

CINF 3331 - Spring 2024
Introduction to Computer Networks
Lecture 1 - Logical & Physical Addressing

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What is a computer network?



Definition

A **computer network** is a set of interconnected computers that communicate with each other to share resources and information. Networks can be classified into different types based on their size and geographic scope, such as Local Area Networks (LANs), Wide Area Networks (WANs), and the Internet.

Network Communication



Computer networks communicate with each other through a set of protocols and standards that define how data is transmitted, received, and interpreted. Devices are expected to be able to find each other and transmit/interpret data, this is possible through several methods of allocating different types addresses which serve special purposes. There are two main address types, logical and physical.

Logical Addresses



Definition

A **logical address** is a network address that is assigned to a device or a network node to identify it uniquely within a network (at a higher-layer).

Purpose

Logical addresses are used for routing and communication purposes at the network layer (Layer 3) of the OSI model. Their purpose is to uniquely identify devices across the internet.

Note:

Logical addresses, such as IP addresses, are assigned by software protocols and can be changed or reconfigured. These addresses can extend beyond the local network and facilitate communication across different networks.

IPv4

"Internet Protocol version 4" addresses are 32-bit integers that have to be expressed in decimal notation. It is represented by 4 (octets) numbers separated by dots in the range of 0-255, which have to be converted to 0 and 1 to be understood by computers. For Example, an IPv4 Address can be written as 189.123.123.90.

Static vs Dynamic IP addresses

IPv4 is more common than IPv6, so we will talk about IPv4 for now. Static IP addresses do not change for the lifetime of a network device, but can be changed (or created) by requesting one from your ISP.

Dynamic IP addresses change but not very often. Most customers are assigned dynamic IP addresses due to their cost, security, and reliability.

DHCP (Dynamic Host Configuration Protocol) is a network management protocol used to dynamically assign an IP address to any device, or node, on a network so it can communicate using IP.



IP Address Example

Watch the following video demonstration at 00:45-2:40, pay attention to how and why IP addresses are used.

Example

How the Internet Works in 5 Minutes by Aaron Titus

https://www.youtube.com/watch?v=7_LPdttKXPc



Physical Addresses



Definition

A physical address, also known as a hardware address or MAC (Media Access Control) address, is a unique identifier assigned to the network interface card (NIC) of a device.

Purpose

Physical addresses are used at the data link layer (Layer 2) of the OSI model to identify devices on a local network. They are used for addressing within a LAN and are typically assigned by the manufacturer.

Network Interface Cards

Some manufacturers provide both wired and wireless MAC addresses. Most of the time they are displayed somewhere on the device.



Note:

MAC addresses are only used to identify a specific device within an immediate network. They are hardware oriented and cannot be modified.

MAC

Network Interface Cards are assigned a 48 bit (6 bytes) address by the vendor which is represented as a 12 digit hexadecimal string. These addresses are usually written as six two-digit hexadecimal number pairs, such as "01:23:45:67:89:AB"

MAC Address Example

Watch the following video demonstration at 1:17-3:30, pay attention to how and why MAC addresses are used.

Example

MAC Address Explained by PowerCert Animated Videos

<https://www.youtube.com/watch?v=TIiQiw7fpsU>



Some differences between physical and logical addresses are:

- physical address (MAC) vs. logical address (IP)
- permanent addresses vs. dynamically changing addresses
- OSI layer 2 (data link) vs. Layer 3 (network) operation
- local identification vs. global identification
- number of bits (48 vs. 32)

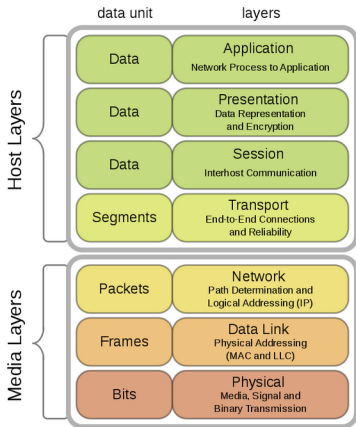
Logical addresses (e.g. IP addresses) are used for network-wide communication and routing decisions (layer 3), while physical addresses (e.g., MAC addresses) are used for direct communication between devices within the same network segment (layer 2).

The Open Systems Interconnection model or OSI is a conceptual model from the International Organization for Standardization (ISO) that "provides a common basis for the coordination of standards development for the purpose of systems interconnection."

Purpose

To standardize data networking protocols to allow communication between all networking devices across the entire planet.

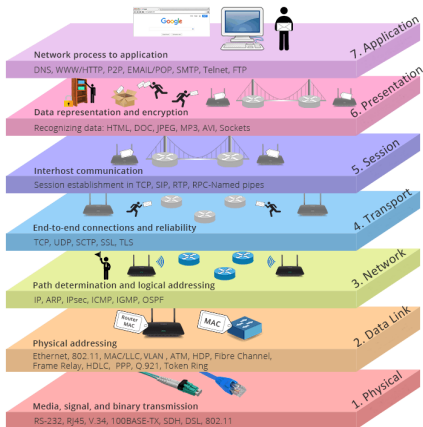
ISO is an independent, non-governmental international organization. It brings global experts together to agree on the best ways of doing things, from making products to managing processes.



In 1984, the International Organization for Standardization (ISO) published the OSI framework to standardize network design and equipment manufacturing principles.

Figure: OSI Model (Open Systems Interconnection Model)

OSI Visualization



The OSI model helps engineers, systems manufacturers, and network professionals conceptualize the layers that computer systems use to communicate over a network; including their uses, protocols, and properties.