



CCIE Routing & Switching
Advanced Troubleshooting Bootcamp

IPv4 IGP Routing Troubleshooting

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IPv4 Routing Workflow

- IPv4 routing can be subdivided into three discrete steps
 - Routing lookup
 - Switching method
 - Layer 2 encapsulation
- Subdividing these functions gives us a “layered” approach to routing troubleshooting

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IPv4 Routing Lookup

- Three goals: find the...
 - Longest match(es)
 - Outgoing interface(s)
 - Next-hop(s)
- Troubleshooting considerations
 - Administrative Distance
 - Metric
 - Overlapping routes
 - Policing routing
 - Can override this step

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IPv4 Switching Method

- Goal is to move packets between interfaces
- Methods are...
 - Process
 - Fast
 - CEF
 - Etc.
- Load balancing occurs at this stage
 - not all hosts use the same routing path
 - E.g. `show ip cef exact-route...`
- Troubleshooting considerations
 - PING result !.!.!
 - High CPU utilization

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Layer 2 Encapsulation

- Goal is to build layer 2 frame header
- Multipoint interfaces require layer 3 to layer 2 resolutions
 - Point-to-point interfaces do not
- Troubleshooting considerations
 - Routing to interface vs. next-hop
 - ARP, Proxy-ARP, & Inverse-ARP
 - Subnet mismatches

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Further Reading

- [Troubleshooting Cisco Express Forwarding Routing Loops](#)
- [Troubleshooting Incomplete Adjacencies with CEF](#)
- [Troubleshooting High CPU Utilization in IP Input Process](#)

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RIP Workflow

- RIP operation can be subdivided into three discrete steps
 - Receive routing updates
 - Choose best path
 - Advertise routing updates

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Receiving RIP Updates

- Troubleshooting considerations
 - UDP 520 transport
 - Broadcast vs. multicast vs. unicast
 - Filtering
 - Not on common subnet
 - `validate update-source`
 - Version mismatches
 - Global vs. send/receive
 - Authentication
 - Type vs. key
 - Distribute lists

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RIP Path Selection

- Lowest hop count wins
- 16 = Infinite
 - Route poisoning issues
- `debug ip rip` to verify hop counts

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Sending RIP Updates

- RIP only advertises what it installs in routing table
- Like receiving, considerations are...
 - UDP transport
 - Common subnets
 - Version
 - Authentication
 - Filtering

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Common RIP Verification

- `show ip route`
- `show ip rip database`
- `debug ip rip`

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EIGRP Workflow

- EIGRP operation can be subdivided into four discrete steps...
 - Discover EIGRP Neighbors
 - Exchange Topology Information
 - Choose Best Path
 - Neighbor and Topology Table Maintenance

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Discovering EIGRP Neighbors

- EIGRP neighbors discovered through multicast
 - Implies bi-directional multicast transport of IP protocol 88 to 224.0.0.10 is needed
 - Possible NBMA pseudo-broadcast support issues
 - Possible filtering issues
- If **neighbor** statement configured, only unicast hellos are accepted
 - If not agreed upon adjacency cannot continue

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Discovering EIGRP Neighbors (cont.)

- Attributes that must match to proceed
 - Common subnet
 - Must be primary IP address, not secondary
 - ASN
 - Authentication
 - K Values (metric weights)

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Exchanging EIGRP Topology Info

- Topology info exchanged through unicast, not multicast
 - Implies bi-directional unicast transport of IP protocol 88 needed
 - Multicast still required unless `neighbor` statement used
- EIGRP only advertises what it installs in routing table
 - Troubleshooting considerations
 - Auto-summary
 - Split-horizon
 - Duplicate Router-IDs for external routes
 - No seed metric for external routes
 - Distribute-list filters

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EIGRP Path Selection

- Feasible distance must be finite to use and advertise a path
 - `show ip eigrp topology`
- Unequal cost load balancing only supported for Feasible Successors
 - IF Advertised Distance < Feasible Distance, Feasible Successor = TRUE
- Modifying bandwidth for path selection can starve EIGRP updates of bandwidth
 - `ip bandwidth percent eigrp`

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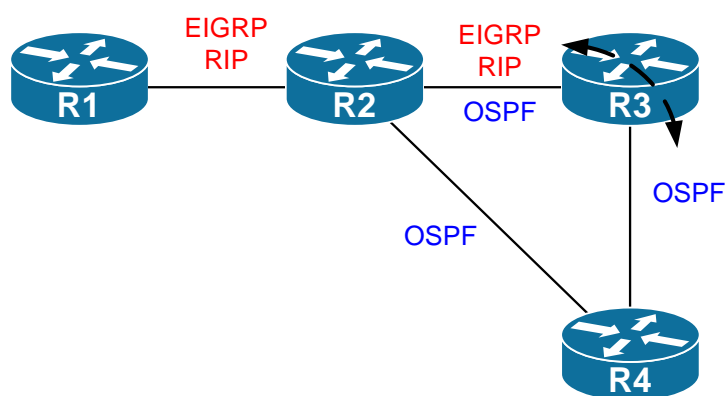
Common EIGRP Verifications

- `show ip route`
- `show ip eigrp neighbor`
- `show ip eigrp topology`
- `show ip eigrp topology all-links`
- `debug eigrp packet hello`
- `debug eigrp packet query reply`
- More info at [Troubleshooting EIGRP](#)

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Troubleshooting RIP & EIGRP Advertisement



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OSPF Workflow

- OSPF operation can be subdivided into four discrete steps...
 - Discover OSPF Neighbors
 - Exchange Topology Information
 - Choose Best Path
 - Neighbor and Topology Table Maintenance

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Discovering OSPF Neighbors

- Requires IP protocol 89 multicast (224.0.0.5/224.0.0.5) or unicast transport depending on network type
 - Possible NBMA pseudo-broadcast support issues
 - Possible filtering issues

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Discovering OSPF Neighbors (cont.)

- Attributes that must be unique to proceed
 - IP address
 - Router-ID
- Attributes that must match to proceed
 - Subnet
 - Area
 - Compatible Network Types
 - Timers
 - MTU
 - Stub Flags
 - Authentication

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Exchanging OSPF Topology Info

- Intra-area routes flooded via LSA 1 & LSA 2
 - Duplicate router-id issues
 - DR/BDR on NBMA issues
- Inter-area routes flooded via LSA 3 by ABR
 - Discontiguous area 0 issue
- External routes flooded via LSA 4, and 5 or 7
 - Duplicate router-id issues
 - NSSA connectivity issues
 - Forward address issue on translated 7 to 5 LSA

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Common OSPF Verifications

- `show ip route`
- `show ip ospf neighbor`
- `show ip ospf database`
- `debug ip ospf adj`
- More info at [Troubleshooting OSPF](#)