NSS

Networks

Networking Introduction

Understanding networking basics will help you to build and upkeep better code, troubleshoot problems and make design trade offs within your applications.

What is a network?

A group or system of interconnected things (computers and networking devices)

Networking History (Redux)

1960 - First commercial modem

1964 - IBM’s SABRE linked 2000 terminals

1970 - ARPANET

1971 - First Email

1973 - Ethernet was designed

1975 - Telnet (commercial packet switching)

1979 - The First Multi-User Dungeon (MUD1) goes online

1990 - The World Wide Web is born HTML, URL, HTTP

1993 - Mosaic Born (first graphical web browser)

An Analogy

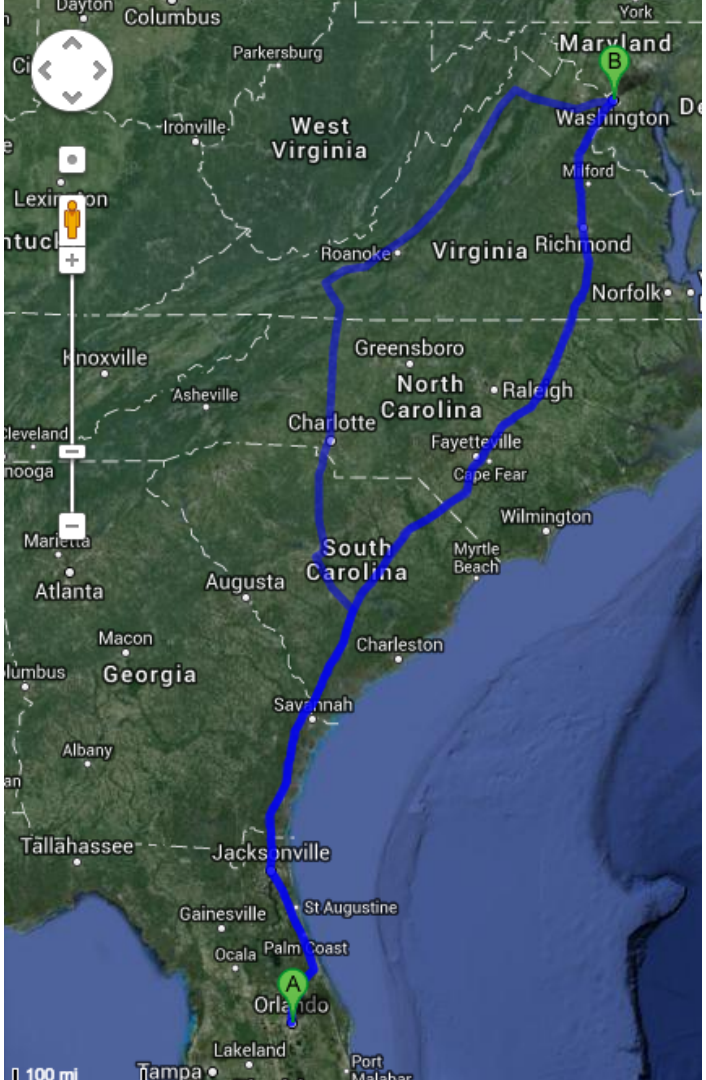
It may help to think of networks as roads.

Can you name some similar properties?

Quick Activity

Using your favorite mapping program get directions from here, to a remote major city (like New York, or Washington DC) that is connected by our road network.

Does the mapping program give multiple options for a route?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Asheville
Charlotte
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Cape Fear
Wilmington
Myrtle Beach
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Augusta
Macon
Georgia
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Network Devices

Hub

Repeater

Modem

Network Interface Card (NIC)

Media Converters

Switch

Bridge

Wireless access point

Router

Firewall

Dynamic Host Configuration Protocol (DHCP) Server

Network Interface

A network interface controller (NIC) is computer hardware that provides a computer with the ability to access the transmission media, and has the ability to process low-level network information.

Repeaters & Hubs

A repeater is an electronic device that receives a network signal, cleans it of unnecessary noise, and regenerates it. The signal is retransmitted at a higher power level, or to the other side of an obstruction, so that the signal can cover longer distances without degradation.

Bridges

A network bridge connects and filters traffic between two network segments at the data link layer (layer 2) of the OSI model to form a single network.

Switches

A network switch is a device that forwards and filters OSI layer 2 datagrams between ports based on the MAC addresses in the packets.

Routers

A router is an internetworking device that forwards packets between networks by processing the routing information included in the packet or datagram (Internet protocol information from layer 3).

Modems

A **modem** (**mo**dulator-**dem**odulator) is a device that modulates an analog carrier signal to encode digital information and demodulates the signal to decode the transmitted information.

Firewalls

A firewall is a network device for controlling network security and access rules.

Load balancers

Load balancing is a computer networking method for distributing workloads across multiple computing resources, such as computers, a computer cluster, network links, central processing units or disk drives.

Technologies

Wiring Standards/Connector Standards

Protocols

Ports

Physical Topologies

Logical Topologies

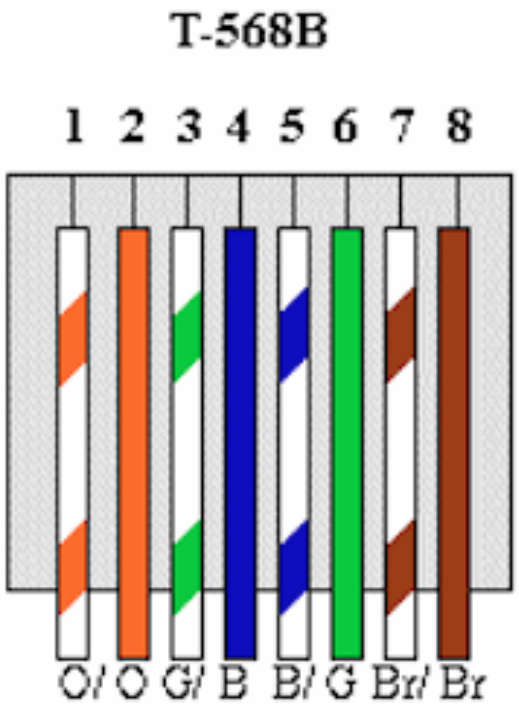
LANS/WANS/Wireless

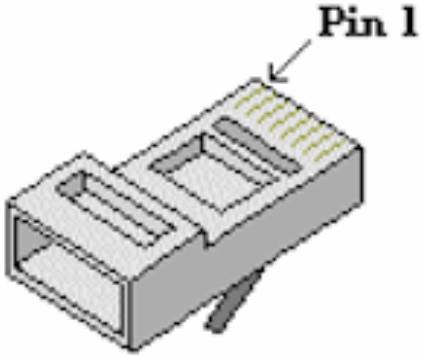
Physical Devices

Wiring Standards (examples)

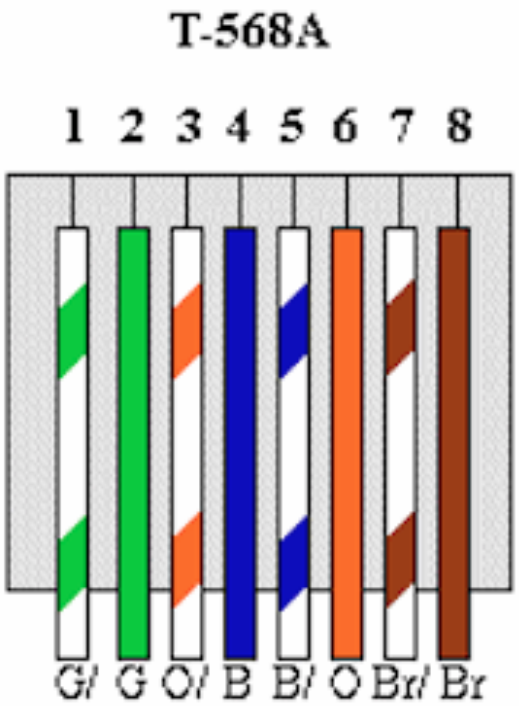
Cat 3 – used for voice cabling and 10Mb Ethernet
Cat 5 – used for 10/100Mb Ethernet and works for voice as well
Cat 5E – Enhanced Cat 5 cabling that helps to prevent cross-talk, works for 10/100Mb and 1000Mb (or Gigabit Ethernet)
Cat 6 – Like Cat 5E but with larger gauge wires, works for 10/100/1000Mb. This cable is better than Cat 5e for Gigabit Ethernet.
Cat 7 – Also called Class F, this is fully-shielded cabling and supports up to 600Mhz. This is a relatively new type of cabling and isn't used much.

Cat-5 Standards

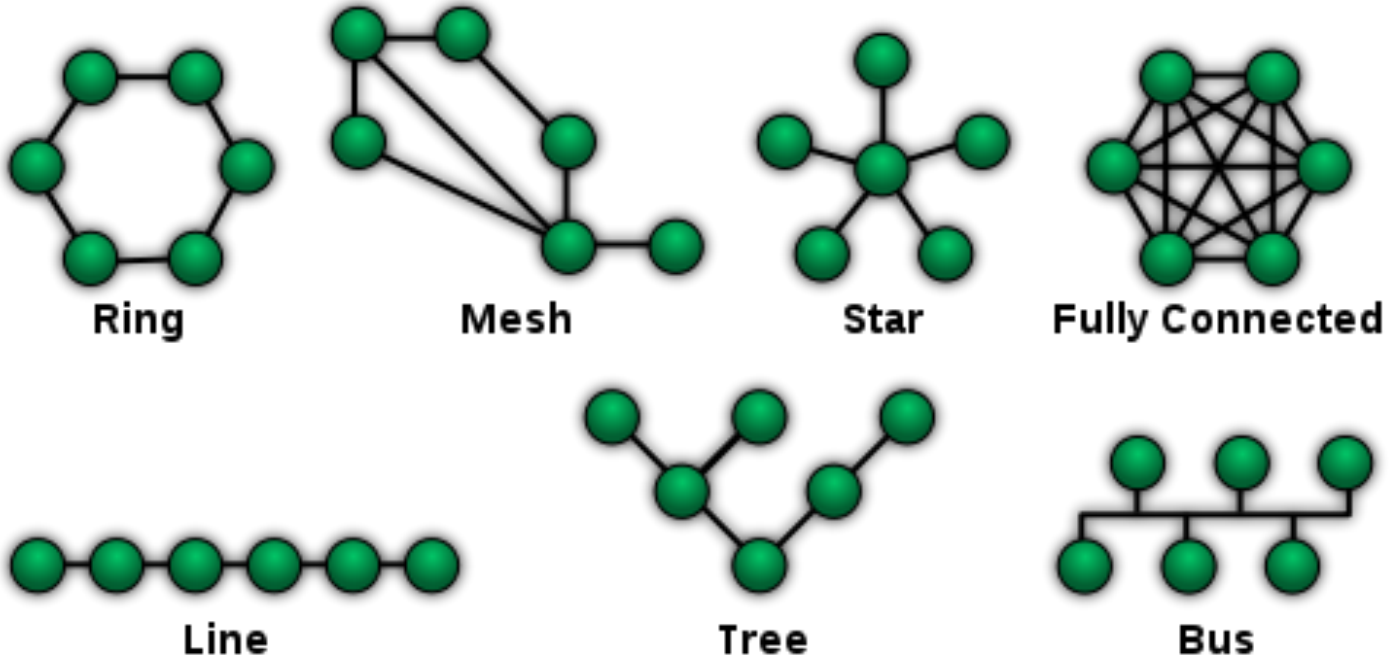




RJ-45 Plug



Physical Topologies



Network Architectures

Peer to Peer

Client - Server

VLAN

In computer networking, a single layer-2 network may be partitioned to create multiple distinct broadcast domains, which are mutually isolated so that packets can only pass between them via one or more routers; such a domain is referred to as a virtual local area network, virtual LAN or VLAN.

Virtual Local Area Networks (VLAN's) were developed as an alternative solution to using routers to contain broadcast traffic.

IP Address/MAC address

An IP address is a logical address of a device

MAC address is a physical address of a device

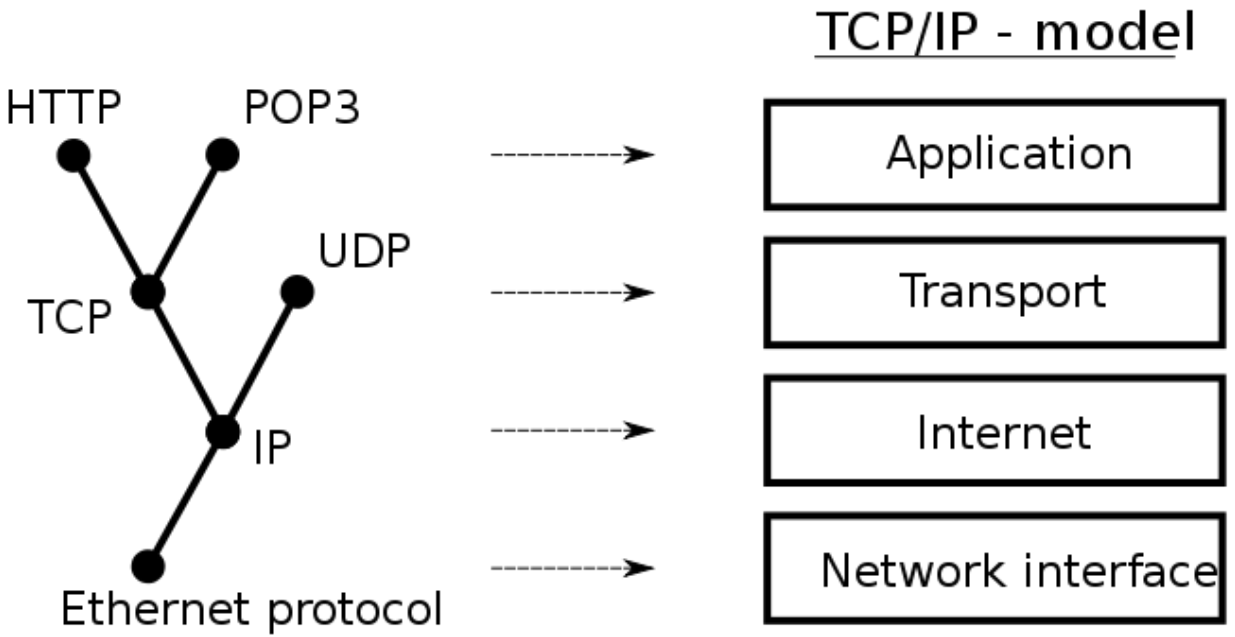
Protocols

In computing, a protocol is a convention or standard that controls or enables the connection, communication, and data transfer between computing endpoints.

In its simplest form, a protocol can be defined as the rules governing the syntax, semantics, and synchronization of communication.

Protocols may be implemented by hardware, software, or a combination of the two.

Protocols (Continued)



Example Protocols by Layer

OSI Layer	Protocols
Link	ARP
Internet	IP (IPv4, IPv6), ICMP, IGMP
Transport	TCP, UDP
Application	DNS, TFTP, TLS/SSL, FTP, HTTP, IMAP4, POP3, SIP, SMTP, SNMP, SSH, Telnet, RTP

TCP/IP

TCP/IP The Internet protocol suite is the networking model and a set of communications protocols used for the Internet and similar networks.

IP Internet Protocol

TCP Transmission Control Protocol

Ports

A virtual data connection between computer programs possibly through a computer network.

A port is identified for each address and protocol by a 16-bit number, commonly known as the port number.

Ports (common)

20-21 FTP

22 SSH/SCP

23 Telnet

25 SMTP

3306 MySQL

587 SMTP

Addressing

Is the logical method of finding a device on the network.

Network Interface Card (NIC)

is a computer hardware component that connects a computer to a computer network.

Media Converters

is a simple networking device that makes it possible to connect two dissimilar media types such as twisted pair with fiber optic cabling.

Wireless access point

A device which allows devices to connect to a wired network by using Wi-Fi

DHCP

The Dynamic Host Configuration Protocol (DHCP) is a standardized networking protocol used by servers on an IP network to allocate IP addresses to computers.

Network Management

In computer networks, network management refers to the activities, methods, procedures, and tools that pertain to the operation, administration, maintenance, and provisioning of networked systems.

DNS and You

DNS stands for Domain Name System. DNS translates a URL or web address (such as “www.google.com”) into the correct IP address to contact (for example “74.125.19.147”).

Uniform Resource Locator (URL)

This is the address of a resource on the Internet, the same value included in your browser's location bar.

A Record

Address or A records (also known as host records) are the central records of DNS. These records link a domain to an IP address.

CNAME Records

Canonical Name or CNAME records link an alias name to another canonical domain name. For instance, alias.example.com might link to example.com.

Email Records

Mail Exchange (MX) records direct email to servers for a domain. Multiple MX records can be defined for a domain, each with a different priority where the lowest number is the highest priority. If mail can't be delivered using the first priority record, the second priority record is used, and so on.

TXT Records

Text or TXT records may contain arbitrary text but can also be used to define machine readable text. TXT records are used primarily with Google Apps for domain ownership verification purposes. Also, you'll need to use TXT records to implement email abuse prevention methods such as SPF, DKIM, and DMARC.

NS Records

Name server (NS) records determine which servers will communicate DNS information for a domain. Generally, you will have primary and secondary name server records for your domain.

Types of Networks

Intranets

Extranets

Internetwork

Internet

Darknet

Intranets

An intranet is a set of networks that are under the control of a single administrative entity.

Extranets

An extranet is a network that is also under the administrative control of a single organization, but supports a limited connection to a specific external network.

Internetwork

An internetwork is the connection of multiple computer networks via a common routing technology using routers.

Internet

The largest example of an internetwork

Darknet

Is an overlay network running on the internet, accessible only through specialized software.

Local Area Network

A local area network (LAN) is a network that connects computers and devices in a limited geographical area such as a home, school, office building, or closely positioned group of buildings.

Home Area Network

Residential Local Area Network

Storage Area Network

A storage area network (SAN) is a dedicated network that provides access to consolidated, block level data storage.

Campus Area Network

A campus area network (CAN) is made up of an interconnection of LANs within a limited geographical area.

Backbone Network

A backbone network is part of a computer network infrastructure that provides a path for the exchange of information between different LANs or sub-networks.

Metropolitan Area Network

A Metropolitan area network (MAN) is a large computer network that usually spans a city or a large campus.

Wide Area Network

A wide area network (WAN) is a computer network that covers a large geographic area such as a city, country, or spans even intercontinental distances.

Enterprise Private Network

An enterprise private network is a network built by a single organization to interconnect its office locations (e.g., production sites, head offices, remote offices, shops) in order to share computer resources.

Virtual Private Network

A virtual private network (VPN) is an overlay network in which some of the links between nodes are carried by open connections or virtual circuits in some larger network (e.g., the Internet) instead of by physical wires.

Global Area Network

A global area network (GAN) is a network used for supporting mobile across an arbitrary number of wireless LANs, satellite coverage areas, etc.

Wireless (various)

Wireless PAN

Wireless LAN

Wireless mesh network

Wireless MAN

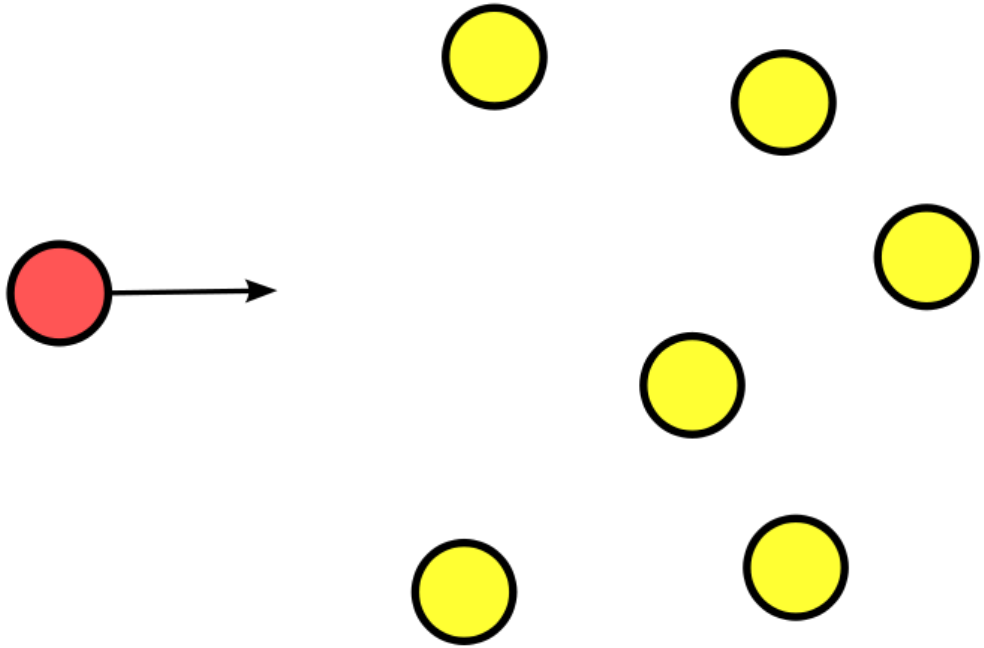
Wireless WAN

Cellular network

Routing

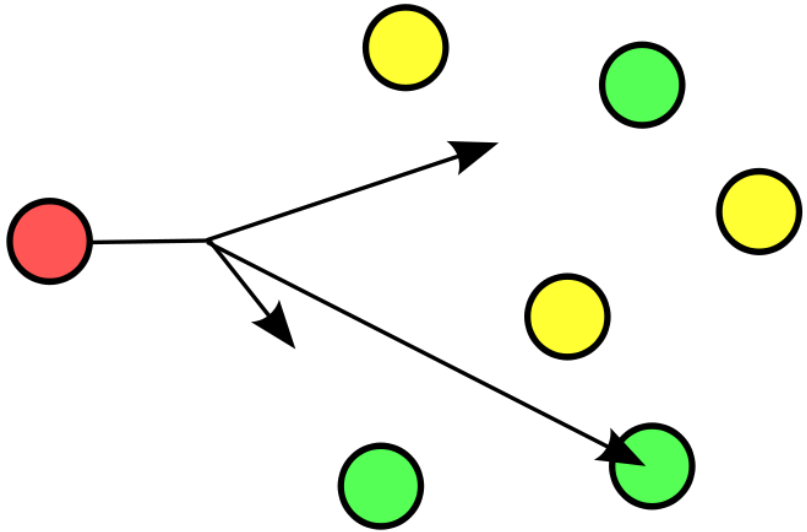
Routing is the process of selecting best paths in a network.

Routing Schemes



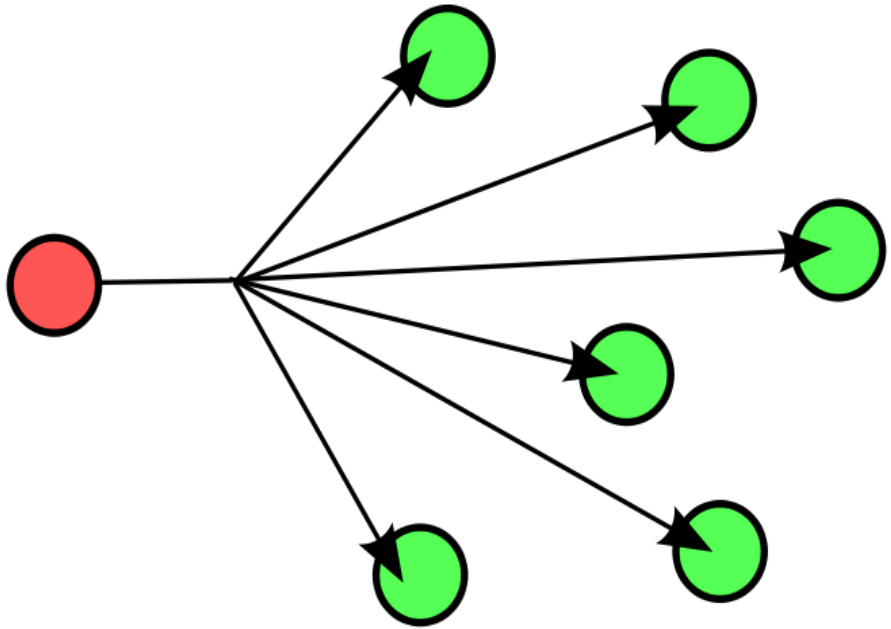
Anycast

Anycast is a network addressing and routing methodology in which datagrams from a single sender are routed to the topologically nearest node in a group of potential receivers, though it may be sent to several nodes, all identified by the same destination address.



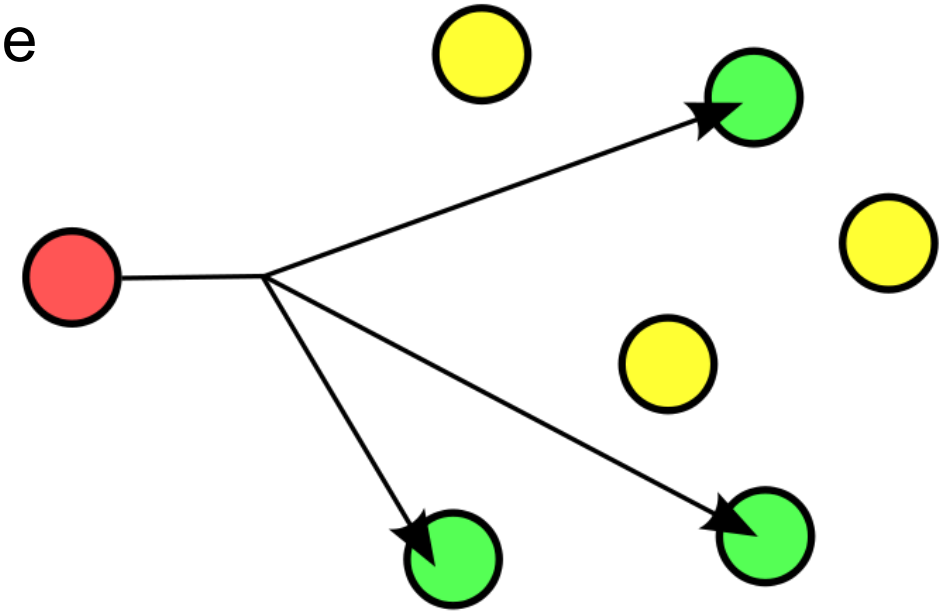
Broadcast

Broadcasting refers to a method of transferring a message to all recipients simultaneously



Multicast

Multicast delivers a message to a group of nodes that have expressed interest in receiving the message



Geocast

Geocast delivers a message to a geographic area