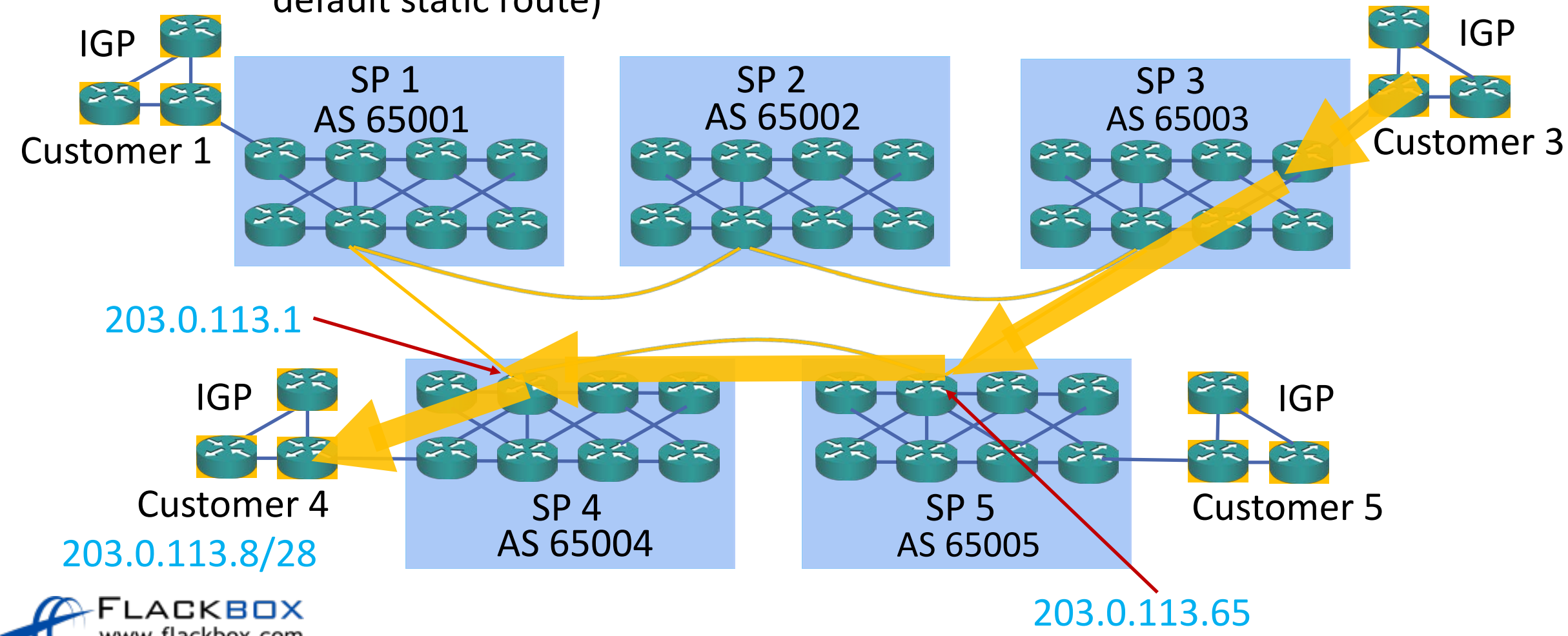
- SP3 learns two different paths that it can take to reach 203.0.113.8/29
  - Via SP2 with an AS Path of 65002 65001 65004 and a next hop address of 203.0.113.33
  - Via SP5 with an AS Path of 65005 65004 and a next hop address of 203.0.113.65
- Both these paths will be visible in the BGP table on SP3

BGP Example

- Just like with an IGP, only the best path will make it into the routing table and be used
- SP3 will insert the path via SP5 into its routing table because it has a shorter AS Path (2 AS's vs 3 AS's)

BGP Example

(Customer 3 sends traffic to Customer 4 via SP3 according to its default static route)



BGP Load Balancing

- By default, BGP selects only a single best path and does not perform load balancing.
- If multiple paths to a destination network are available with identical AS Path lengths, only one will make it into the routing table

BGP Policy

- The shortest AS path is the preferred route by default
- Administrators can override this by configuring BGP policy
- A reason for doing this would be if an AS has links to other AS's with different bandwidths on those links
- BGP can be configured to prefer the higher bandwidth links even if they have a longer AS Path
- Paths can be manipulated for both outbound and inbound traffic