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# DETECTING AND ANALYZING LIMITATIONS OF ETHERNET CABLE CONNECTING MULTIPLE COMPUTER DEVICES IN SERIES.

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## Abstract:
The paper introduces a new concept of connecting multiple devices using a single LAN (Ethernet) cable. The goal is to develop an LMC (Ethernet Multiple Connection) system to simplify and reduce cable costs for internet access. Daily research findings will be documented in an Excel file. To physically connect three or more computers, crossover Ethernet cables should be used, plugged into devices like hubs, switches, or routers. Ethernet is preferred for its reliable, high-speed connection and versatility for expanding networks. The proposed solution aims to reduce costs by connecting multiple networking devices in series using a single Ethernet cable.
**Keywords:** LMC – Lan Multiple Connection, ethernet cable, Multiple connections in series, LAN connection.

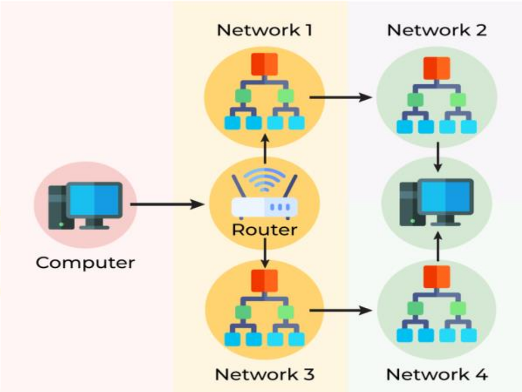
## INTRODUCTION
When connecting three or more PCs using a crossover Ethernet cable, it's important to have a facilitating device for signal transfer. This can be a hub, switch, or router. Traditionally, connecting two computers involves creating a dedicated link using different types of cables such as Ethernet crossover cable, null modem serial cable, parallel peripheral cable, or special-purpose USB cables. The Ethernet method is preferred due to its reliable, high-speed connection with minimal configuration, and it offers a versatile solution for expanding networks to include more than two computers.
If one computer has an Ethernet adapter and the other has only a USB port, you can still use an Ethernet crossover cable by employing a USB-to-Ethernet converter for the USB-only computer. Additionally, to connect multiple computers across various LANs, you can use networking equipment like hubs and switches. This can be achieved economically by connecting multiple networking devices in series with a single Ethernet cable, which reduces the overall cable cost.
**LMC (LAN MULTIPLE CONNECTIONS)**
LMC, which stands for "Lan Multiple Connection," is a network configuration related to Local Area Network (LAN). It utilizes guided media, such as Ethernet, to transmit signals between devices. Guided media provides a physical pathway for signals to travel, including coaxial, fiber-optic, and twisted-pair cables. This type of media is also known as bounded media.
In an LMC setup, Ethernet's design is based on creating a bus structure by connecting multiple computers to a lengthy wire, often referred to as the "ether." Through this setup, LMC allows multiple access to stations connected via a single LAN cable.
In an LMC network, a switch is used to accept responses from the server and then forward them to other devices connected through LMC cables. Data packets are exchanged to link devices in the network, enabling communication among them. The LAN cable is divided into multiple cables by separating the inner wire combinations, effectively multiplying the functionality of a single Ethernet cable.

LMC operates within the first two tiers of the OSI model: the Physical Layer and the Data Link Layer. It utilizes a bus topology for its network configuration.

The maximum transmission speed of an LMC network is up to 100 Mbps, which is the same as that of a normal Ethernet cable. This speed remains consistent over a maximum distance of 100 meters. LMC provides a serial connection, making it less complex in nature.

**NETWORK LAYER**

The network layer, which is the third layer in the OSI model of computer networks, plays a crucial role in transferring network packets from the source to the destination. It is responsible for handling the transfer of data between the source host and the destination host. When a packet is received from the transport layer at the source, the network layer encapsulates it into a datagram before delivering it to the data link layer for further transmission to the receiver. Upon reaching the destination, the datagram is decapsulated, and the packet is extracted and then delivered to the corresponding transport layer.

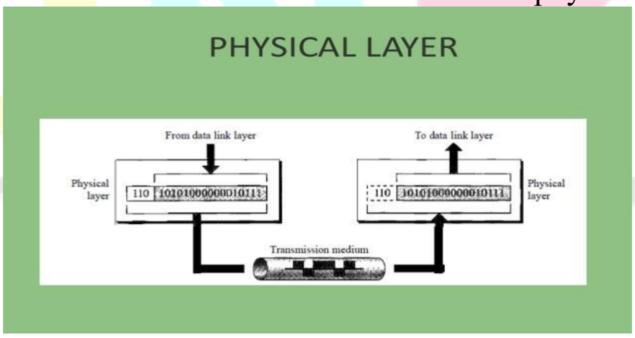



**Features of Network Layer**

- The main responsibility of the Network layer is to transmit data packets from the source to the destination without altering or inspecting them.
- If the packets are too large for delivery, they are fragmented, meaning they are broken down into smaller packets.
- The network layer decides the route the packets will take to travel from the source to the destination among the multiple routes available in a network (also called routing).
- The source and destination addresses are added to the data packets inside the network layer.

**PHYSICAL LAYER**

The physical layer serves as the foundation of the Open System Interconnection (OSI) Model, providing a physical and electrical representation of the system. It encompasses a wide range of network components, including power plugs, connectors, receivers, and various cable types. This layer is responsible for transmitting data bits from one device, such as a computer, to another device. Additionally, the physical layer defines the encoding techniques used to represent 0s and 1s in the signal. It plays a crucial role in facilitating the communication of unstructured raw data streams over a physical medium.




## LITERATURE REVIEWS

**Transport Layer Congestion Control**

Manoj Dahal According to Ref [2] The transport layer plays a crucial role in managing congestion on the Internet. TCP, the most widely used protocol for Internet data transport, relies on congestion control to ensure efficient data transmission. This is achieved through a congestion detection and recovery strategy. The primary objective of TCP is to guarantee the successful delivery of user data to the destination host application process. It accomplishes this through an acknowledgment system, where the recipient notifies the sender with an acknowledgment (ACK) upon receiving a packet free of errors. To keep track of packets awaiting acknowledgments, a timer is associated with each packet sent from the sender's end. If an ACK is not received within the timeout window, the packet is considered lost, and the sender retransmits the missing packets. The round-trip time (RTT) is used to determine the timeout period, which is the time interval between transmitting a packet and receiving its acknowledgment back at the sender's end. To prevent premature termination, the timeout duration is set to be a multiple of times greater than the average RTT. In today's modern world, computer networking systems are fundamental to the concept of the global village. It's challenging to imagine functioning without computer networking, as it underpins various aspects of daily life. Data transmission, involving the transfer of data from one location to another, is a fundamental operation within computer networking systems.

**UTP_CABLES**

According to Sarma Mitamoni Ref [2], The most commonly used type of copper-based cable for networking that currently supports 10G Ethernet is Unshielded Twisted Pair (UTP) cable. This type of cable is widely used in local area network (LAN) technology, primarily due to its affordability, ease of installation, and ability to handle large amounts of data transfer. However, UTP cables have a significant drawback compared to other networking cables, such as coaxial or shielded twisted pair (STP) cables. They are more susceptible to electromagnetic interference (EMI) due to their lack of shielding.

Electromagnetic interference (EMI) is an unwanted occurrence that causes disturbances in the responses of electrical or electronic systems. It is caused by electromagnetic fields present in the environment, which can impair the performance of electronic systems. In today's world, where all electric signals are electromagnetic waves, the impact of EMI has become a crucial consideration in the design of electronic systems.

Various everyday devices and equipment, such as lighting fixtures, electric hand drills, transceiver sets, fluorescent lights, microwave ovens, generators, elevator motors, and medical devices, can act as sources of electromagnetic interference. To mitigate the effects of EMI, most electronic equipment is equipped with EMI filters at the front end of their power supplies to prevent interference or noise from being carried through power lines. However, there is still a risk of noise entering the system through data wires or metal enclosures.

UTP cables are particularly vulnerable to electromagnetic interference, especially when they are not properly grounded or are installed in close proximity to EMI sources. Without proper shielding, the cables can be affected by EMI, leading to potential disruptions in data transmission and even causing communication systems to shut down.

In contrast, shielded cables are designed to protect signals being transmitted over them from strong electromagnetic interference sources. This shielding helps to safeguard the integrity of the transmitted signals and reduce the impact of EMI on the communication system.

**Control Mechanism For Internet Environment**

According to Revathi Ref [3], This thesis investigates congestion control techniques for enhancing Quality-of-Service (QoS) in the Internet, focusing on throughput, delay, and packet drop rates. Congestion can be managed at the end-to-end system, the router, or both. The study covers five main topics:

1. **Active Queue Management (AQM) Schemes**: These schemes improve congestion control. The design and implementation of fuzzy logic-enabled packet drop functions are explored.
2. **Differentiated Services Networks**: The impact of fuzzy logic-based drop schemes on these networks is analyzed to cater to the specific QoS requirements of various traffic flows.
3. **Adaptive Virtual Queue with Fuzzy Logic**: Integrating fuzzy logic into queue parameters is proposed and shown to effectively control congestion in network bottlenecks through extensive simulations.
4. **Explicit Congestion Notification (ECN)**: The study examines AQM schemes with and without ECN to inform traffic sources about congestion, allowing them to adjust their traffic accordingly.
5. **Wireless and Wired Networks**: Differentiating between congestion and wireless losses in biased queue management schemes is discussed to prevent performance degradation due to misinterpretation of wireless losses as congestion losses.

The thesis also addresses the fairness/efficiency tradeoff, proposing an improvement to the Linear Increase Multiplicative Decrease (LIMD) algorithm, which enhances both efficiency and fairness in bandwidth utilization.

In the context of increasing Internet traffic and the rise of self-similarity and long-range dependency in network traffic, efficient congestion control mechanisms are essential. These mechanisms need to handle both naturally occurring and maliciously induced congestion. The study highlights the challenges posed by wireless networks, especially with the widespread use of IEEE 802.11 standards and the advent of WiMax, which exacerbate congestion due to lower bandwidth and higher packet loss rates compared to wired networks. The research aims to develop a novel fuzzy logic-based AQM scheme to better manage congestion in such heterogeneous network environments.

# METHODOLOGY

A Local Area Network (LAN) is a data communication network that connects multiple terminals or computers within a building or a limited geographical area. The connection among the devices can be either wired or wireless. Examples of standard LAN technologies include Ethernet, Token Ring, and Wireless LAN using IEEE 802.11.

**ETHERNET**

Ethernet stands as the most commonly utilized LAN technology, defined under IEEE standards 802.3. Its widespread use is attributed to its simplicity in comprehension, implementation, and maintenance, as well as its cost-effectiveness for network deployment. Additionally, Ethernet offers flexibility in terms of allowable topologies, with a preference for Bus Topology. Operating within the Physical Layer and Data Link Layer of the OSI model, Ethernet utilizes frames as its protocol data unit due to its focus on the Data Link Layer. To manage collisions, Ethernet employs the CSMA/CD access control mechanism. Furthermore, Ethernet utilizes the Manchester Encoding Technique.

**Key features of Ethernet –**

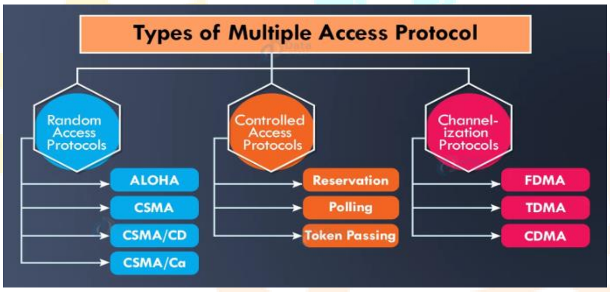
- **Speed:** Ethernet is capable of transmitting data at high speeds, with current Ethernet standards supporting speeds of up to 100 Gbps.
- **Flexibility:** Ethernet is a flexible technology that can be used with a wide range of devices and operating systems. It can also be easily scaled to accommodate a growing number of users and devices.
- **Reliability:** Ethernet is a reliable technology that uses error-correction techniques to ensure that data is transmitted accurately and efficiently.
- **Cost-effectiveness:** Ethernet is a cost-effective technology that is widely available and easy to implement. It is also relatively low-maintenance, requiring minimal ongoing support.
- **Interoperability:** Ethernet is an interoperable technology that allows devices from different manufacturers to communicate with each other seamlessly.
- **Security:** Ethernet includes built-in security features, including encryption and authentication, to protect data from unauthorized access.
- **Manageability:** Ethernet networks are easily managed, with various tools available to help network administrators monitor and control network traffic.
- **Compatibility:** Ethernet is compatible with a wide range of other networking technologies, making it easy to integrate with other systems and devices.
- **Scalability:** Ethernet is highly scalable, which means it can easily accommodate the addition of new devices, users, and applications without sacrificing performance or reliability.

**GENERAL METHOD FOR MAKING ETHERNET CABLE**

- Unroll the required length of network cable and add a little extra wire
- Carefully remove the outer jacket of the cable
- Inspect the newly revealed wires for any cuts or scrapes that expose the copper wire inside
- Untwist the pairs so they will lay flat between your fingers.
- Arrange the wires based on the wiring specifications

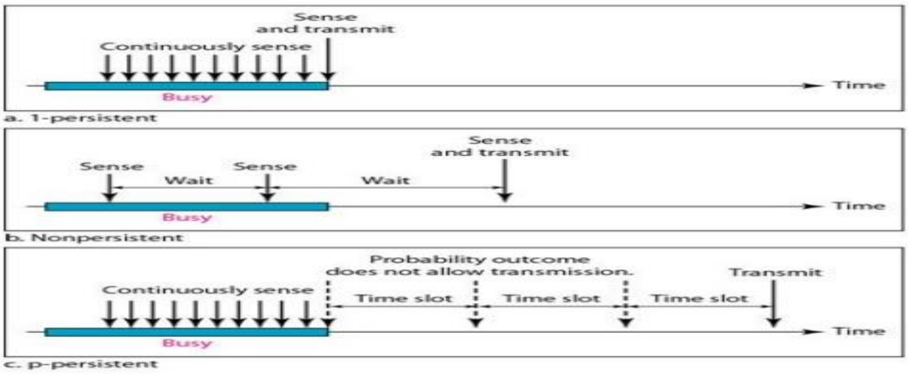
# TECHNIQUES / ALGORITHMS

When a sender and receiver have a dedicated link to transmit data packets, the data link control is sufficient to manage the channel. However, if there is no dedicated path for communication or data transfer between two devices, multiple stations may need to access the channel and simultaneously transmit data, which can lead to collisions and crosstalk. To address this, a multiple access protocol is required to reduce collisions and prevent crosstalk among the channels. One of the early multiple access protocols is ALOHA, which allows all terminals to access a medium without interfering with each other. ALOHA operates at the data-link layer and was later improved by Roberts in 1972 to double its capacity. Another important multiple access protocol is Carrier Sense Multiple Access (CSMA), which operates in the Medium Access Control layer. CSMA involves sensing whether the shared transmission channel is busy and transmitting data only when the channel is not in use. This protocol allows multiple users or nodes to send and receive data through a shared medium, such as a single cable, optical fiber, or a portion of the wireless spectrum. In the context of early Ethernet technology and LANs with a shared bus topology, Carrier Sense Multiple Access/Collision Detection (CSMA/CD) was widely used. However, with the evolution of Ethernet to full duplex and the adoption of star or point-to-point topologies, CSMA/CD is no longer commonly used, although it is still supported. Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA) is a protocol designed for carrier transmission in 802.11 networks. It requires each station to check the state of the medium before initiating a transmission, helping to minimize potential collisions by allowing stations to transmit when the channel is free. In reservation-based protocols, such as Reservation, the reservation interval is divided into slots, with each station having its own slot to announce its intention to transmit. Polling involves a primary station (controller) sending messages to secondary stations in turn, similar to a roll-call, to manage data exchanges. In token passing, stations are logically connected in a ring or bus, and access to stations is governed by the circulation of a token, which is passed from one station to the next in a predefined order.




## DATA DESCRIPTION

The protocol in question is referred to as a carrier sense multiple access/collision avoidance (CSMA/CA) network protocol. Its primary function is to facilitate the transmission of data frames over a carrier. This protocol operates at the medium access control layer. When a data frame is transmitted to the channel, the sender awaits an acknowledgment to confirm the channel's availability. If the station receives only its own acknowledgment, this signifies the successful transmission of the data frame to the intended receiver. However, if the station receives two signals - one from its own transmission and another from a collision of frames - it indicates that a collision has occurred in the shared channel. The collision is detected by the sender upon receiving the acknowledgment signal.




## OBJECTIVES OF WORK

In order to mitigate such issues, we are exploring a method that enables multiple computer devices to be linked together using just a single connection.

- Our project aims to simplify and reduce the cost of cables used for connecting devices to the internet.
- We are working on developing an LMC (Ethernet several Connection) connection, which will provide internet access to multiple devices using a single Ethernet cable.
- We have been conducting tests on various LAN configurations by trimming, crimping, and testing connections.

- The design is based on a bus topology, making it easy to install and understand, and allowing for easy experimentation. This simple architecture also reduces the complexity of the devices involved.

**CONCLUSION**

The research and development of the LAN Multiple Connection (LMC) system propose a novel approach to simplifying network setups and reducing cable costs by leveraging the strengths of Ethernet technology. The LMC system aims to connect multiple devices using a single Ethernet cable, thereby streamlining network infrastructure and minimizing expenses. The use of crossover Ethernet cables, hubs, switches, and routers in this configuration enhances the feasibility and practicality of the system, offering a reliable, high-speed, and versatile solution for network expansion.

Ethernet, due to its inherent advantages such as high-speed data transmission, reliability, and flexibility, serves as the backbone of the LMC system. By adopting a bus topology, the LMC system ensures a straightforward and cost-effective setup, making it accessible for various applications ranging from small office networks to larger institutional setups.

The implementation of the LMC system within the first two layers of the OSI model—Physical and Data Link layers—leverages the principles of guided media and bus structure to facilitate multiple connections through a single cable. This method not only maintains the standard transmission speed of up to 100 Mbps but also ensures a maximum transmission distance of 100 meters, consistent with traditional Ethernet capabilities.

The primary goal of the LMC system is to reduce the complexity and cost associated with network cabling by enabling serial connections of multiple devices. This approach is particularly beneficial in scenarios where cable management and cost are significant concerns. Additionally, the use of techniques such as crimping and trimming in the setup process highlights the practical and hands-on nature of the LMC system, making it easy to install and maintain.

Future work will focus on refining the LMC system to further enhance its performance, scalability, and security. Potential areas of improvement include exploring advanced routing protocols, enhancing data encryption methods, and integrating more robust error-detection and correction mechanisms. Moreover, comprehensive testing in diverse environments will help in identifying and addressing any potential limitations, ensuring the LMC system's adaptability to various network requirements.

In conclusion, the LMC system presents a promising solution for reducing network cable costs and simplifying network configurations. By harnessing the strengths of Ethernet technology and innovative network design, the LMC system can significantly benefit both small-scale and large-scale network deployments, making it a valuable addition to the field of networking technology.

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