DHCP on IOS

```
Router(config)# ip dhcp pool LAN
Router(dhcp-config)# network 192.168.1.0 255.255.255.0
Router(dhcp-config)# default-router 192.168.1.1
Router(dhcp-config)# dns-server 8.8.8.8
Router(config)# ip dhcp excluded-address 192.168.1.1 192.168.1.10
```

- **DHCP relay (`ip helper -ad dress`):** forwards client broadcasts to a remote DHCP server — configured on the router interface facing clients.
- **Troubleshoot:** client gets APIPA → check pool, exclusions, relay, and that the server is reachable. `show ip dhcp binding` lists active leases.

More from ByteBar

CCNA 200-301 — Go Deeper

Like this cheat sheet? The full ByteBar CCNA (200-301) Study Guide covers all six exam domains in exam-weight order, with must-memorize tables, EXAM TIP boxes, and 30 practice questions with full explanations — in the ByteBar shop on Etsy (ByteBarExamPrep). Studying for one of the 28 simulator exams instead? Practice like it's test day — the ByteBar Practice Exam Simulator is $9.99 one-time at bytebarhq.com.

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Updated practice question count from 30 to 100.

Exam-Day Rapid Fire

- **Simlets first.** CLI simulations pay the most and eat the most time — do them while fresh.
- **Subnet in the margins.** Write the CIDR ladder on scratch paper before starting — free reference for the whole exam.
- **Read like a troubleshooter:** match symptoms to causes (APIPA = DHCP, native mismatch = trunk, EXSTART stuck = MTU).
- **AD ladder:** 0-1-20-90-110-120-200. Longest prefix match beats everything.
- **Eliminate aggressively.** Two answers are usually nonsense — kill them, then decide between the survivors.
- **Never leave blanks.** No penalty for guessing.
- **Version check:** v2.0 blueprint exam goes live February 3, 2027 — booked before that date, you sit v1.1.
- About the exam: ~100 questions (multiple choice, drag-and-drop, simlets), 120 minutes, passing score not published, valid 3 years.

Essential CLI Commands

Command	Does what
`show ip route`	Routing table — [AD/metric], next-hop, exit interface
`show interfaces status`	Port status at a glance
`show interfaces trunk`	Verify trunking + allowed VLANs
`show vlan brief`	VLAN-to-port mapping
`show spanni ng-tree vlan 10`	Root bridge, port roles/states per VLAN
`show etherc hannel summary`	Channel-group status: (P) bundled vs. (I) standalone
`show cdp neighbors` / `show lldp neighbors`	Directly connected neighbor identity and capabilities
`show ip ospf neighbor`	OSPF adjacencies and states (FULL, 2WAY…)
`show ip ospf interface brief`	OSPF-enabled interfaces
`show ip dhcp binding`	Active DHCP leases

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Essential CLI Commands (cont)

`show standby brief`	HSRP/VRRP active/standby roles
`ping` / extended `ping`	Basic reachability; extended sets source interface
`traceroute`	Hop-by-hop path (find where inter-VLAN routing breaks)

Protocols Quick Reference

Protocol	What the guide says
Telnet (23)	Block it in ACLs (`deny tcp... any eq 23`); disable in favor of SSH
SSH	Encrypted device management
DNS	Name resolution (A, AAAA, CNAME, MX, NS, PTR)
DHCP	Address assignment; relay with `ip helper -ad dress`; APIPA = DHCP failed
SNMP	Monitoring — v2c community strings (plaintext), v3 auth + privacy
Syslog	Centralized logging, severity 0–7
NTP	Time synchronization
TFTP	Insecure — never across untrusted networks
SFTP / SCP	Secure transfer of IOS images and configs
RADIUS / TACACS+	AAA — RADIUS open (encrypts password only), TACACS+ Cisco (encrypts whole payload)
IPsec / IKE	VPN tunnels; IKE negotiates the security association
HSRP / VRRP	First-hop redundancy — virtual IP + virtual MAC gateway
OSPF	Single-area (area 0) interior routing
CDP / LLDP	Neighbor discovery — CDP Cisco-proprietary, LLDP open (multi-vendor)
CAPWAP / LWAPP	Lightweight APs tunnel traffic to the WLC
ICMP	ping (extended ping sets source interface), traceroute (hop-by-hop path)

Management, Monitoring & Automation

Approaches

Approach	Know this
Device-based (traditional)	CLI/SSH per device — fine for small networks, doesn't scale
Controller-based (SDN)	Central controller (e.g., Catalyst Center) pushes policy; devices follow
Cloud-based	Management plane in the cloud (e.g., Meraki dashboard)
Automation / IaC	Configs as versioned code (Ansible playbooks, Terraform) — consistent, repeatable, reviewable

Planes: management (SSH/SNMP — how you administer), control (routing protocols — how devices learn paths), data (forwarding — the actual packets).

SNMP, Syslog, NTP

Tool	Know this
SNMPv2c	Community strings (plaintext) — `snmp-s erver community`; agents, managers, MIBs, traps
SNMPv3	Adds auth + privacy (encryption) — the secure choice
Syslog severity	0 Emergency → 7 Debug (mnemonic: **E**very **A**wesome **C**isco **E**ngineer **C**an **N**ow **P**lay **D**aily). Lower number = worse

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Management, Monitoring & Automation (cont)

| NTP | Time sync for logs and certs — `ntp server 10.1.1.50` |

`

Router(config)# logging host 10.1.1.100
Router(config)# logging trap warnings
Router(config)# snmp-server community NETOPS RO

`

`logging trap warnings` sends severity 0–4 (that level and everything more severe).

Automation & AI

- **Ansible:** agentless automation over SSH; playbooks (YAML) declare desired state.
- **REST APIs / JSON:** how controllers and scripts talk to network devices programmatically.
- **Agentic AI in NetOps:** can analyze telemetry, suggest config changes, draft troubleshooting steps — but a human validates before anything touches production.

Wireless Principles

Concept	Know this
Bands	2.4 GHz (range), 5 GHz (speed/capacity), 6 GHz (Wi-Fi 6E/7, fastest)
Channels (2.4 GHz)	Only 1, 6, 11 are non-overlapping
Security	WPA3 current; WPA2-AES minimum; WEP is broken
Enterprise auth	802.1X + RADIUS — per-user credentials, not a shared passphrase
Interference	Microwaves, Bluetooth, neighboring APs on 2.4 GHz; rogues and overlap generally
LWAPP/CAPWAP	Lightweight APs tunnel traffic to a wireless LAN controller (WLC)

Management Security & VPNs

Concept	Know this
SSH	Encrypted management: `crypto key generate rsa`, `ip ssh version 2`, disable telnet (line vty: `transport input ssh`)
Passwords	`service passwo rd- enc ryption` obscures type-7 passwords; `enable secret` uses strong MD5 for the privileged password
AAA	Authentication, Authorization, Accounting — TACACS+ (Cisco, encrypts whole payload) vs. RADIUS (open, encrypts password only)
SFTP/SCP	Secure file transfer for IOS images and configs — never TFTP across untrusted networks
IPsec VPN	Site-to-site (routers/firewalls) and remote-access (clients); tunnel vs. transport mode; IKE negotiates the SA

Layer 2 Security

Feature	Stops
Port security	MAC flooding / rogue devices — limit MACs per port; violation: protect, restrict, shutdown (default)
DHCP snooping	Rogue DHCP servers — trust only uplink ports; builds a binding table
Dynamic ARP Inspection (DAI)	ARP spoofing — validates ARP against the DHCP snooping table
Storm control	Broadcast/multicast storms — throttles when traffic exceeds a threshold
RA guard	Rogue IPv6 router advertisements

`

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Layer 2 Security (cont)

```
Switch(config-if)# switchport port-security
Switch(config-if)# switchport port-security maximum 2
Switch(config-if)# switchport port-security violation restrict
Switch(config-if)# switchport port-security mac-address sticky
```

Violation modes: protect = drop only; restrict = drop + log/trap, port stays up; shutdown (default) = err-disables the port. DHCP snooping drops server messages (OFFER/ACK) arriving on untrusted ports.

ACLs — The Packet Filter

Type	Range	Filters on	Place it
Standard	1–99	Source IP only	Close to the destination
Extended	100–199	Source + dest IP, protocol, ports	Close to the source

```
Router(config)# access-list 101 deny tcp 192.168.10.0 0.0.0.255 any eq 23
Router(config)# access-list 101 permit ip any any
Router(config-if)# ip access-group 101 in
```

- Rules process top-down, first match wins, ending in an **implicit deny all** — finish with `permit ip any any` (or your traffic dies).
- **Wildcard masks** invert subnet masks: /24 → 0.0.0.255. `host 10.1.1.1` = 0.0.0.0 wildcard. (/26 → 0.0.0.63.)
- Named ACLs allow editing/removal of individual lines; numbered are append-only (`ip access -list extended NAME`).

NAT / PAT

Type	What it does
Static NAT	One private IP ↔ one public IP (1:1). For servers needing a fixed public address
Dynamic NAT	Pool of public IPs assigned on demand — 1:1 while in use
PAT (overload)	Many private IPs ↔ one public IP using port numbers — the SOHO/branch standard

```
Router(config)# ip nat inside source list 1 interface Gi0/0 overload
Router(config)# access-list 1 permit 192.168.1.0 0.0.0.255
Router(config-if)# ip nat inside
Router(config-if)# ip nat outside
```

Inside source translates private→public (outbound). Mark interfaces: `ip nat inside` on the LAN side, `ip nat outside` toward the ISP. Reversed = nothing translates.

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Intro

CCNA 200-301 Cheat Sheet

The commands, tables, and exam traps from the CCNA 200-301 blueprint — subnetting, VLANs, STP, OSPF, ACLs, NAT, wireless, and automation on one page.

DNS Records

Record	Maps
A	Hostname → IPv4
AAAA	Hostname → IPv6
CNAME	Alias → canonical name
MX	Domain → mail server
NS	Domain → authoritative name servers
PTR	IP → hostname (reverse lookup)

Single-Area OSPFv2 / OSPFv3

Concept	Know this
Area	CCNA covers single-area only — backbone area 0
Router ID	Highest loopback IP, else highest active physical IP; or set manually (best practice)
DR/BDR election	Highest OSPF priority (default 1), tie-break: highest router ID. Priority 0 = never DR
Neighbor requirements	Same area, same hello/dead timers, same subnet, matching authentication, unique router IDs
Cost	Reference bandwidth (100 Mbps default) / interface bandwidth — lower cost = preferred path
OSPFv3	Same concepts for IPv6; uses link-local addresses for neighbor formation

```
Router(config)# router ospf 1
Router(config-router)# router-id 1.1.1.1
Router(config-router)# network 10.0.0.0 0.0.0.255 area 0
Router# show ip ospf neighbor
Router# show ip ospf interface brief
```

Troubleshooting: neighbors stuck in EXSTART/EXCHANGE → suspect MTU mismatch. Stuck in INIT → hellos aren't getting through (ACL, timer mismatch, or multicast blocked).

First Hop Redundancy (HSRP / VRRP)

- Give hosts a virtual IP + virtual MAC as their gateway; one router is active, another standby — failover is transparent to hosts.
- HSRP (Cisco-proprietary) vs. VRRP (open standard) — same idea, know both names.
- Verify with `show standby brief`; preemption lets the higher-priority router retake the active role.

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Static Routing

```
Router(config)# ip route 192.168.20.0 255.255.255.0 10.0.0.2
Router(config)# ipv6 route 2001:db8::/32 2001:db8:1::2
Router(config)# ip route 0.0.0.0 0.0.0.0 10.0.0.2
Router(config)# ip route 192.168.30.0 255.255.255.0 10.0.0.6 10 (floating static)
```

- **Default route (0.0.0.0/0):** the "route of last resort" — points toward the ISP/internet.
- **Floating static:** same destination with a higher AD (e.g., 10) — sleeps until the primary route fails.
- **Host route (/32):** a route to one specific address — most specific, always wins the match.

Reading a Routing Table

```
R1# show ip route
O 192.168.20.0/24 [110/2] via 10.0.0.2, 00:14:33, Gig0/1
```

Field	Meaning
O	Source protocol: O=OSPF, C=connected, S=static, D=EIGRP, B=BGP
110/2	Administrative distance / metric — lower AD wins between protocols
via 10.0.0.2	Next-hop address
Gig0/1	Exit interface

Route selection order: 1) longest prefix match (most specific wins), 2) lowest administrative distance, 3) lowest metric.

Administrative Distance Ladder (memorize: 0-1-20-90-110-120-200)

Source	AD
Connected	0
Static	1
eBGP	20
EIGRP	90
OSPF	110
RIP	120
iBGP	200

Equal prefix length → lowest AD wins, regardless of metric.

Switch Port Recipes

- **Desktop/printer:** access port in the right VLAN + PortFast.
- **IP phone:** access (data) VLAN + voice VLAN; trust QoS markings from the phone.
- **Wireless AP:** trunk carrying AP-management + SSID VLANs (or access port for single-SSID).
- **PoE:** powers phones/APs/cameras over the data cable — check the switch's power budget before adding devices.

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Spanning Tree — Rapid PVST+

Concept	Know this
Purpose	Prevents Layer 2 loops by blocking redundant paths; one instance per VLAN (PVST+)
Root bridge election	Lowest bridge ID wins (priority + MAC). Default priority 32768; set 4096/8192 to force it
Port roles	Root port (toward root), designated (forwarding per segment), alternate (blocked backup)
PortFast	Edge ports skip listening/learning — hosts come up instantly. Never on trunk/uplink ports
BPDU guard	Shuts down (err-disables) a PortFast port if a BPDU arrives — rogue switch protection
Root guard	Blocks a port from becoming root (keeps the hierarchy stable)
Loop guard	Prevents alternate/blocked ports from wrongly transitioning to forwarding

```
Switch(config)# spanning-tree vlan 10 root primary
Switch(config-if)# spanning-tree portfast
Switch(config-if)# spanning-tree bpduguard enable
```

Election order is everything: lowest bridge ID → root bridge. For root ports: lowest path cost to the root, then lowest neighbor bridge ID, then lowest port priority/number.

EtherChannel / LACP

Concept	Know this
Purpose	Bundle 2–8 physical links into one logical link — more bandwidth + redundancy
LACP modes	active (initiates) / passive (responds) — at least one side must be active
Static ('on' mode)	No negotiation protocol — both sides must be 'on'
Rules	Same speed/duplex, same VLAN config on all member ports; max 8 active + 8 standby

```
Switch(config)# interface range Gi0/1-2
Switch(config-if-range)# channel-group 1 mode active
Switch(config)# interface port-channel 1
Switch(config-if)# switchport mode trunk
```

`show etherc hannel summary` — (P) bundled vs. (I) standalone/misconfigured.

VLANs & Trunking

Concept	Know this
VLAN	Broadcast-domain segmentation at Layer 2; hosts in different VLANs need a router (SVI) to talk
Access port	Carries one VLAN — connects end hosts
Trunk port	Carries multiple VLANs using 802.1Q tagging — switch-to-switch
Native VLAN	Untagged traffic on a trunk (default VLAN 1 — change it for security)
Voice VLAN	Separates VoIP traffic; phone + PC can share one port (data + voice VLANs)

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VLANs & Trunking (cont)

`

```
Switch(config)# vlan 10
Switch(config-vlan)# name SALES
Switch(config)# interface Gi0/1
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 10
Switch(config)# interface Gi0/24
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk allowed vlan 10,20
```

`

Trunk troubleshooting: native VLAN mismatch on the two ends breaks untagged traffic, and a VLAN missing from `allowed vlan` silently drops that VLAN's frames. Check both first.

Inter-VLAN Routing

- **SVI (switched virtual interface):** the Layer 3 path between VLANs on a multilayer switch.
- **Router-on-a-stick:** a router subinterface per VLAN over one trunk link.
- Same-VLAN works + gateways respond but VLANs can't reach each other → inter-VLAN routing (SVI/router) is misconfigured or missing.

Cables & Interfaces — Diagnose Fast

Issue	Symptom / check
Speed/duplex mismatch	Late collisions, terrible throughput — hard-code both sides or leave both auto
Wrong cable type	No link — straight-through vs. crossover (auto-MDIX fixes most modern gear)
Distance exceeded	100 m copper limit; errors climb past it — move to fiber
Fiber: wrong type	Single-mode vs. multimode mismatch = no link; check TX/RX polarity
Dirty connectors	Intermittent errors on fiber — clean with proper tools, never touch the endface
Collisions	Half-duplex relic; full-duplex links shouldn't show collisions at all

`show interfaces status` · `show interfaces Gi0/1 counters errors`

Layers — Quick Map (as used in the guide)

Layer	Lives here	Examples from the blueprint
Layer 2	Switching	VLANs, trunks (802.1Q), STP, EtherChannel, MAC/frames
Layer 3	Routing	IP addressing, static routes, OSPF, ACLs, NAT, packets

IP Addressing Essentials

IPv4

Concept	Know this
Private (RFC 1918)	10.0.0.0/8, 172.16.0.0/12, 192.168.0.0/16
APIPA	169.254.x.x — DHCP failed
Loopback	127.0.0.0/8 (reserved, not Class A usable)

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IP Addressing Essentials (cont)

| Default route | 0.0.0.0/0 — "everything" |
| Limited broadcast | 255.255.255.255 — "everyone here" |

IPv6

Concept	Know this
Global unicast	2000::/3 — publicly routable
Link-local	fe80::/10 — auto-configured on every interface; used for neighbor discovery
EUI-64	Builds the host portion from the MAC: flip the 7th bit, insert ff:fe in the middle
SLAAC	Stateless auto-configuration — hosts self-assign using router advertisements
Shorthand	Compress the longest run of zeros once with :: (e.g., 2001:db8::1)

Subnetting — The 30-Second Method

1. **Magic number** = 256 − interesting octet. Subnets increment by the magic number.
2. **Broadcast** = next subnet − 1. **Usable range** = everything between.
3. Example: 192.168.1.0/26 → magic 64 → subnets .0, .64, .128, .192; first subnet usable .1–.62, broadcast .63.
4. Usable hosts = 2^(host bits) − 2. Subnet and broadcast addresses are never assignable.

CIDR Ladder (memorize cold)

CIDR	Mask	Hosts	Use it for
/24	255.255.255.0	254	Standard LAN subnet
/25	255.255.255.128	126	Splitting a /24 in half
/26	255.255.255.192	62	Small departments
/27	255.255.255.224	30	Point-of-sale, small VLANs
/28	255.255.255.240	14	Tiny segments
/29	255.255.255.248	6	DMZ server clusters
/30	255.255.255.252	2	Point-to-point WAN links

Exam favorite: /30 = 2 usable hosts is the standard point-to-point mask.

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