📡 DHCP – Dynamic Host Configuration Protocol

DHCP is a protocol used to automatically assign IP addresses and other network settings (like DNS and gateway) to computers and devices on a network.

Without DHCP, each device would need to be configured manually.

🔁 How DHCP Works — The DORA Process

When a client (computer) connects to the network, it follows this 4-step process:

Step	Name	What Happens
1	Discover	The client broadcasts: "Is there a DHCP server? I need an IP."
2	Offer	A DHCP server replies: "Here's an available IP you can use."
3	Request	The client says: "I'd like to use the IP you offered, please."
4	Acknowledge	The server confirms: "You've got it. This is your IP for the lease time."

🧠 This process happens quickly and automatically every time a device connects to the network.

🔧 What DHCP Assigns

- IP address (e.g. 192.168.1.20)
- Subnet mask (e.g. 255.255.255.0)
- Default gateway (router IP)
- DNS server(s)
- Lease duration (how long the IP is valid)

📍 DHCP Port Numbers (UDP)

Direction	Port	Description
Client → Server	67	DHCP Discover, Request
Server → Client	68	DHCP Offer, Acknowledge

These ports are used every time a device requests or renews an IP.

💉 How to Tell DHCP Is Working (Client Side)

- Use ipconfig /all → See "DHCP Enabled: Yes"

- Look at assigned IP: should be from DHCP range (e.g. 192.168.x.x)
- Run ipconfig /renew to request a new IP

🆘 What If DHCP Fails?

Symptom	Cause	Result
IP address = 169.254.x.x	No DHCP response	No internet connection
"IP address conflict" message	Two devices using same IP	One or both devices can't connect
Wrong DNS or Gateway	Misconfigured DHCP scope options	Can't browse or connect
No IP assigned	DHCP service not running	Device gets no network access

🧠 Tip: 169.254.x.x is called an APIPA address → it means "I couldn't get an IP from DHCP."

🧰 Tools to Troubleshoot DHCP

Tool	What It Helps You Do
ipconfig /all	See current IP, DNS, gateway, DHCP status
ipconfig /renew	Request a new IP from DHCP
arp -a	View IP-to-MAC mappings on network
Event viewer	Check for errors (Event ID 1001, 4199, DHCP failures)
DHCP Console (Server)	View active leases, scope, reservations
Wireshark (advanced)	See DORA packets between client/server

🧠 Real-World Example

You join a PC to the network and it says "No Internet."
You run ipconfig /all and see:

- IP address: 169.254.121.55
- DHCP Enabled: Yes
  → That means the PC couldn't talk to a DHCP server. Time to check:
- Is the DHCP service running on the server?
- Is there a scope with free IPs?

- Is there a firewall or VLAN blocking DHCP broadcast?

✅ Summary: What You Should Remember

- DHCP automates IP address assignment using the DORA process
- All communication happens over UDP 67/68
- It’s easy to set up, but one small error (bad gateway, IP conflict) can break everything
- You’ll use DHCP tools almost daily in IT support