

IP Network Administration

Internet protocol suite

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The Internet protocol suite, commonly known as TCP/IP, is a framework for organizing the communication protocols used in the Internet and similar computer networks according to functional criteria. The foundational protocols in the suite are the Transmission Control Protocol (TCP), the User Datagram Protocol (UDP), and the Internet Protocol (IP). Early versions of this networking model were known as the Department of Defense (DoD) Internet Architecture Model because the research and development were funded by the Defense Advanced Research Projects Agency (DARPA) of the United States Department of Defense.

The Internet protocol suite provides end-to-end data communication specifying how data should be packetized, addressed, transmitted, routed, and received. This functionality is organized into four abstraction layers, which classify all related protocols according to each protocol's scope of networking. An implementation of the layers for a particular application forms a protocol stack. From lowest to highest, the layers are the link layer, containing communication methods for data that remains within a single network segment (link); the internet layer, providing internetworking between independent networks; the transport layer, handling host-to-host communication; and the application layer, providing process-to-process data exchange for applications.

The technical standards underlying the Internet protocol suite and its constituent protocols are maintained by the Internet Engineering Task Force (IETF). The Internet protocol suite predates the OSI model, a more comprehensive reference framework for general networking systems.

IP address

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An Internet Protocol address (IP address) is a numerical label such as 192.0.2.1 that is assigned to a device connected to a computer network that uses the Internet Protocol for communication. IP addresses serve two main functions: network interface identification, and location addressing.

Internet Protocol version 4 (IPv4) was the first standalone specification for the IP address, and has been in use since 1983. IPv4 addresses are defined as a 32-bit number, which became too small to provide enough addresses as the internet grew, leading to IPv4 address exhaustion over the 2010s. Its designated successor, IPv6, uses 128 bits for the IP address, giving it a larger address space. Although IPv6 deployment has been ongoing since the mid-2000s, both IPv4 and IPv6 are still used side-by-side as of 2025.

IP addresses are usually displayed in a human-readable notation, but systems may use them in various different computer number formats. CIDR notation can also be used to designate how much of the address should be treated as a routing prefix. For example, 192.0.2.1/24 indicates that 24 significant bits of the address are the prefix, with the remaining 8 bits used for host addressing. This is equivalent to the historically used subnet mask (in this case, 255.255.255.0).

The IP address space is managed globally by the Internet Assigned Numbers Authority (IANA) and the five regional Internet registries (RIRs). IANA assigns blocks of IP addresses to the RIRs, which are responsible

for distributing them to local Internet registries in their region such as internet service providers (ISPs) and large institutions. Some addresses are reserved for private networks and are not globally unique.

Within a network, the network administrator assigns an IP address to each device. Such assignments may be on a static (fixed or permanent) or dynamic basis, depending on network practices and software features. Some jurisdictions consider IP addresses to be personal data.

IP aliasing

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IP aliasing is associating more than one IP address to a network interface. With this, one node on a network can have multiple connections to a network, each serving a different purpose.

According to the Linux Kernel documentation, IP-aliases are an obsolete way to manage multiple IP-addresses/masks per interface. Newer tools such as `iproute2` support multiple address/prefixes per interface, but aliases are still supported for backwards compatibility.

In the Linux kernel, it was first implemented by Juan José Ciarlante in 1995. On Solaris IP aliasing was called logical network interface and was first available in Solaris 2.5 in 1995. It has also been possible in Microsoft Windows NT since (at least) Windows NT 3.51, released in 1995.

IP aliasing can be used to provide multiple network addresses on a single physical interface. This demonstrates using IP version 4 addresses only. One reason for using this could be to make a computer look as though it is multiple computers, so for example you could have one server that is acting as both a gateway (router) and a DHCP server and DNS using three different IP addresses, perhaps with a future plan to use a hardware router and to move the functionality to separate DNS and DHCP servers. Or indeed the opposite you could decide to replace the three different hardware devices with a single server to reduce the administration overhead. In this case you can have three different addresses which are all on the same computer without having to install many physical network interfaces. Another reason to use IP aliasing could be to have the computer on two different logical network subnets whilst using a single physical interface.

Email

RFC 3834, and updated by RFC 5436. RFC 5518. Craig Hunt (2002). TCP/IP Network Administration. O'Reilly Media. p. 70. ISBN 978-0-596-00297-8. "What is unicode

Electronic mail (usually shortened to email; alternatively hyphenated e-mail) is a method of transmitting and receiving digital messages using electronic devices over a computer network. It was conceived in the late-20th century as the digital version of, or counterpart to, mail (hence e- + mail). Email is a ubiquitous and very widely used communication medium; in current use, an email address is often treated as a basic and necessary part of many processes in business, commerce, government, education, entertainment, and other spheres of daily life in most countries.

Email operates across computer networks, primarily the Internet, and also local area networks. Today's email systems are based on a store-and-forward model. Email servers accept, forward, deliver, and store messages. Neither the users nor their computers are required to be online simultaneously; they need to connect, typically to a mail server or a webmail interface to send or receive messages or download it.

Originally a text-only ASCII communications medium, Internet email was extended by MIME to carry text in expanded character sets and multimedia content such as images. International email, with internationalized email addresses using UTF-8, is standardized but not widely adopted.

Voice over IP

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Voice over Internet Protocol (VoIP), also known as IP telephony, is a set of technologies used primarily for voice communication sessions over Internet Protocol (IP) networks, such as the Internet. VoIP enables voice calls to be transmitted as data packets, facilitating various methods of voice communication, including traditional applications like Skype, Microsoft Teams, Google Voice, and VoIP phones. Regular telephones can also be used for VoIP by connecting them to the Internet via analog telephone adapters (ATAs), which convert traditional telephone signals into digital data packets that can be transmitted over IP networks.

The broader terms Internet telephony, broadband telephony, and broadband phone service specifically refer to the delivery of voice and other communication services, such as fax, SMS, and voice messaging, over the Internet, in contrast to the traditional public switched telephone network (PSTN), commonly known as plain old telephone service (POTS).

VoIP technology has evolved to integrate with mobile telephony, including Voice over LTE (VoLTE) and Voice over NR (Vo5G), enabling seamless voice communication over mobile data networks. These advancements have extended VoIP's role beyond its traditional use in Internet-based applications. It has become a key component of modern mobile infrastructure, as 4G and 5G networks rely entirely on this technology for voice transmission.

IP Multimedia Subsystem

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The IP Multimedia Subsystem or IP Multimedia Core Network Subsystem (IMS) is a standardised architectural framework for delivering IP multimedia services. Historically, mobile phones have provided voice call services over a circuit-switched-style network, rather than strictly over an IP packet-switched network. Various voice over IP technologies are available on smartphones; IMS provides a standard protocol across vendors.

IMS was originally designed by the wireless standards body 3rd Generation Partnership Project (3GPP), as a part of the vision for evolving mobile networks beyond GSM. Its original formulation (3GPP Rel-5) represented an approach for delivering Internet services over GPRS. This vision was later updated by 3GPP, 3GPP2 and ETSI TISPAN by requiring support of networks other than GPRS, such as Wireless LAN, CDMA2000 and fixed lines.

IMS uses IETF protocols wherever possible, e.g., the Session Initiation Protocol (SIP). According to the 3GPP, IMS is not intended to standardize applications, but rather to aid the access of multimedia and voice applications from wireless and wireline terminals, i.e., to create a form of fixed-mobile convergence (FMC). This is done by having a horizontal control layer that isolates the access network from the service layer. From a logical architecture perspective, services need not have their own control functions, as the control layer is a common horizontal layer. However, in implementation this does not necessarily map into greater reduced cost and complexity.

Alternative and overlapping technologies for access and provisioning of services across wired and wireless networks include combinations of Generic Access Network, softswitches and "naked" SIP.

Since it is becoming increasingly easier to access content and contacts using mechanisms outside the control of traditional wireless/fixed operators, the interest of IMS is being challenged.

Examples of global standards based on IMS are MMTel which is the basis for Voice over LTE (VoLTE), Wi-Fi Calling (VoWiFi), Video over LTE (ViLTE), SMS/MMS over WiFi and LTE, Unstructured Supplementary Service Data (USSD) over LTE, and Rich Communication Services (RCS), which is also known as joyn or Advanced Messaging, and now RCS is operator's implementation. RCS also further added Presence/EAB (enhanced address book) functionality.

Simple Network Management Protocol

Simple Network Management Protocol (SNMP) is an Internet Standard protocol for collecting and organizing information about managed devices on IP networks and

Simple Network Management Protocol (SNMP) is an Internet Standard protocol for collecting and organizing information about managed devices on IP networks and for modifying that information to change device behavior. Devices that typically support SNMP include cable modems, routers, network switches, servers, workstations, printers, and more.

SNMP is widely used in network management for network monitoring. SNMP exposes management data in the form of variables on the managed systems organized in a management information base (MIB), which describes the system status and configuration. These variables can then be remotely queried (and, in some circumstances, manipulated) by managing applications.

Three significant versions of SNMP have been developed and deployed. SNMPv1 is the original version of the protocol. More recent versions, SNMPv2c and SNMPv3, feature improvements in performance, flexibility and security.

SNMP is a component of the Internet Protocol Suite as defined by the Internet Engineering Task Force (IETF). It consists of a set of standards for network management, including an application layer protocol, a database schema, and a set of data objects.

Router (computing)

or more data lines from different IP networks. When a data packet comes in on a line, the router reads the network address information in the packet header

A router is a computer and networking device that forwards data packets between computer networks, including internetworks such as the global Internet.

Routers perform the "traffic directing" functions on the Internet. A router is connected to two or more data lines from different IP networks. When a data packet comes in on a line, the router reads the network address information in the packet header to determine the ultimate destination. Then, using information in its routing table or routing policy, it directs the packet to the next network on its journey. Data packets are forwarded from one router to another through an internetwork until it reaches its destination node.

The most familiar type of IP routers are home and small office routers that forward IP packets between the home computers and the Internet. More sophisticated routers, such as enterprise routers, connect large business or ISP networks to powerful core routers that forward data at high speed along the optical fiber lines of the Internet backbone.

Routers can be built from standard computer parts but are mostly specialized purpose-built computers. Early routers used software-based forwarding, running on a CPU. More sophisticated devices use application-specific integrated circuits (ASICs) to increase performance or add advanced filtering and firewall functionality.

Telecommunications network

suite (TCP/IP) provide the control and routing of messages across the and IP data network. There are many different network structures that IP can be used

A telecommunications network is a group of nodes interconnected by telecommunications links that are used to exchange messages between the nodes. The links may use a variety of technologies based on the methodologies of circuit switching, message switching, or packet switching, to pass messages and signals.

Multiple nodes may cooperate to pass the message from an originating node to the destination node, via multiple network hops. For this routing function, each node in the network is assigned a network address for identification and locating it on the network. The collection of addresses in the network is called the address space of the network.

Examples of telecommunications networks include computer networks, the Internet, the public switched telephone network (PSTN), the global Telex network, the aeronautical ACARS network, and the wireless radio networks of cell phone telecommunication providers.

IP routing

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IP routing is the application of traffic routing methodologies to IP networks. This involves technologies, protocols, structure, administrations, and policies of the worldwide Internet infrastructure. In each IP network node, IP routing involves the determination of a suitable path for a network packet from a source to its destination. The process uses rules, obtained from either static configuration or dynamically with routing protocols, to select specific packet forwarding methods to direct traffic to the next available intermediate network node one hop closer to the desired final destination. The total path potentially spans multiple computer networks.

Networks are separated from each other by specialized hosts, called gateways or routers with specialized software support optimized for routing. IP forwarding algorithms in most routing software determine a route through a shortest path algorithm. In routers, packets arriving at an interface are examined for source and destination addressing and queued to the appropriate outgoing interface according to their destination address and a set of rules and performance metrics. Rules are encoded in a routing table that contains entries for all interfaces and their connected networks. If no rule satisfies the requirements for a network packet, it is forwarded to a default route. Routing tables are maintained either manually by a network administrator, or updated dynamically by a routing protocol.

A routing protocol specifies how routers communicate and share information about the topology of the network, and the capabilities of each routing node. Different protocols are often used for different topologies or different application areas. For example, the Open Shortest Path First (OSPF) protocol is generally used within an enterprise and the Border Gateway Protocol (BGP) is used on a global scale. BGP is the de facto standard for worldwide Internet routing.

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