Local Area Networks

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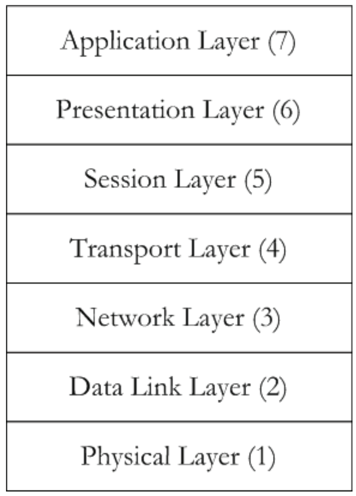
INTRODUCTION

Local area networks (LAN) are extremely popular in both the consumer and enterprise markets. The LAN has become ubiquitous throughout both of these markets as the Internet has grown in size and use, PCs have become readily available at an attractive price point, and high-speed broadband connections have become readily available. Yet, with all the usage of LANs for connecting computer equipment of all types, there is no standard, formal industry accepted definition for a local area network (Comer, 2006, 15). According to the Institute of Electrical and Electronics Engineers (IEEE), a local area network is describes as being "distinguished from other types of data networks in that they are optimized for a moderate-sized geographic area, such as a single office building, a warehouse, or a campus" (2001). Some definitions include a distinction concerning physical proximity (Palmer & Sinclair, 2003, 2), while others provide definitions based on topology, physical medium, or performance characteristics. Vendors, governing/standards bodies, and even network managers have yet their own definition of the exact meaning of what a local area network is and means. These definitions tend to use terminology loosely and allow the end user to determine actual meaning based on context and technologies used. The following discussion will give the reader the foundational information of LANs, including LAN addressing (both MAC and IP addressing), architecture, and protocols.

BACKGROUND

Many discussions of local area networks utilize the Open System Interconnection (OSI) Network Reference Model (Figure 1) to ensure accurate communications between all the parties involved. Discussions of network operations can center on a specific layer, or layers, of the OSI model while providing a common context for all parties involved.

Figure 1. OSI network reference model

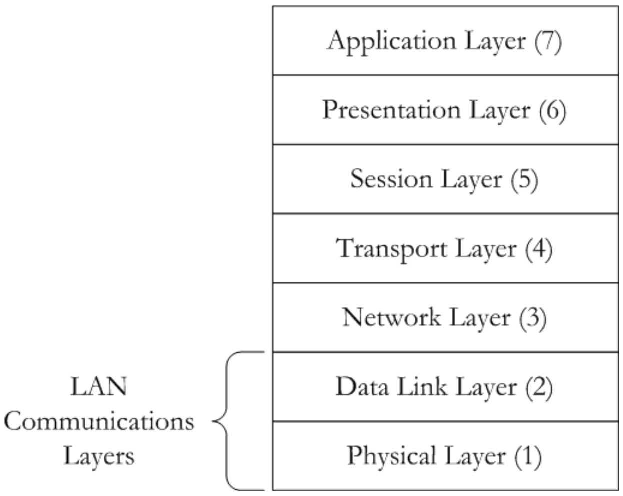


The main benefit of the OSI model is that it provides data communications technology and standards developers a mechanism to discuss the interconnection of two networks or network nodes using a common set of terms and terminology (Goldman & Rawles, 2004, 25). The OSI model describes a layered approach to the necessary functionality required for network communications. Each layer of the OSI model is able to directly communicate with its adjacent layers, with the information passed between each layer being necessary for the successful transmission of data between the source and destination hosts. For example, in a LAN, data is passed down from an application to the Application Layer via the appropriate API. The Application Layer then passes the information to the Presentation Layer through a defined service access point (SAP) after any layer-specific processing has occurred. Each

Figure 2. OSI model vs. TCP/IP model

OSI Model	TCP/IP Model
Application Layer (7)	Application Layer
Presentation Layer (6)	
Session Layer (5)	
Transport Layer (4)	Transport Layer
Network Layer (3)	Internetwork Layer
Data Link Layer (2)	Network Access Layer
Physical Layer (1)	

Figure 3. LAN communication layers of the OSI model



layer has a set of defined SAPs for direct communication with directly adjacent layers. Data for network communication can only be passed between adjacent layers via these defined SAPs.

It should be mentioned that the OSI Network Reference Model is only one of many models that can be utilized to discuss network operations from a layered perspective. It is an extremely popular model, but it is not the only useful model for these discussions. Another highly popular model is the TCP/IP Network Model. Instead of the seven layered approach used by the OSI model, the TCP/IP model uses a four layer approach. A comparison between these two popular network reference models is shown in Figure 2 below.

Strictly speaking, only the physical and data link layers are required for communications between nodes on the LAN. These are the LAN communication layers of the OSI model, as shown in Figure 3 below. The data link layer provides unique addressing for every network node and the physical layer provides the mechanism to construct, maintain, and tear down the necessary communications channel (Goldman & Rawles, 2000, 38). The unique data link layer address is typically tied directly to the physical network interface card on that node. Therefore, the data link layer address is also called the physical address of the node.

In practice, nearly all applications require utilization of the network layer in order to provide network communications, regardless of the locale of the destination node on either a local network segment or remote network segment (Sportack, 1999, 12). In this instance, each network-enabled application requires the knowledge of the network layer address of a specific node, such as a server. The application then relies on the functionality of the LAN protocols to provide the necessary translation from network layer to data link layer addressing, and vice versa. The following discussion will further describe LAN addressing and the correlation between data link layer and network layer addresses.

LOCAL AREA NETWORK ARCHITECTURES

In order to provide node to node communications on a LAN, each node must be uniquely addressed. Without unique addressing for each node, it would be impossible to provide reliable, efficient communications between any two network nodes.

LAN Addressing: MAC and IP. This unique addressing begins at the data link layer of the OSI model, as the physical layer rarely is given a unique address (Comer, 21). By and large, the most popular data link layer addressing scheme is media access control (MAC) layer addressing. A MAC address is tied directly to a specific network interface card, making in the *hardware address*. This hardware address is used to uniquely identify that specific NIC to every other network connected device. MAC addresses are intended to be globally unique through the use of vendor codes, product line