C PROGRAMMING
SOCKET COMMUNICATION

2024

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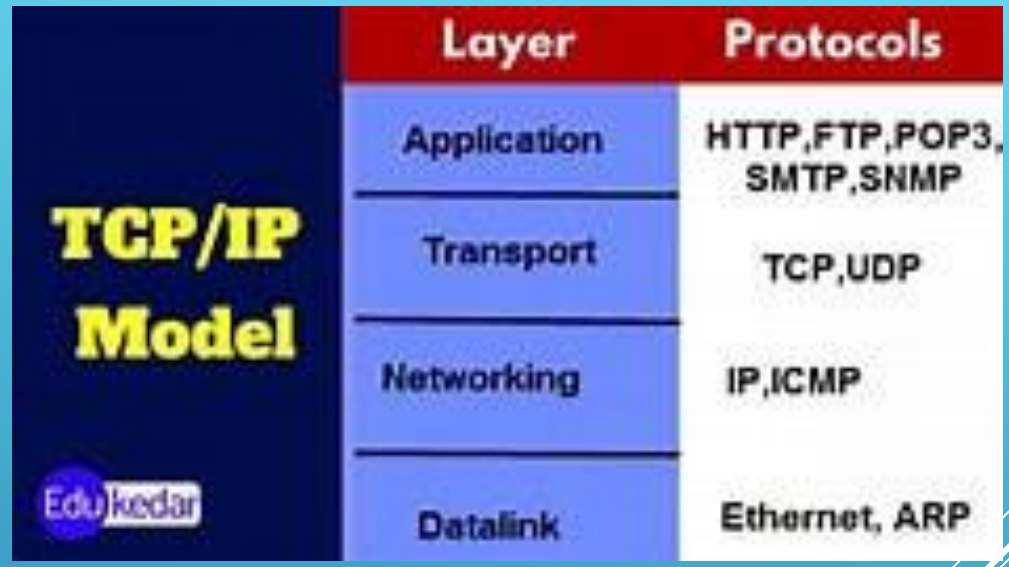
Application Layer: This layer is responsible for providing network services directly to end-users or applications. It includes protocols such as HTTP (Hypertext Transfer Protocol), FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), and DNS (Domain Name System).

Transport Layer: The transport layer is responsible for end-to-end communication between the source and destination hosts. It ensures reliable and orderly delivery of data by handling issues such as flow control, error correction, and congestion control. The most common protocols at this layer are TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).

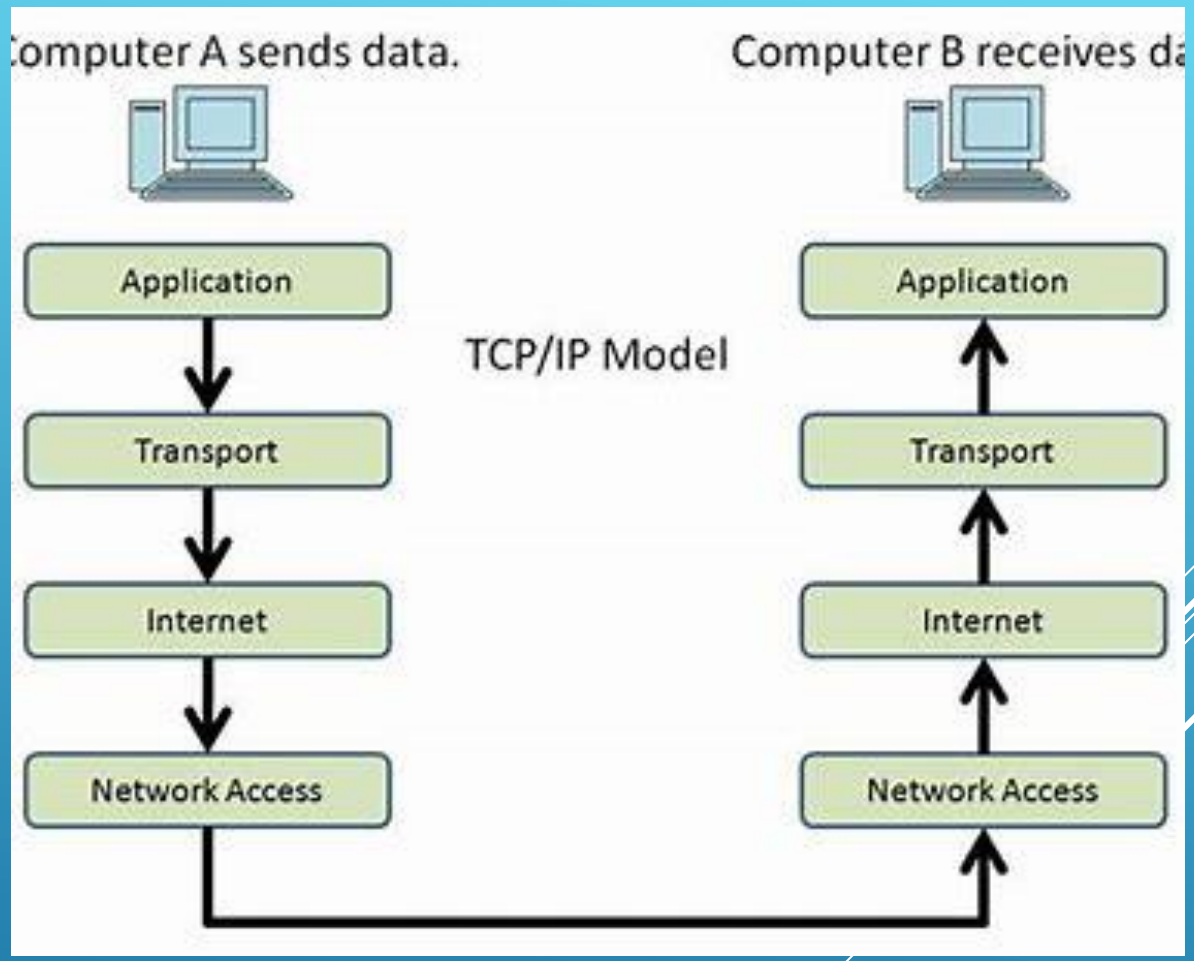
Internet Layer: This layer is responsible for routing packets across different networks to reach their destination. It deals with logical addressing (such as IP addresses) and packet forwarding. The main protocol at this layer is the Internet Protocol (IP).

Link Layer: Also known as the Network Interface Layer or Network Access Layer, this layer deals with the physical transmission of data over the network medium. It includes protocols and standards for connecting devices within the same local network, such as Ethernet, Wi-Fi, and PPP (Point-to-Point Protocol).

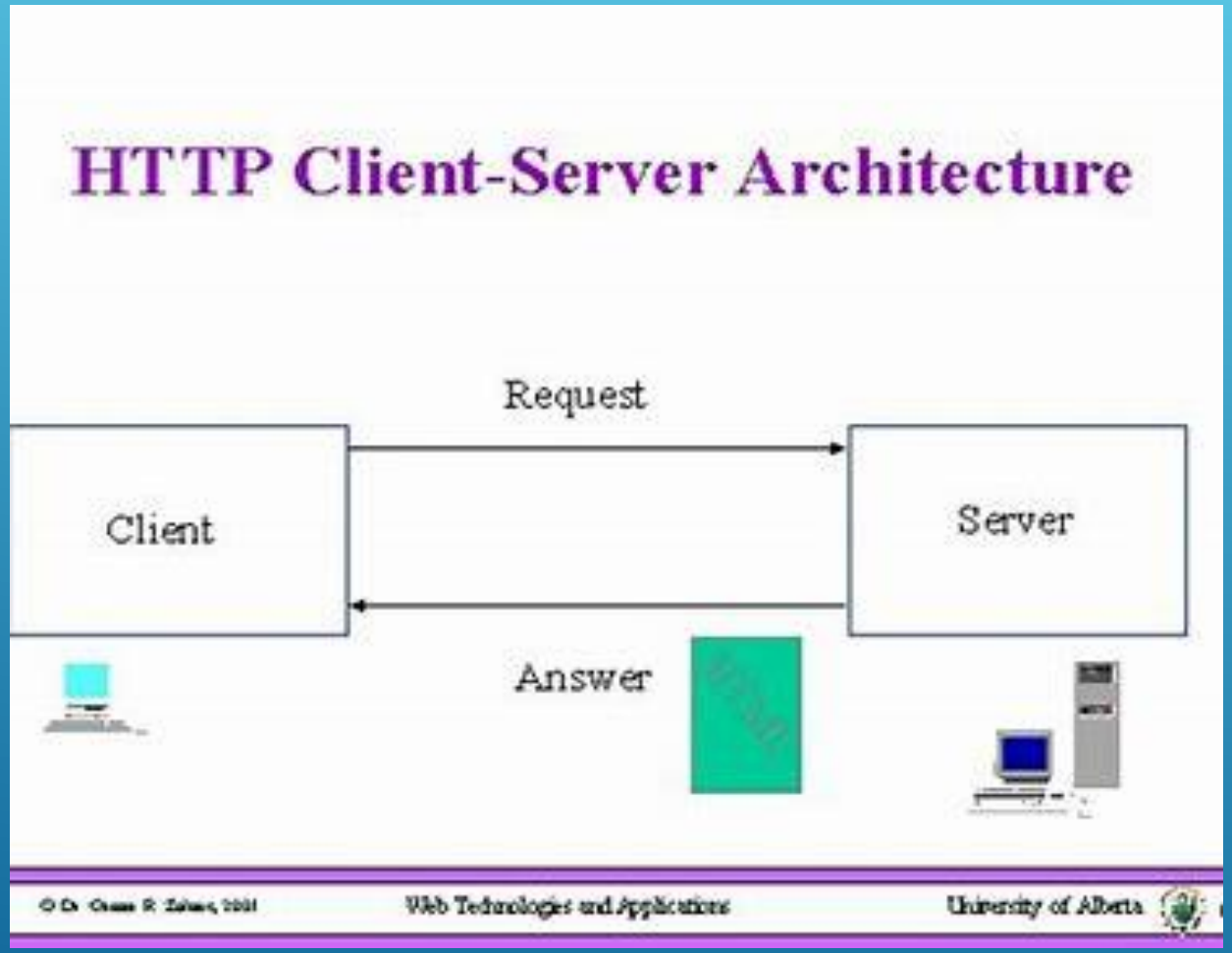


ENCAPSULATION

encapsulation refers to the process of adding protocol headers (and possibly trailers) to data packets as they move down the protocol stack. Each layer of the TCP/IP model adds its own header to the data received from the layer above before passing it down to the next layer. When data is transmitted across a network, each layer of the TCP/IP model encapsulates the data with its own header, creating a packet.



CLIENT SERVER MODEL



CLIENT PROGRAM

```
#include <stdio.h>
#include <winsock2.h>
#pragma comment(lib, "ws2_32.lib")

#define PORT 8080
#define MAX_BUFFER_SIZE 1024

int main() {
    WSADATA wsa;
    SOCKET client_socket;
    struct sockaddr_in server;
    char buffer[MAX_BUFFER_SIZE];

    // Initialize Winsock
    if (WSAStartup(MAKEWORD(2, 2), &wsa) != 0)
    {
      printf("WSAStartup failed.\n");
        return 1;
    }

    // Create socket
    if ((client_socket = socket(AF_INET, SOCK_STREAM, 0)) == INVALID_SOCKET)
    {
        printf("Socket creation failed.\n");
        WSACleanup();
        return 1;
    }

    // Prepare the sockaddr_in structure
    server.sin_family = AF_INET;
    server.sin_addr.s_addr = inet_addr("127.0.0.1");
    server.sin_port = htons(PORT);

    // Connect to server
    if (connect(client_socket, (struct sockaddr*)&server, sizeof(server)) < 0)
    {
        printf("Connection failed.\n");
        closesocket(client_socket);
        WSACleanup();
        return 1;
    }

    // Actual communication
    char message[] = "Hello from client";
    send(client_socket, message, strlen(message), 0);
    printf("Message sent to server: %s\n", message);

    int bytes_received = recv(client_socket, buffer, MAX_BUFFER_SIZE, 0);
    printf("Message from server: %s\n", buffer);

    closesocket(client_socket);
    WSACleanup();
    return 0;
}
```

SERVER PROGRAM

```
#include <stdio.h>
#include <winsock2.h>

#define PORT 8080
#define MAX_BUFFER_SIZE 1024

int main() {
    WSADATA wsa;
    SOCKET server_socket, client_socket;
    struct sockaddr_in server, client;
    int client_len = sizeof(client);
    char buffer[MAX_BUFFER_SIZE];

    // Initialize Winsock
    if (WSAStartup(MAKEWORD(2, 2), &wsa) != 0)
{
        printf("WSAStartup failed.\n");
        return 1;
    }

    // Create socket
    if ((server_socket = socket(AF_INET,
SOCK_STREAM, 0)) == INVALID_SOCKET) {
        printf("Socket creation failed.\n");
        return 1;
    }

    // Prepare the sockaddr_in structure
    server.sin_family = AF_INET;
    server.sin_addr.s_addr = INADDR_ANY;
    server.sin_port = htons(PORT);

    // Bind
    if (bind(server_socket, (struct
sockaddr*)&server, sizeof(server)) == SOCKET_ERROR)
    {
        printf("Bind failed.\n");
        closesocket(server_socket);
        WSACleanup();
        return 1;
    }

    // Listen
    listen(server_socket, 3);

    // Accept an incoming connection
    if ((client_socket = accept(server_socket,
(struct sockaddr*)&client, &client_len)) ==
INVALID_SOCKET)
    {
        printf("Accept failed.\n");
        closesocket(server_socket);
        WSACleanup();
        return 1;
    }

    // Actual communication
    int bytes_received = recv(client_socket,
buffer, MAX_BUFFER_SIZE, 0);
    send(client_socket, buffer, bytes_received, 0);
    printf("Message from client: %s\n", buffer);


    closesocket(server_socket);
    closesocket(client_socket);
    WSACleanup();
    return 0;
}
```

WSAStartup()

- initializing the Winsock library
- Winsock (Windows Sockets)
  - a programming interface and the supporting library
  - handling communication between a client and server applications over a network in the Windows operating system.

SOCK_STREAM

- specify the type of communication protocol
- Stream-oriented communication: This type of communication establishes a virtual connection between two endpoints, providing a continuous and reliable data flow. It ensures that data is delivered in the same order it was sent and without duplication or loss

AF_INET

- specify that we are using the IPv4 address family

struct sockaddr_in

- specify the address and port of the server

bind

- bind the server_socket to the local address and port specified

INADDR_ANY

- bind the socket to all available network interfaces on the machine

htons()

- convert the port number from host byte order to network byte order
  In Windows programming, the byte order of the host machine is typically little-endian, meaning that the least significant byte is stored at the lowest memory address. However, when transmitting data over a network, it's often necessary to convert values like port numbers to network byte order (big-endian) using functions like htons() to ensure compatibility with different systems.