

CCNA 200-301 v1.1

MODULE 3 — IP CONNECTIVITY

Complete Hands-on Training Labs

Topology • Sequential Device Configuration • Verification Output • Troubleshooting

NETWORK GUIDE ACADEMY

Instructor / Student Lab Guide

Scope: CCNA v1.1 Module 3 — IP Connectivity objectives 3.1 through 3.5. The labs intentionally use one configuration path per device and then move forward to verification and troubleshooting.

Module 3 Lab Map

- 3.1 Routing table and forwarding-plane interpretation — route codes, prefix/mask, next hop, administrative distance, metric, gateway of last resort and CEF.
- 3.2 Router forwarding decision — longest prefix match first, administrative distance second; OSPF metric selection is validated in Lab 3.4.
- 3.3A IPv4 static routing — default route, network route, host route and floating static backup.
- 3.3B IPv6 static routing — default route, network route, host route and floating static backup.
- 3.4 Single-area OSPFv2 — neighbor adjacency, point-to-point network type, broadcast DR/BDR election, router ID and route cost.
- 3.5 First-hop redundancy — HSRP, VRRP and GLBP using one dual-distribution topology with failover verification.

How to use the detailed device configurations

Every lab follows one forward sequence: topology and addressing → Device 1 complete configuration and verification → Device 2 / remaining devices → end-to-end validation → controlled fault test → recovery verification. A command that already appears in the full device configuration is not repeated later unless the later command intentionally changes state for troubleshooting.

Verification output note

CLI output is representative Cisco IOS / IOS XE output. Exact interface hardware strings, uptime, MAC addresses, timers and minor formatting vary by platform and software release. Verify the fields and state identified in the What to verify section rather than memorizing every character of the sample output.

Recommended lab platforms

- Cisco Packet Tracer for routing-table reading, IPv4/IPv6 static routes, basic OSPF and HSRP where supported.
- Cisco Modeling Labs (CML), EVE-NG or GNS3 with a compatible IOS/IOS XE image for complete OSPF, VRRP and GLBP behavior.
- Physical IOS/IOS XE routers and multilayer switches when available. Adapt GigabitEthernet numbering to the hardware in use.

Standard verification workflow

1. Confirm every routed interface is up/up and has the intended IPv4/IPv6 address.
2. Read the routing table before testing traffic. Confirm the selected route, next hop, AD/metric and default route.
3. Use route-specific show commands and CEF/forwarding information to prove the router will send the packet where expected.
4. Run ping and traceroute only after the control-plane state is correct.
5. Introduce one controlled failure, predict the new route or FHRP state, then verify that prediction.
6. Restore the failed component and prove the original state returns.

Lab 3.1 — Interpret the Routing Table and CEF Forwarding Entry

CCNA objective: Interpret routing-table components including routing protocol code, prefix, network mask, next hop, hop, administrative distance, metric and gateway of last resort.

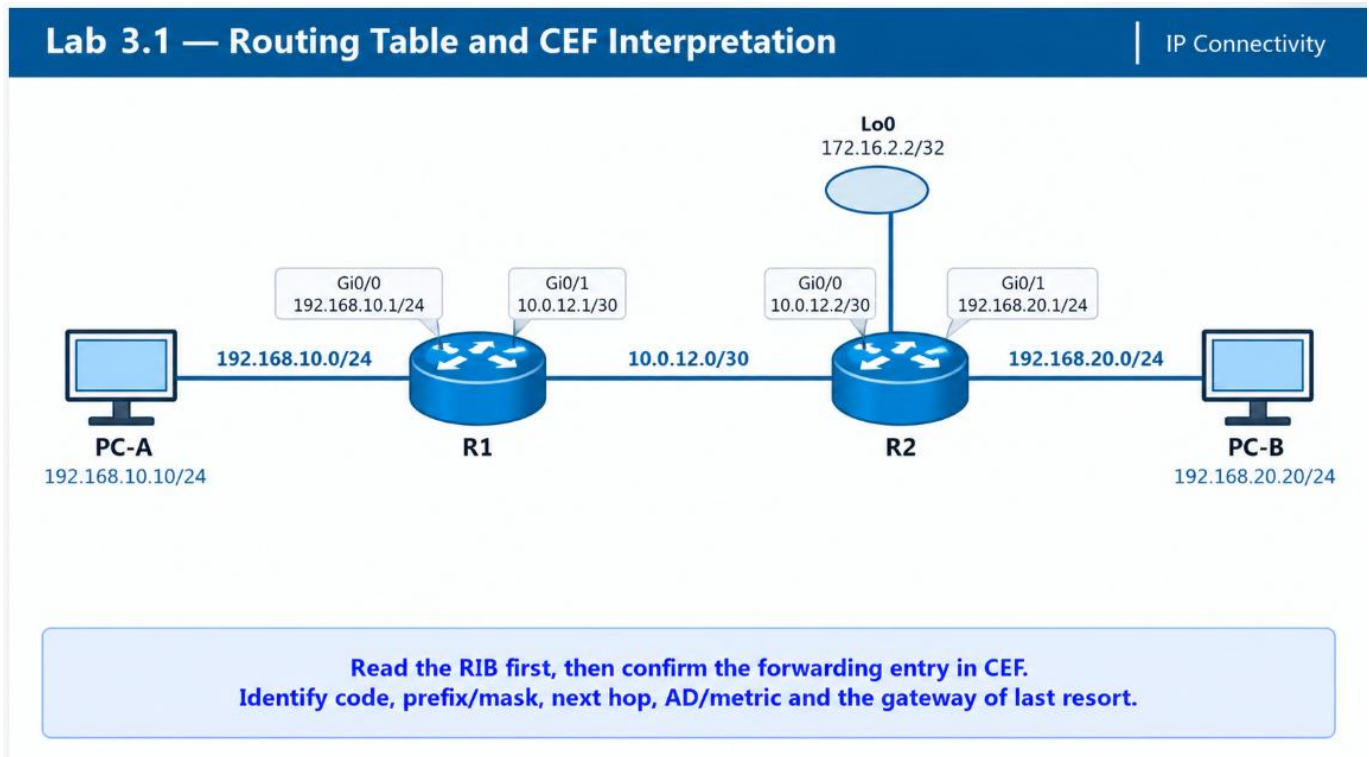


Figure 3.1: Routing Table and CEF Interpretation reference topology

Lab objectives

- Build a small routed network with connected, local, static, host and default routes.
- Read the route code, prefix length/mask, next hop and outgoing interface.
- Interpret the [administrative-distance/metric] values on a static route.
- Identify the gateway of last resort and the S* default route.
- Compare the routing table (RIB) with the Cisco Express Forwarding entry used by the data plane.

Addressing / interface plan

Device	Interface	Address / Mask	Purpose
PC-A	NIC	192.168.10.10/24	User LAN; GW 192.168.10.1
R1	Gi0/0/0	192.168.10.1/24	PC-A LAN
R1	Gi0/0/1	10.0.12.1/30	Transit to R2
R2	Gi0/0/0	10.0.12.2/30	Transit to R1
R2	Gi0/0/1	192.168.20.1/24	PC-B LAN
R2	Lo0	172.16.2.2/32	Host-route target
PC-B	NIC	192.168.20.20/24	Remote LAN; GW 192.168.20.1

Execution sequence

Configure each device once in the order shown below. After the configuration is complete, use the verification output and the What to verify bullets to prove the expected state. Configuration is not repeated later; subsequent commands are only verification or controlled fault tests.

Lab execution — device-by-device configuration and verification

R1 — Complete lab configuration

```
enable
configure terminal
hostname R1
!
interface GigabitEthernet0/0/0
description LAN_PC_A
ip address 192.168.10.1 255.255.255.0
no shutdown
!
interface GigabitEthernet0/0/1
description TRANSIT_TO_R2
ip address 10.0.12.1 255.255.255.252
no shutdown
!
ip route 192.168.20.0 255.255.255.0 10.0.12.2
ip route 172.16.2.2 255.255.255.255 10.0.12.2
ip route 0.0.0.0 0.0.0.0 10.0.12.2
end
write memory
```

R1 — Verification output

```
R1# show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0/0 192.168.10.1   YES manual up          up
GigabitEthernet0/0/1 10.0.12.1      YES manual up          up

R1# show ip route
Gateway of last resort is 10.0.12.2 to network 0.0.0.0

S*  0.0.0.0/0 [1/0] via 10.0.12.2
    10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    10.0.12.0/30 is directly connected, GigabitEthernet0/0/1
L    10.0.12.1/32 is directly connected, GigabitEthernet0/0/1
S    172.16.2.2/32 [1/0] via 10.0.12.2
    192.168.10.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.10.0/24 is directly connected, GigabitEthernet0/0/0
L    192.168.10.1/32 is directly connected, GigabitEthernet0/0/0
S    192.168.20.0/24 [1/0] via 10.0.12.2

R1# show ip route 192.168.20.20
Routing entry for 192.168.20.0/24
  Known via "static", distance 1, metric 0
  Routing Descriptor Blocks:
    * 10.0.12.2
      Route metric is 0, traffic share count is 1

R1# show ip cef 192.168.20.20
192.168.20.0/24
  nexthop 10.0.12.2 GigabitEthernet0/0/1
```

What to verify

- Gi0/0/0 and Gi0/0/1 are up/up. A route cannot use a next hop reached through a failed interface.
- C identifies the directly connected network and L identifies R1's own /32 interface address.
- S identifies a static route. S* identifies the candidate default route.
- The value [1/0] means administrative distance 1 and metric 0 for the static route.
- The gateway of last resort is 10.0.12.2 because the default route points to R2.
- The CEF entry forwards 192.168.20.20 to next hop 10.0.12.2 out Gi0/0/1, matching the RIB.

R2 — Complete lab configuration

```
enable
configure terminal
hostname R2
!
interface GigabitEthernet0/0/0
description TRANSIT_TO_R1
ip address 10.0.12.2 255.255.255.252
no shutdown
!
interface GigabitEthernet0/0/1
description LAN_PC_B
ip address 192.168.20.1 255.255.255.0
no shutdown
!
interface Loopback0
description HOST_ROUTE_TARGET
ip address 172.16.2.2 255.255.255.255
!
ip route 192.168.10.0 255.255.255.0 10.0.12.1
end
write memory
```

R2 — Verification output

```
R2# show ip route static
S    192.168.10.0/24 [1/0] via 10.0.12.1

R2# ping 192.168.10.10
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.10, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5)
```

What to verify

- R2 has a return route to the PC-A LAN through R1. Without the return route, forward traffic may arrive but replies fail.
- The successful ping proves two-way routing after PC-A is configured with default gateway 192.168.10.1.

End-device addressing

- PC-A: 192.168.10.10/24, default gateway 192.168.10.1.
- PC-B: 192.168.20.20/24, default gateway 192.168.20.1.