Common Network Configuration Concepts

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Overview

Network configuration concepts

- IP Addressing
- DNS
- DHCP

Network ports and protocols

- TCP vs UDP

Network Configuration Concepts

Network Configuration Concepts

IP address

Subnet mask

Gateway

DNS

DHCP

IP Addressing

An Internet Protocol address (IP address) is a logical numeric address that is assigned to every single computer, printer, switch, router or any other device that is part of a TCP/IP-based network.

https://www.techopedia.com/definition/2435/internet-protocol-address-ip-address

IP Addressing

IPv4

IPv6

IPv4 Address Basics

Defined in RFC 791 (1981)

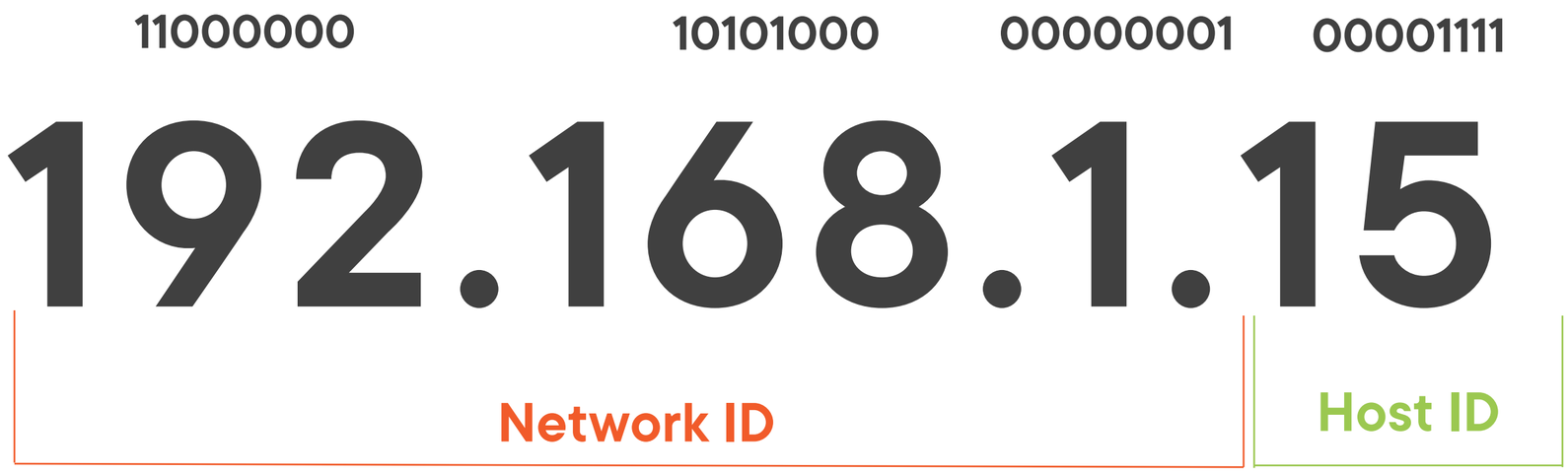
Internet Assigned Numbers Authority (IANA)

32 bits

4.2 billion addresses

Public address pool is exhausted

IPv4 Structure



IPv4 Structure

192.168.1.15

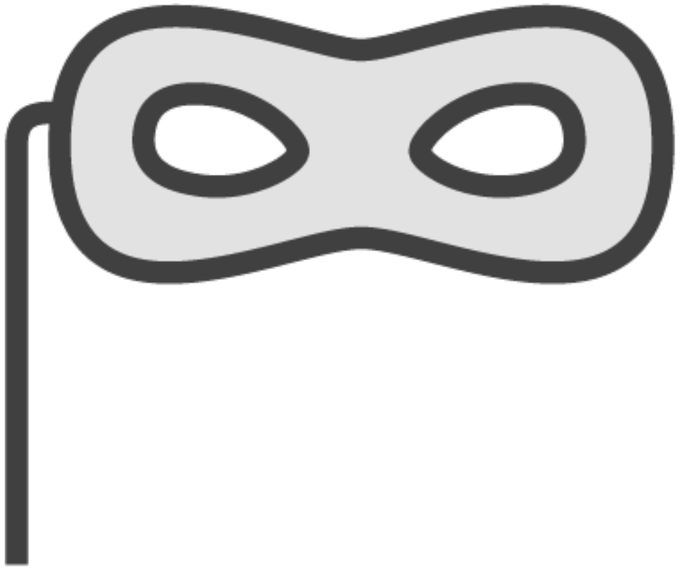
11000000 10101000 00000001 00001111

8 bits / 1 byte / 1 octet

32 bits / 4 bytes

$$(11111111)_2 = (255)_{10}$$

Subnet Mask



Used to determine what subnet a host is on

- **Sub network**

Parts of the IP address used for network and host are not fixed

Subnet mask is a 32-bit number

Subnet Mask Example

IP address - 192.168.123.132 - 11000000.10101000.01111011.10000100
Subnet mask 255.255.255.0 - 11111111.11111111.11111111.00000000

Network address 192.168.123.0 - 11000000.10101000.01111011.00000000
Host address 000.000.000.132 - 00000000.00000000.00000000.10000100

IPv4 Network Classes

Class	First Octet	Subnet Mask	Example IP
A	1-126	255.0.0.0	10.52.36.11
B	128-191	255.255.0.0	172.16.52.63
C	192-223	255.255.255.0	192.168.123.132
D	Multicast IP addresses		
E	Experimental IP addresses		

CIDR (Classless Inter-Domain Routing)

Class	First Octet	Subnet Mask	CIDR Mask
A	1-126	255.0.0.0	/8
B	128-191	255.255.0.0	/16
C	192-223	255.255.255.0	/24
D	Multicast IP addresses		
E	Experimental IP addresses		

Classless addressing: *Network break at any bit boundary*

192.168.0.0 /19 (255.255.224.0)

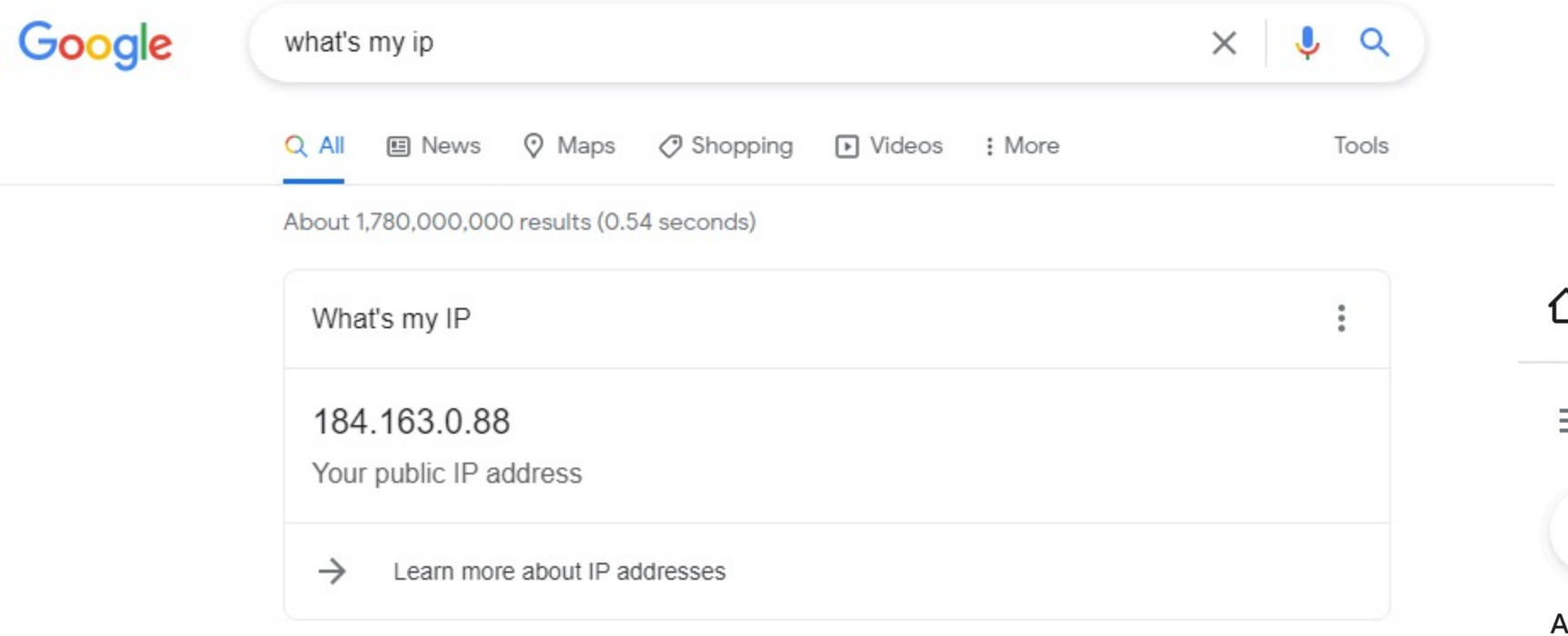
8 subnets with 8,190 hosts per subnet

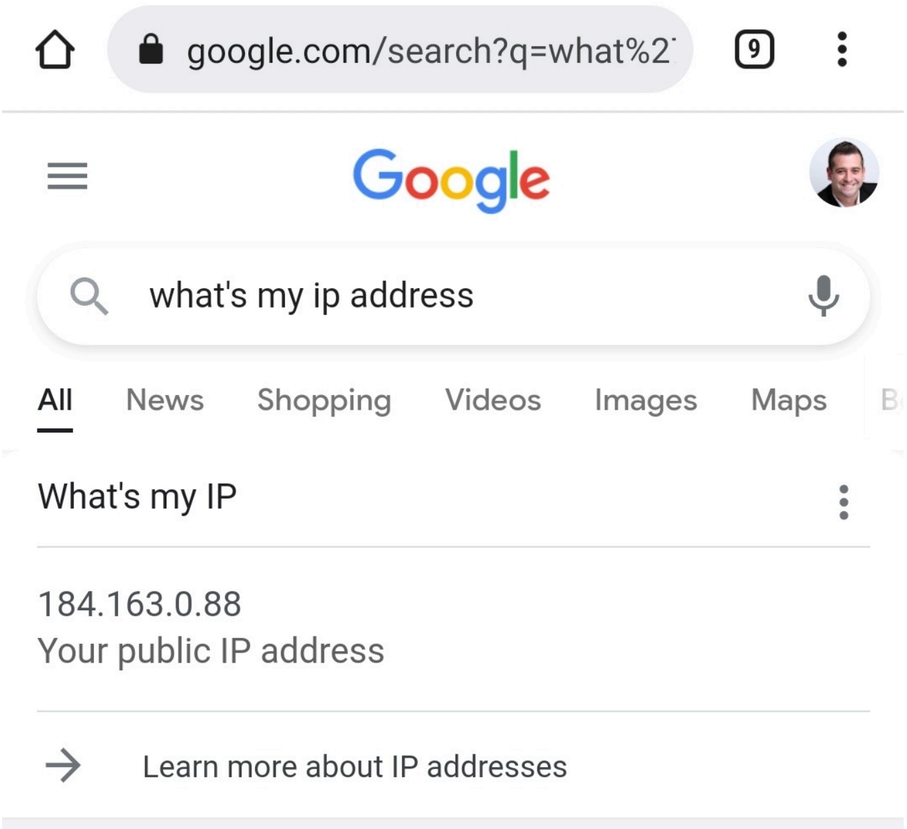
Private Addresses

RFC1918 Name	IP Address Range	Number of Addresses	Largest CIDR Block (Subnet Mask)
24-bit block	10.0.0.0 – 10.255.255.255	16,777,216	10.0.0.0/8 (255.0.0.0)
20-bit block	172.16.0.0 – 172.31.255.255	1,048,576	172.16.0.0/12 (255.240.0.0)
16-bit block	192.168.0.0 – 192.168.255.255	65,536	192.168.0.0/16 (255.255.0.0)

Network address translation (NAT) on router will remap (translate) to a public IP Address as we go on the internet

Test It Out – Your Public Address





IPv6

128 bits

340,282,366,920,938,463,463,374,607,431,
768,211,456 addresses

Represented in hexadecimals

Co-exists with IPv4

IPv6 Structure

0010000000000001 0000000000000000 0011001000111000 1101111111100001 0000000001100011
0000000000000000 0000000000000000 1111111011111011

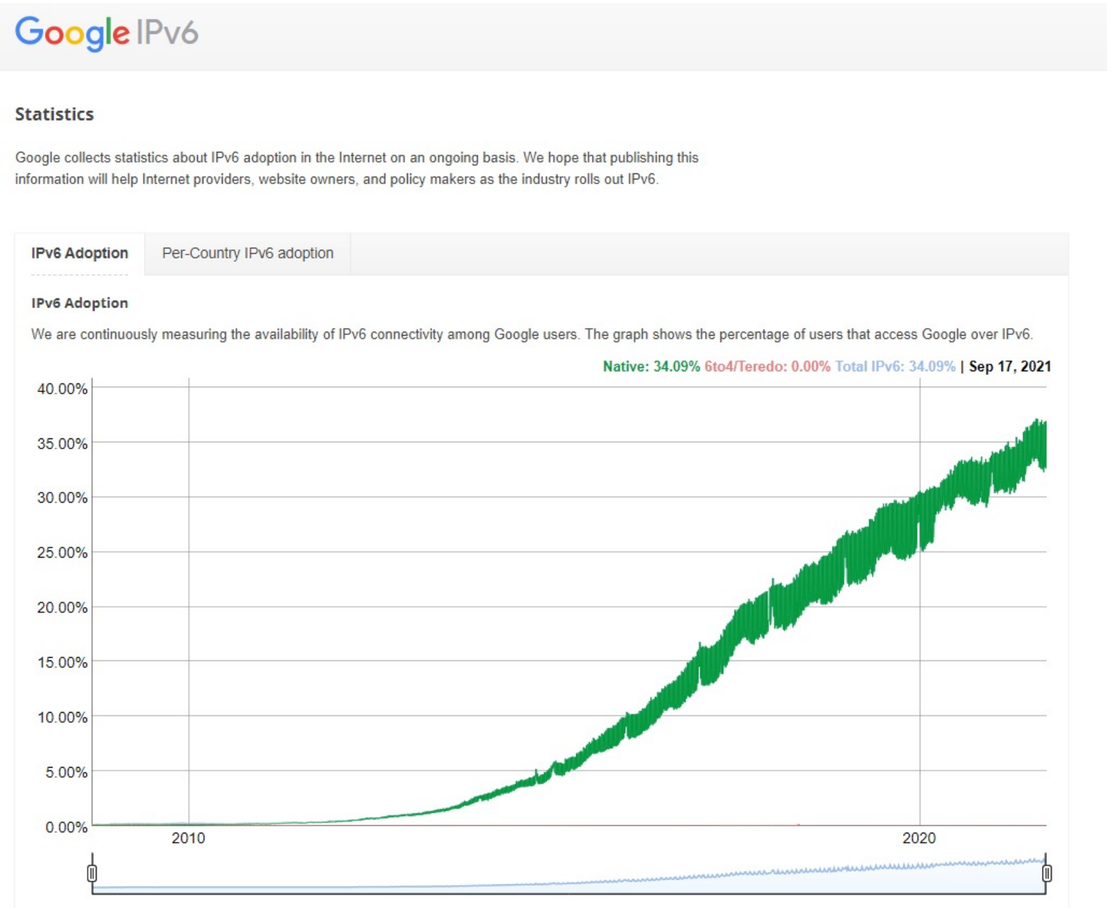
2001:0000:3238:DFE1:0063:0000:0000:FEFB

First discard leading Zero(es):
2001:0000:3238:DFE1:63:0000:0000:FEF

Then replace consecutive zeroes with double colon sign
2001:0000:3238:DFE1:63::FEF

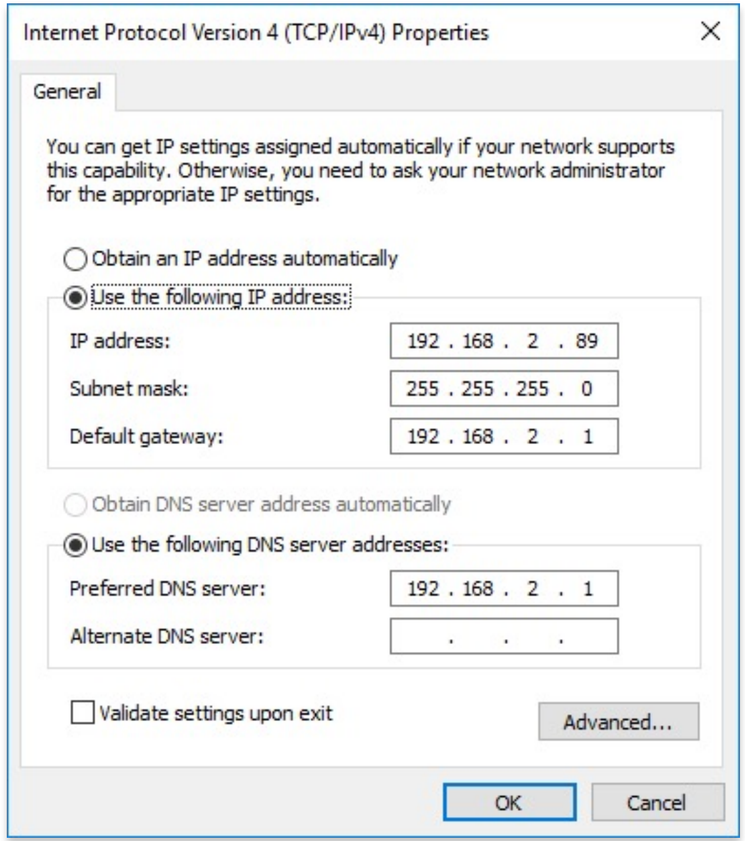
Replace blocks of zero with a single zero
2001:0:3238:DFE1:63::FEF

IPv6 Adoption – September 2021

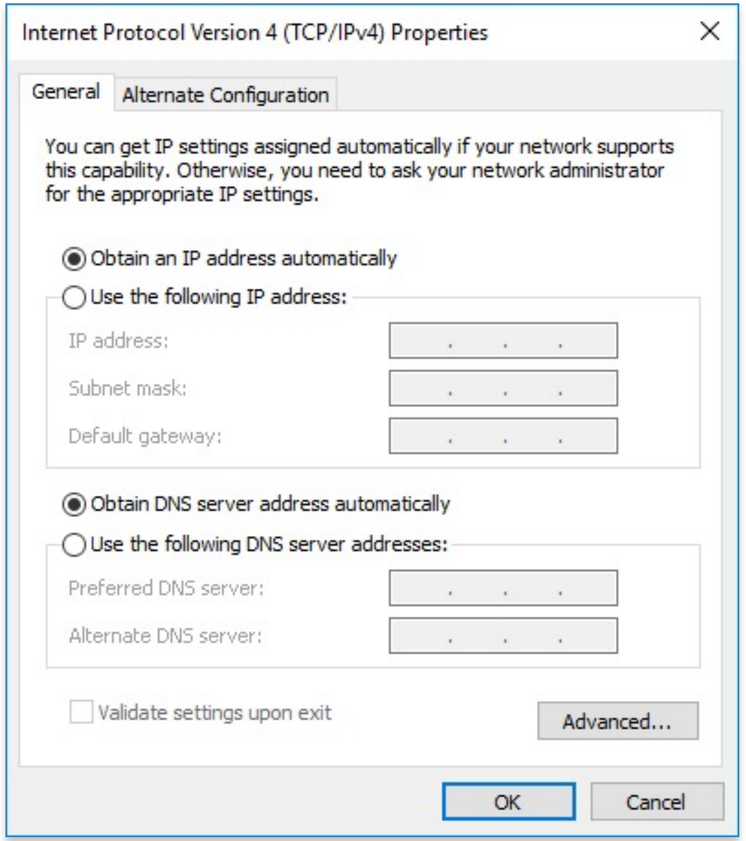


https://www.google.com/intl/en/ipv6/statistics.html

Getting an IP Address



Static



Dynamic

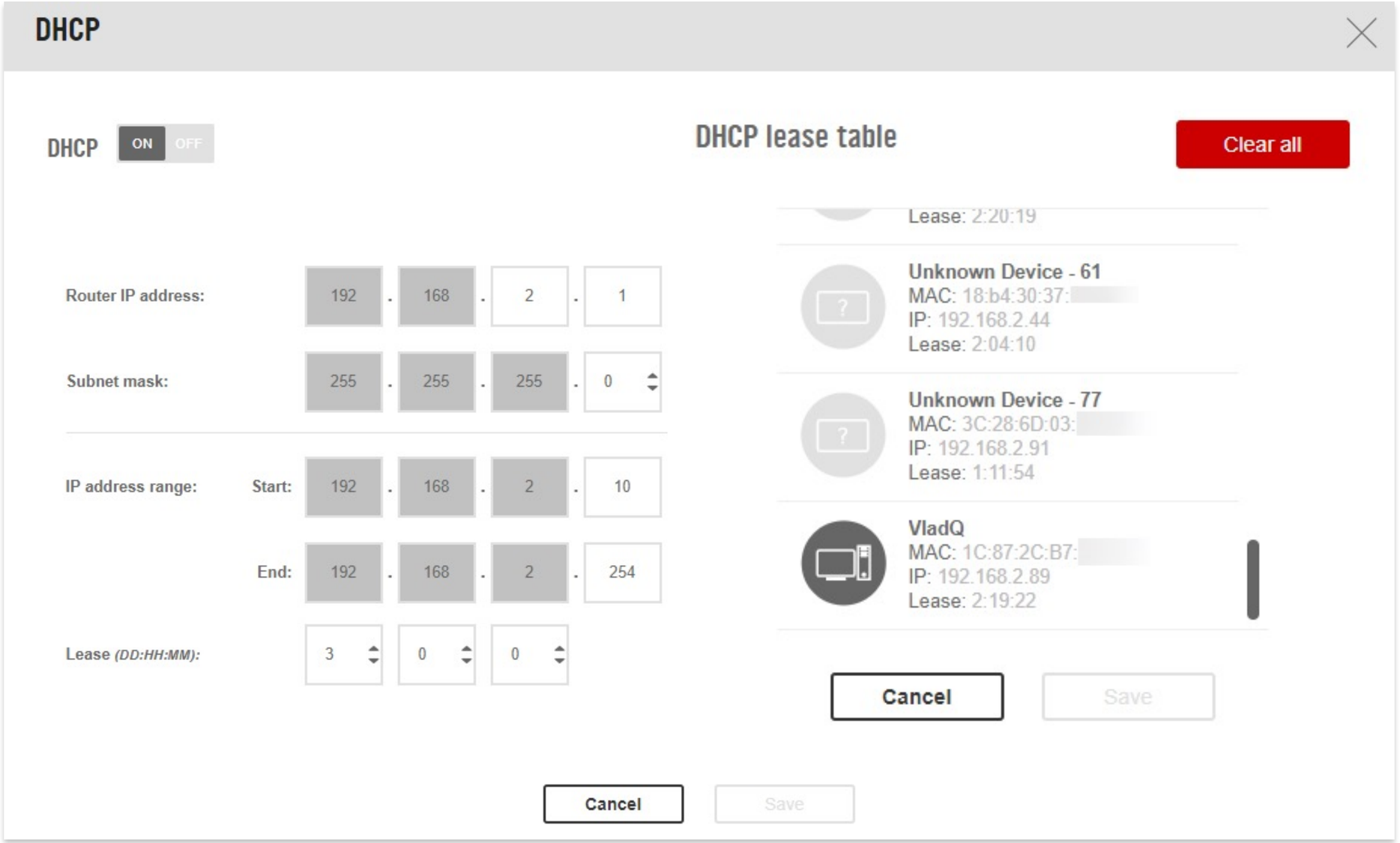
Dynamic Host Configuration Protocol (DHCP)

Every time a device connects to a network it gets an IP address

The IP address assignment expires after a set amount of time

The IP address gets assigned back to the pool of available addresses

DHCP Example – Home Router



Automatic Private IP Addressing (APIPA)

Assign an IP address if DHCP is not available

- **Also called Link-local address**

Can communicate on local network

- **Not outside**

IPV4 - 169.254.0.0/16 (255.255.0.0)

- **169.254.0.1 – 169.254.255.254**

IPV6 – fe80::/64

Domain Name Server (DNS)

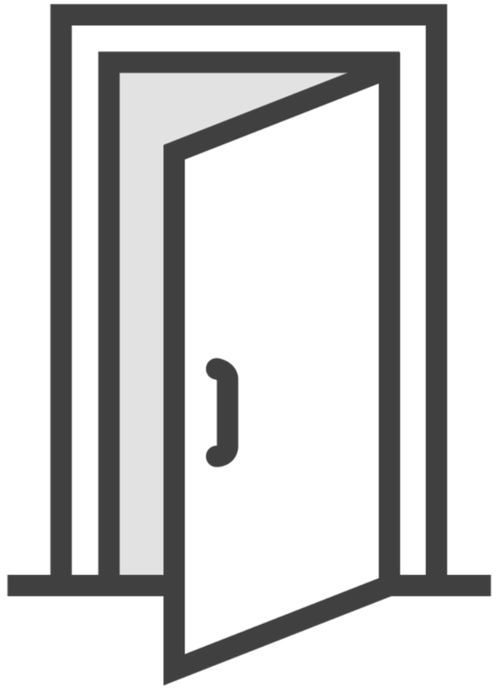
Core component of every network

- **Even the internet!**

Translate domain names to IP addresses

- **Pluralsight.com > 35.161.255.88**
- **https://intranet.globomantics.org > 192.168.0.15**

Gateway



Device located at the boundary of a network

Transfers communications between your local network

- **And the Internet**

The router on a home network

Try It Yourself

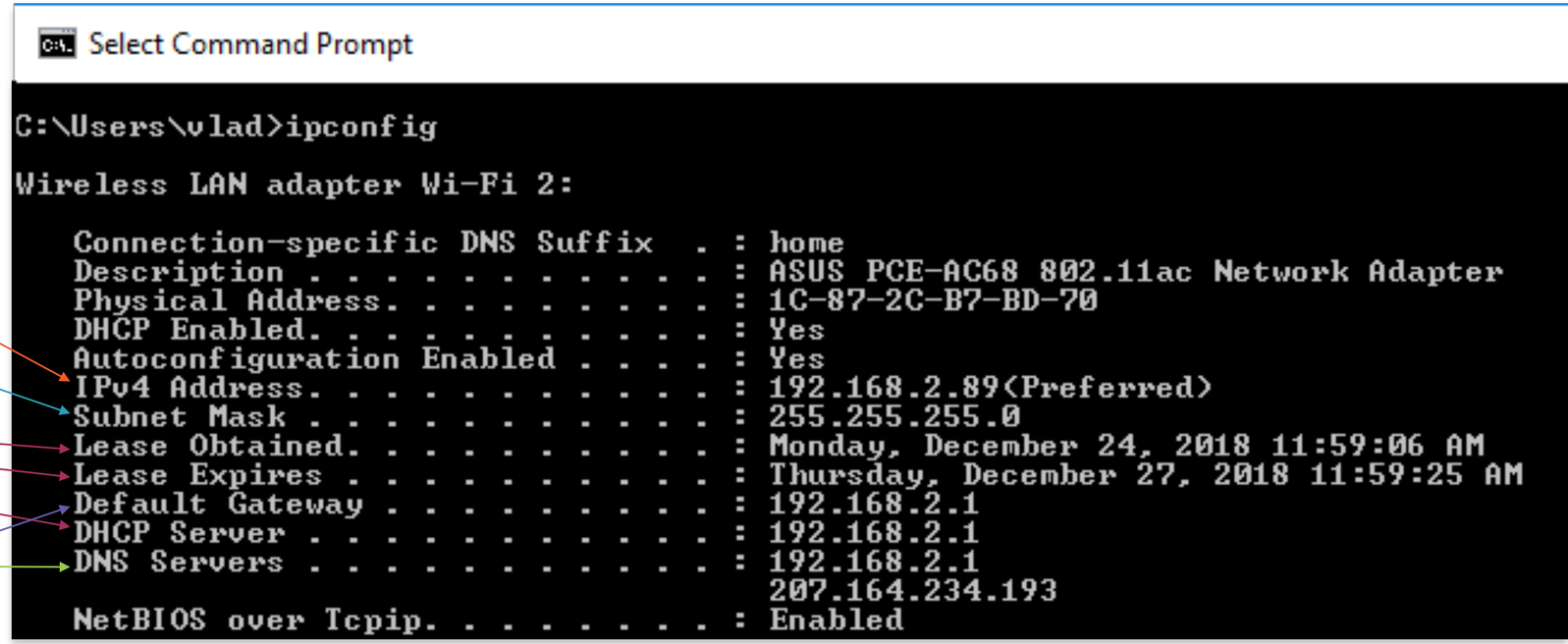
IP Address

Subnet Mask

DHCP

DNS

Gateway



Network Ports and Protocols

TCP & UDP Protocols

TCP
Transmission Control Protocol

UDP
User Datagram Protocol

Send Information from one device to another

TCP/IP

UDP/IP

Transmission Control Protocol

Connection-oriented protocol

Establish a connection

- **Data can be sent both ways**

TCP is all about reliability

- **Built-in systems to check for errors**
- **Guarantee data will be delivered in the right order**

TCP is perfect for

- **Images**
- **Data files**
- **Web Pages**
- **E-mails**

User Datagram Protocol

Connectionless protocol

Data is continuously sent to the recipient

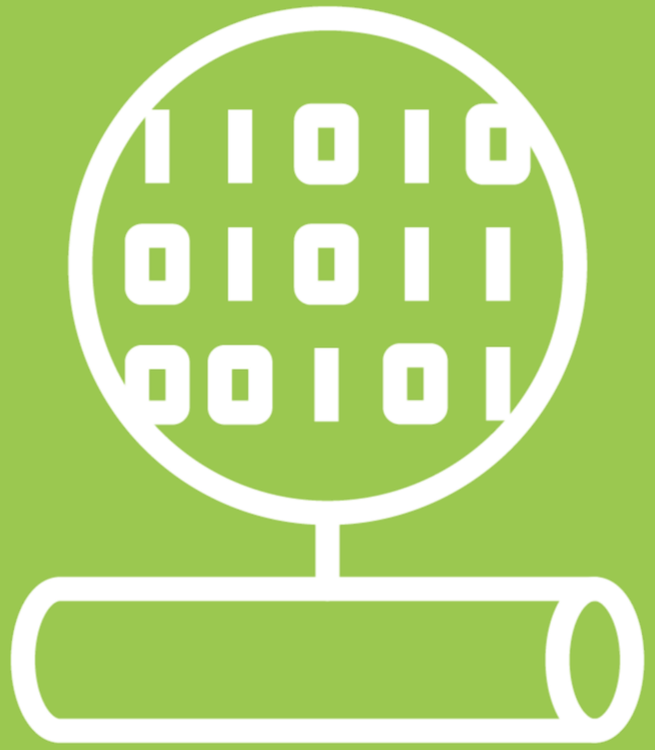
- **Whether or not they receive it**
- **No error checking or confirmation**

Great for real-time communications

- **Live Broadcast**
- **Online multiplayer games**

TCP & UDP Protocols

TCP	UDP
Requires an established connection to transmit data (which should be closed after transmission is complete)	Connectionless protocol with no requirements for opening, maintaining, or terminating a connection
Can guarantee delivery of data	Cannot guarantee delivery of data
Able to retransmit lost packets	No retransmission of lost packets
Extensive error checking capabilities	Basic error checking capabilities
Slower	Faster



Common Protocols and The TCP / UDP Ports They Use

Network Ports

A network port is a process-specific or an application-specific software construct serving as a communication endpoint, which is used by the Transport Layer protocols of Internet Protocol suite, such as User Diagram Protocol (UDP) and Transmission Control Protocol (TCP).

https://www.techopedia.com/definition/24717/network-port

File Transfer Protocol (**FTP**)

One of the most used file transfer protocols

Move files from one system to another

Uses TCP 20/21

Secure management of network devices at the command level

Uses TCP port 22

Secure Shell

(**SSH**)

Telnet

Management of network devices at the command level

Only provides an unsecured connection

Not recommended over public networks

Uses TCP port 23

Used to transfer e-mail between mail servers

Used when end-users send an e-mail to a mail system

Uses TCP port 25

Simple Mail Transfer Protocol

(**SMTP**)

Domain Name System (**DNS**)

Translate domain names to IP addresses

Used on public and private networks

Uses TCP/UDP port 53

Used to assign an IP to devices

Uses ports UDP 67/68

Dynamic Host Configuration Protocol

(DHCP)

Hypertext Transfer Protocol

(**HTTP**)

Used to display web pages

- **http://<yoursite>.com**

Data transfer is unsecured / unencrypted

Uses TCP port 80

Also used to by browsers to display pages

httpS://Pluralsight.com

Encryption done via SSL or TLS

Uses TCP port 443

Hypertext Transfer Protocol Secure

(**HTTPS**)

Post Office Protocol (**POP**) version 3

Used to retrieve emails from a server

Uses TCP port 110

Used to retrieve email from a server

Supports a wider array of remote mailbox operations

Uses TCP port 143

Internet Message Access Protocol

(**IMAP**)

Simple Network Management Protocol

(**SNMP**)

Collecting and organizing information about managed devices

Uses TCP/UDP Ports 161 and 162

Central protocol used to interconnect Microsoft Windows devices

Communicates on TCP/UDP Ports 137/138/139

NetBIOS over TCIP/IP

(**NetBT)**

Lightweight Directory Access Protocol

(LDAP)

Mechanism for accessing and maintaining distributed directory information

Uses TCP/UDP Port 389

Foundation of Microsoft's Windows networking capability

Common Internet File System (CIFS)

Uses TCP port 445

Server Message Block

(**SMB**)

Remote Desktop Protocol

(**RDP**)

View the remote desktop of a device across the network

Uses TCP port 3389

TCP & UDP Ports Cheat Sheet

Files

- TCP 20 - FTP
- TCP 21 - FTP
- TCP 445 – SMB / CIFS

E-mail

- TCP 25 - SMTP
- TCP 110 – POP3
- TCP 143 - IMAP

Web

- TCP 80 - HTTP
- TCP 443 - HTTPs

Management

- TCP 22 - SSH
- TCP 23 - Telnet
- TCP/UDP 161 - SNMP
- TCP/UDP 162 - SNMP
- TCP 3389 - RDP

Utilities

- TCP/UDP 53 - DNS
- UDP 67 - DHCP
- UDP 68 - DHCP
- TCP/UDP 137 - NetBIOS
- TCP/UDP 138 - NetBIOS
- TCP/UDP 139 - NetBIOS
- TCP/UDP 389 - LDAP

Conclusion

Network configuration concepts

- IP Addressing
  - IPv4
  - IPv6
- Subnet Mask
- DNS
- DHCP

Network ports and protocols

- TCP & UDP

Up Next:
Common Networking Hardware