Metric

- A router will typically only learn routes to a particular destination from a single routing protocol

- When multiple routes to a destination are learned through a routing protocol, the router will install the path or paths with the best (lowest) metric into the routing table

- Different routing protocols use different methods to calculate the metric

Metric

- For example in RIP, path A>B>C>D has a hop count of 3, path A>B>D has a hop count of 2, so A>B>D would be preferred

- In OSPF, if path A>B>C>D has a cost of 60, and path A>B>D has a cost of 100, then A>B>C>D would be used

Administrative Distance

- If paths to the same destination are received from different routing protocols, their metrics cannot be compared

- For example, a RIP hop count of 5 cannot be compared to an OSPF cost of 60. The comparison would be meaningless because the routing protocols calculate the metric in completely different ways

- The router must use a different method to choose when routes to the same destination are received from different routing protocols

- The Administrative Distance (AD) is used for this

Administrative Distance

- The Administrative Distance is a measure of how trusted the routing protocol is

- If routes to the same destination are received via different routing protocols, the protocol with the best (lowest) AD wins

Default Administrative Distance

Route Source	Default AD
Connected Interface	0
Static Route	1
External BGP	20
EIGRP	90
OSPF	110
IS-IS	115
RIP	120

Administrative Distance and Metric

- Administrative Distance is used to choose between multiple paths learned via different routing protocols

- Metric is used to choose between multiple paths learned via the same protocol

- The Administrative Distance is considered first to narrow the choice down to the single best routing protocol

- The Metric is then considered to choose the best path or paths which make it into the routing table

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Show ip route

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```
R1#sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set


      10.0.0.0/8 is variably subnetted, 12 subnets, 2 masks
C        10.0.0.0/24 is directly connected, FastEthernet0/0
L        10.0.0.1/32 is directly connected, FastEthernet0/0
R        10.1.0.0/24 [120/1] via 10.0.0.2, 00:00:00, FastEthernet0/0
R        10.1.1.0/24 [120/2] via 10.0.0.2, 00:00:00, FastEthernet0/0
```

Connected interfaces have an AD of 0

Administrative Distance   Metric

Administrative Distance Example

- Example: A router receives multiple routes to the 10.10.10.0/24 network from both OSPF and RIP

- When paths to the same destination are received from multiple routing protocols, the Administrative Distance is considered first

- OSPF has a better AD than RIP so the RIP routes will be discarded

Administrative Distance Example

- The router will then compare the routes received via OSPF and install the one with the lowest cost in the routing table

- If multiple equal cost paths are received via OSPF they will all be installed in the routing table and the router will load balance outbound traffic to the destination between them
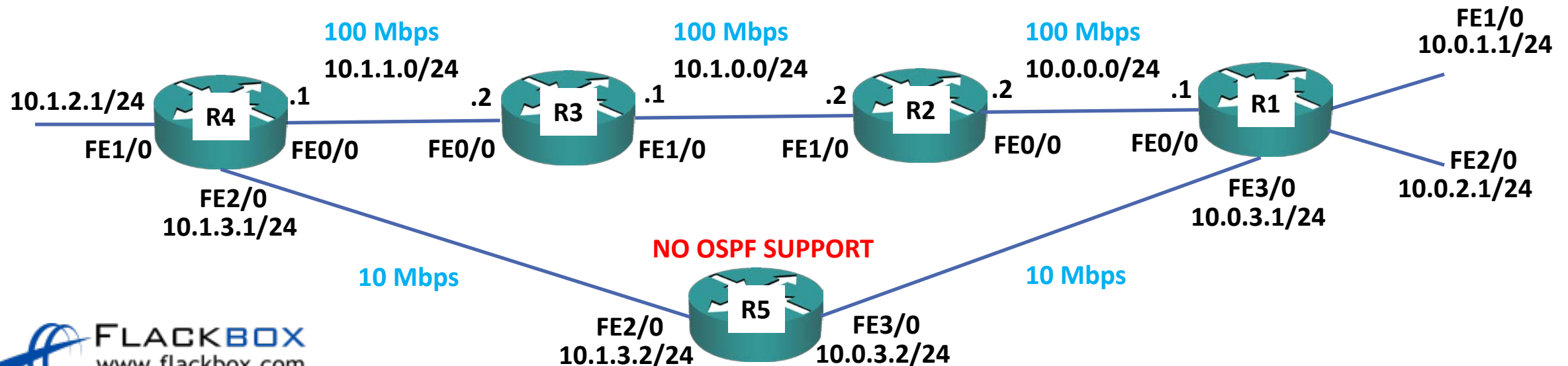
Floating Static Routes

- If the best path to a destination is lost (for example because a link went down) it will be removed from the routing table and replaced with the next best route

- We might want to configure a static route as a backup for the route learned via a routing protocol

- A problem is that static routes have a default Administrative Distance of 1 which will always be preferred over routes learned via an IGP

Floating Static Routes – OSPF

- We can change the Administrative Distance of a static route to make it act as the backup (rather than the preferred) route

- Floating static route for OSPF example

```
R4(config)#ip route 10.0.1.0 255.255.255.0 10.1.3.2 115
```
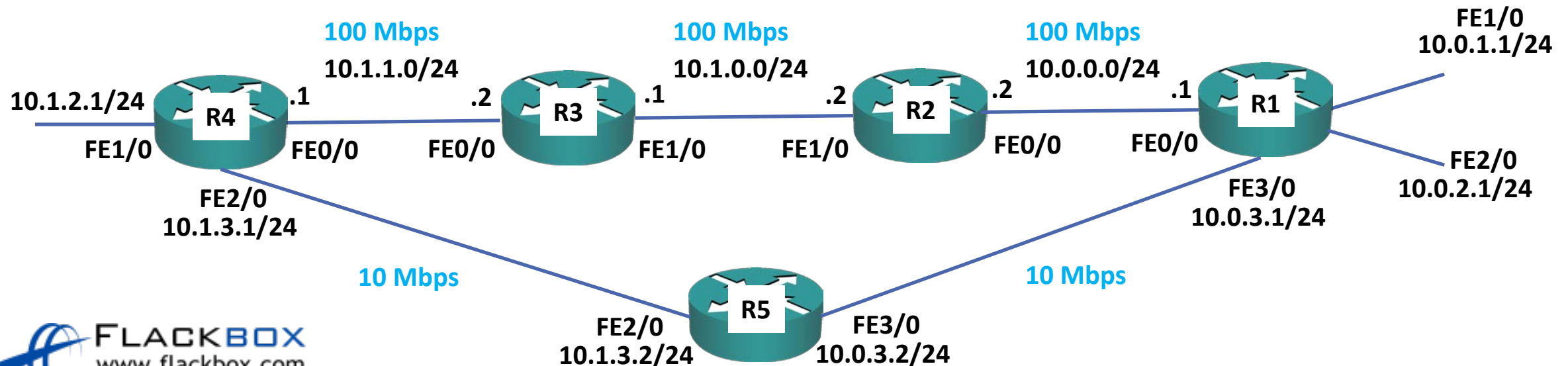
Floating Static Routes – Static Routes

- Floating static routes can also be used where we are using purely static routing

```
ip route 10.0.1.0 255.255.255.0 10.1.1.2
ip route 10.0.1.0 255.255.255.0 10.1.3.2 5
```

Lab

100 Mbps
10.1.1.0/24

100 Mbps
10.1.0.0/24

100 Mbps
10.0.0.0/24

FE1/0
10.0.1.1/24

10.1.2.1/24

R4

.1

.2

R3

.1

.2

R2

.2

.1

R1

FE1/0

FE0/0

FE0/0

FE1/0

FE1/0

FE0/0

FE0/0

FE2/0
10.1.3.1/24

FE2/0
10.0.2.1/24

FE3/0
10.0.3.1/24

10 Mbps

10 Mbps

R5

FE2/0
10.1.3.2/24

FE3/0
10.0.3.2/24

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