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Performance Investigation of Fiber Distributed Data Interface in Networking

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Abstract: The extent of the ring, the number of stations on the ring, the number of stations waiting to communicate, and the frame size are all setup and workload characteristics that affect the performance of an FDDI LAN. In addition, the target token rotation time is a significant parameter that network management may regulate to optimise performance (TTRT). The influence of the TTRT on various performance indicators for different ring topologies was investigated using analytical modelling and simulation approaches. The performance of the FDDI network is the topic of this research. The functionality of the FDDI network was then assessed in terms of efficiency, reaction time, and network cost using various values of ring latency, fixed target token rotation time (TTRT), and number of stations. The entire project is done in MATLAB.
Keywords: FDDI LAN, TTRT, Interface, Networking, MATLAB

I. INTRODUCTION

The Fiber Distributed Data Interface (FDDI) is a data transfer standard for local area networks (LAN). A ring-based token network is the logical topology. FDDI adheres to the Open Systems Interconnection (OSI) concept of functional stacking of LANs utilising various protocols [12] as a result of the American National Standards Institute X3T9.5 (now X3T12). FDDI supports thousands of users on a LAN. It also enables for real-time network capacity allocation and the utilisation of a diverse range of traffic kinds. There are two data transmission pathways in an FDDI network. The major path is one, while the secondary way is the other. As a result, it's known as a twin ring network.. If the primary ring fails due to a fault, the secondary ring is utilised to transmit data. The primary ring has a data transmission capacity of 100 Mbits/s, however it may be increased to 200 Mbits/s if the secondary ring is not in operation. FDDI frames are also bigger than regular Ethernet frames, allowing for higher throughput. The IEEE802.4 token bus timed token protocol is the basis for the FDDI. FDDI is meant to function over fibre and may be implemented as a faster version of a token ring. The token ring's primary idea is that communication ring access is limited to one modem at a time. A single message from a single modem is sent at a time. The data from the ring is then deleted by the modem, and control (the token) is given to the next modem after the message has completed its journey around the ring. The transmission medium for this network is optical fibre. The fibre is constructed of glass and is thus less expensive than other transmission media such as coaxial cables.

The performance analysis of the FDDI network is the focus of this research. Then, using various values of ring latency, fixed target token rotation time (TTRT), and number of stations, the performance of the FDDI network was evaluated in terms of efficiency, reaction time, and network cost. MATLAB is used for the entire project.

II. LITERATURE REVIEW

The Terra Link laser communication (laser-com) system was created by Isaac I. Kim et al. [1] as a high-bandwidth, cost-effective, wireless alternative to fibre optic transmission. One of the key advantages of laser-com over fibre optic is that it is more cost effective. They claim that open space laser-com is affected by atmospheric phenomena such as scintillation and attenuation, which cause issues such as reduced link availability and burst error not found in fibre transmission. To decrease the effects of scintillation, the Terra Link transceivers employ methods such as multiple transmit beams. A bit error rate (BER) of 1029 can be attained by instituting laser-com. The Terra Link transceivers' range is limited since they were intended to be eye-safe at the broadcast aperture. Link power budgets and link margin statistics for the Terra Link systems were published, which quantitatively characterise how the efficient laser link range fluctuates in various weather situations.

Pek-Hooi Sohet [2] looked on how the emergence of complex technology and innovator networks effect the development of new ideas. They established hypotheses to study the stability and transformation of networks punctuated by consecutive technological developments, based on theories of technological evolution and socio-organizational dynamics. They suggested that in complicated technology contexts, incumbents who are early proponents of standards are more likely to survive through partnerships. They found support for their arguments based on 150 enterprises and 319 partnerships in the US data communications sector from 1985 to 1996, and the features of central-periphery structure best match the patterns of industry networks..

III. OBJECTIVES

Any communications network's objective is to transport data (information) from one connected device, referred to as a node, to another node in the network. Any network's performance may be divided into four categories. Throughput, reaction time, data dependability, and network cost are all factors to consider. Keeping the above categories in mind, the following goals have been set:

1) To look at Distributed Fiber Data Interface Networks.
2) To investigate the performance of Fiber Distributed Data Interface Networks in terms of efficiency, reaction time, and network cost.
3) To improve the efficiency of Fiber Distributed Data Interface Networks.

IV. METHODOLOGY

The copper cable can only deliver 100 Mbps of bandwidth over a 1 km distance before signal regeneration is necessary. In contrast, wavelength division multiplexing (WDM) technology is employed by an optical fibre to accommodate a number of wavelength channels [3], each of which may sustain a transmission rate of 10 Gbps. Long-Reach WDM transmitters and receivers can send high-quality optical signals across distances of several tens of kilometres without signal regeneration. As a result, optical fibre can readily provide tens of TBPS (109) of bandwidth. Because fibre is constructed of glass, it is less expensive than other traditional data transmission such as coaxial cable, while having a higher bandwidth.[4]. Glass fibre also provides low attenuation. Another benefit of fibre is that it is unaffected by electromagnetic interference or power outages. Fiber is thin and light, making it simple to install.

Fiber optic cables can be used to replace copper-based power grid. WDM is a paralleled transmission system with non-overlapping wavelength channels that is used in fibre infrastructure to make use of fibre bandwidth [5]. A single optical transmission system is made up of three parts:

1) The optical transmitter
2) The transmission medium
3) The optical receiver

The transmitter employs the '1' bit to indicate a light pulse and the '0' bit to indicate the lack of light. Once the light is detected, the receiver generates an electrical pulse. The fibre employs single mode propagation, which requires light to flow in a straight path along the fiber's core. The single mode fibre is utilised for long-distance transmission because it delivers excellent quality of signal. When a light ray enters a fibre at a specific angle, it may pass through multiple reflections[6]. A fibre with this quality is known as multimode fiber. In an optical network, which might be a local access network (LAN), a metropolitan local exchange network (MAN), or a wide area network, fundamental optical transmission is employed (WAN)

Optical fibre, which is bigger than any other communication medium, provides an amazing bandwidth. A single fibre thread may provide a total bandwidth of 25000 GHz. In light of fiber's enormous potential, it's important to remember that the entire bandwidth of radio on Earth is less than 25 GHz. An optical fibre has other benefits, such as reduced attenuation loss, in addition to its large bandwidth. The high-speed optical networks are building by using fibre links to interconnect geographically distributed nodes. The next sections show how these nodes are related.

A. Optical Point-to-Point Links

Optical fibre has a tremendous network capacity prospect, because everybody fully understands. As a result, it is utilised to construct a high-speed network employing fibre cables to connect numerous nodes that are dispersed across a large region. Optical networks have been around for quite some time [7]. In the beginning the optical fibre was mainly used to study and build point-to-point transmission system. As shown in Figure 1, a single-hop connection between two nodes is provided by an optical point-to-point link without any intermediate node in between. It is also viewed as a beginning of optical network. Two different sites are interconnected by optical point-to-point links for data reception and transmission. The electrical signal is transformed into an optical signal at the transmission side before delivering data across the optical cable (EO conversion). The incoming optical signal is converted back into an electrical signal at the receiving end (OE conversion). For electronic processing and storage, this OE conversion is required [8]..

Multiple optical single-hop point-to-point links can be used in a network to connect more than two nodes, resulting in a variety of network topologies (e.g. star and ring). Figure2 depicts a star coupler that can be used to combine multiple optical point-to-point links to create an optical single-hop star network. The star coupler is primarily an optical component.

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The star coupler's main function is to combine all incoming optical signals and distribute them evenly among all output ports. An optical signal arriving at any input port is forwarded to all output ports without any EO or OE conversion in the star coupler. EO conversion is performed on the sending side, just as it is on the receiving side, in optical point-to-point communications.[9]
As illustrated in Figure 2.1, an optical ring network may be created by joining each pair of neighbouring ring nodes with a distinct optical single-hop point-to-point fibre link (c). Each node in an optical ring network performs OE transition for incoming signals and EO conversion for outgoing signals. OEO conversion refers to the combination of OE and EO. The Fiber Distributed Data Interface (FDDI) standard, which can be used by today's optical transportation system, is a good example of this type of network with OEO conversion at each node.[10]

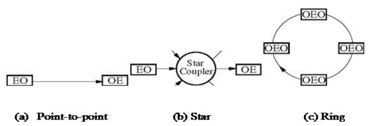

Figure 1Optical single-hop connections: (a) point-to-point, (b) star, and (c) ring configurations [37

As a result, fibre optic system enables the most realistic solution for use in such a network. Any fixed network, whether radio, copper, or fibre, has one disadvantage over a wireless network. In the "star topology" setup, running a separate fibre from the central controller to each node in the field is expensive. To overcome the disadvantage of central device, a linear bus topology is used. Information from the master node is communicated to the remote node closest to it in the bus topology, and then it is retransmitted downwards to the next remote node further down the line until the chain ends. Information is moved upstream in the same manner from the remote node.[11]
However, there are certain issues with the linear bus; for example, if power is lost at one of the intermediate nodes, the remote nodes are unable to communicate with the master node. Similarly, if a cable breaks in the middle of a bus, there is no communication between the remote nodes and the master node. A battery is added to each node to provide backup in order to overcome this problem, however this is costly and requires maintenance. Fiber Distributed Data Interface is another viable answer to this issue.
FDDI (Fiber Consolidated Data Interface) is a fiber optics transport standard [12]. It is utilised in a local area network and has a data transmission rate of 100 Mbits/s over a distance of 200 kilometers. As a logical architecture, FDDI uses a bracelet token net, and its protocol is based on the IEEE 802.4 token bus timed token protocol. FDDI supports thousands of individuals on a LAN. It also offers real-time allotment of network capacity and permits the usage of vast variety of different forms of traffic. It employs optical fibre as the main measure, but it may also use copper; when copper is used as a channel, it is referred to as Copper Distributed Data Interface (CDDI). Dual-Attached Stations are supported by FDDI.

B. Topology and Reliability

As is well known, FDDI's baseline architecture is based on a twin counter rotating ring, commonly known as the trunk ring. In most cases, one ring is utilised for data transmission, and if one ring fails, the second ring is used as a backup. This strategy also improves the network's dependability [13]. As a result, FDDI standards do not employ a single ring. Wrap mode is the process of isolating any failing ring with the support of surviving ring into a single local ring when a connection or a station breaks, causing the network to automatically reorganise. When a failed segment is continually monitored, the network may be automatically reconfigured and the network can be returned to normal operation.. No MAC layer is required for reconfigure; it takes place just on the Physical Layer. As a result, only the nodes covering the network are aware that it is wrapped; other nodes may be unaware of this.
The capacity to dynamically adjust the topology of FDDI is its unique feature. It has enticing implications for accessibility. Both rings can be used to convey data; while a network is wrapped, certain MACs may be able to reach other MAC entities provisionally, but when the network is unwrapped, the MACs are separated again. The FDDI topology's dynamic nature would have no bearing; If just the primary ring was allowed to use MACs (no dual-MAC stations, nor single-MAC stations on the secondary ring)

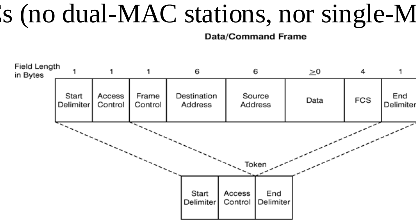

Figure 2 FDDI Frame Format [9]

If a node or connection breaks in either situation, the two rings are wrapped into a single ring that is about twice as long, retaining complete connectivity. The dual ring with hold policy is a lovely concept that helps to fix a lot of flaws. Only when neither ring is active are the rings now wrapped. The two MACs are necessary for checking the operational condition of each ring, not for ensuring dual ring compatibility. In contrast to conventional FDDI station handling, the absence of a second MAC may provide a resolution. Repeated faults at distinct rings lead the smaller rings to be independent. To preserve a unique full ring, it would be necessary to meet both rings. This requires changing the rotation direction of some links, which can only be accomplished with slow optical switches and a more complicated configuration management system. The FDDI standards, on the other hand, provide for a broad range of topologies, and limiting the current options in this way may prevent potentially useful applications. As a result, the negative effects of FDDI's dynamic nature must be taken into account.

V. SYSTEM ARCHITECTURE

A concise statement of a network's purpose may give insight before specifying network performance metrics. Any communications network's objective is to transport data (information) from one connected device, referred to as a node, to another node in the network. There are four primary categories in which performance may be categorised. Throughput, reaction time, data dependability, and network cost are all factors to consider.

A. Throughput

In general, a network's throughput is defined as the rate at which one node sends data to another node in the network [36]. Any network's throughput may be measured in megabytes. Normally, the highest data rate attainable between the two nodes is equal to the throughput limit. If traffic is encrypted for error detection, the network's throughput will be lowered since the encryption of data adds extra information to the data, which takes up space, reducing the amount of real data that can be sent over the network. If 4B/5B compression algorithm is used, for example, the network's transmission rate will be reduced to 80% for the high data rate.
The additional info needed by the network lowered the network's throughput. In the SONET network, for example, a frame of 810 bytes includes only 774 bytes of real data. The network's throughput is reduced by around 5% as a result of this expense.
Unlike the token access protocol of IEEE 802.5, the timed token access protocol is used by FDDI that allow both asynchronous and synchronous traffic simultaneously. The time between successive transmission opportunities called maximum access delay, is bounded for both asynchronous and synchronous traffic. While for the synchronous traffic the maximum access delay is short, that can be long depending upon network configuration and load for asynchronous traffic. Under the controlled conditions, the access delay can be as long as 165 seconds. This means that the station may not get usable token for 165 seconds that wanting to transmit asynchronous traffic. This is very long access delay and not allowed. This access delay can be avoided by using proper setting of the network configurations and parameters. One such parameter was Target Token Rotation Time (TTRT). On various performance metrics the effect of this parameter is investigated and developed a proper guideline for setting its value. To study the effect of TTRT on various performance metrics two models such as a simple analytical model and an emulation model were studied.
A number of responsiveness metrics have been considered in the literature. Some of the familiar ones are:

1) *Propagation Delay:* The time required for abit to travel from the source to the destination station. This is determined by the location of the source and the destination stations on the ring.
2) *Access Delay:* The time between the end of the previous transmission and the beginning of a new transmission.
3) *Queuing Time:* The time between the arrival of the frame and the end of previous transmission.
4) *Transmission Time:* The time between the transmission of the first bit and the last bit. This time is determined entirely by the frame size.
5) *Transfer Delay:* The time between the arrival of the frame and the reception of its last bit at the destination.
6) *Response Time:* The time between the arrival of the frame and the completion of its transmission

A basic analytical model of FDDI will now be explained, using which the efficiency and access latency of FDDI will be computed. Because these measurements are only useful when the FDDI is heavily loaded, it is assumed that there are n active units, each with enough frames to maintain the FDDI fully stocked. The efficiency and greatest access delay for an FDDI network with a ring latency of D and a TTRT value of T may be calculated using equations I and (ii) (ii)
First, assume a ring with three active stations, as illustrated in Figure 3. Following that, the general situation with n active stations will be studied. The graphic depicts the space-time diagram, which depicts numerous occurrences on the ring. The space is presented horizontally, and the time is shown vertically. The token is shown by the thick horizontal line. The thick line on the time axis indicates frame transmission.

Ring latency: The time it takes for a signal to travel once around the ring is known as ring latency. At the data transmission rate, ring delay can be plotted against time or bits.

$$RL = d/v + (N*b)/B \quad (B – \text{bandwidth})$$

Where
d = length of the ring
v = velocity of data in ring
N = no. of stations in ring
b = time taken by each station to hold the bit before transmitting it (bit delay)
We can increase or decrease ring latency by increasing or decreasing any of the above parameters that includes signal propagation delays in the ring medium, the drop cables, and the data stations
Assume that all of the stations are idle until t = D, when three stations get a huge burst of frames to transmit. The following is a timeline of what is happening.

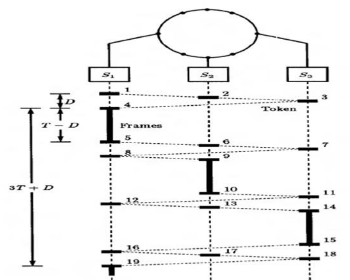

Figure 3 : Space-time diagram of events with three active stations on an FDDI network. The numbers refer to the event numbers in the text [36].

$t = 0$: Station S_1 receives the token and resets its Token Rotation Timer (TRT). Since it has nothing to transmit, the token proceeds to the next station.
$t = t_{12}$: Station S_2 receives the token and resets its TRT. Here t_{12} is the signal propagation delay from stations S_1 to S_2.
$t = t_{13}$: Station S3 receives the token and resets its TRT. Here t_{13} is the signal propagation delay from stations S_1 to S_3.
$t = D$: Station S_1 receives the token. Since it now has an infinite supply of frames to transmit, it captures the token and determines that the TRT (time elapsed since the last time it received the token) is D, and so it can hold the token for the $TTRT - TRT = T - D$ interval.
$t = T$: Token Holding Timer (THT) at station S_1 expires. S_1 releases the token.
$t = T + t_{12}$. Station S_2 receives the token. It last received the token at $t = t_{12}$. The time elapsed since then (and hence its TRT) is T. The station finds that the token is unusable at this time and lets it go.
$t = T + t_{13}$: Station S_3 receives the token. It last received the token at $t = t_{13}$ and so its TRT is also T. It finds the token unusable and lets it go.
$t = T + D$: Station S_1 receives the token. It last received the token at $t = D$ and so its TRT is T. It finds the token unusable and lets it go.
$t = T + D + t_{12}$: Station S_2 receives the token. Since TRT is only D, it sets the THT to the remaining time, namely, $T – D$. It transmits for that interval and releases the token at $t = T + D + t_{12} + (T - D)$.
$t = 2T + t_{13}$: Station S_3 receives the token. Since TRT is T, it lets the token go.
$t = 2T + D$: Station S_1 receives the token. Since TRT is T, it lets the token go.
$t = 2T + D + t_{12}$: Station S_2 receives the token. Since TRT is T, it lets the token go.
$t = 2T + D + t_{13}$: Station S_3 receives the token. Since TRT is only D, it transmits for $T – D$ and releases the token at$t = 2T + D + t_{13} + (T - D)$.The token passes through stations S_1, S_2, and S_3,all of which find it unusable. (Events 14, 15 and16.)
Station S1 catches the token at t=3T+2D, and the sequence of events begins again with event 4 above.
From the preceding description, it is clear that the system goes through a cycle of occurrences, and that one cycle takes 3T + D of time to complete. The three stations transmit for T – D intervals during each cycle. As a result, 3(T – D) is the total transmission time of three stations. During this time, 3(T - D) x 108 bits are transferred, and the throughput is 3(T - D) x 108/ (3T + D) bits per second. The efficiency (throughput to bandwidth ratio) is 3(T - D) / (3T - D).

During each cycle, the maximum access delay for each station will be defined. Each station waits for an interval of 2T + 2D after releasing the token. When the load is lower, the access delay will also be lower. Therefore, for a ring with three active stations, the efficiency an access delay for each station is

$$\text{Efficiency; } \eta = \frac{3(T-D)}{3T+D}$$

Maximum access delay; $MAD = (3-1)T + 2D$

The above equation can be generalized to *n* active stations by replacing 3 by *n*.

$$\text{Efficiency; } \eta = \frac{n(T-D)}{nT+D} \qquad \text{(i)}$$

$$\text{Maximum access delay; } MAD = (n-1)T + 2D \qquad \text{(ii)}$$

Equations (i) and (ii) constitute the analytical model; these equations can be used to compute the Maximum access delay and Efficiency of FDDI systems.

In addition to this the efficiency of network is increased by decreasing the value of D. As the value of D decreased the efficiency of FDDI network will be increased.

B. Response Time

The time in between arrival of a frame and thus the finishing of its transmission, also known as the round-trip time, is the reaction time of a data network (RTT). The response time may also be defined as the time it takes to transport data from one node in a network to another node and back to the original node. This lag, also known as latency, is made up of three parts. (1) the delay in propagation, (2) the delay in transmission, and (3) the queue [36].

The propagation delay is given by equation (iii) as

$$Pr = {}^{d}/_{c} \qquad \text{(iii)}$$

Where: Pr= Propagation Time

d= Distance

c= Group velocity in the transmission medium

The transmission delay is given by equation (iv):

$$Td = {}^{S}/_{B} \qquad \text{(iv)}$$

Where: Td= Transmission Delay

S = Number of bits Transmitted

B= Data Rate (Bandwidth)

Group Velocity: The group velocity of a wave is the velocity with which the overall shape of the waves' amplitudes, known as the envelope of the wave, propagates.

$$c = dw/dk$$

Where w is the angular velocity and k is the wave number.

We can alter the group velocity by increasing the angular velocity of the propagation.

The time it takes each node to decide how to process the packet it receives is referred to as queue delay. The length of this delay varies substantially depending on the protocol in use. The queue delay may be broken down into various components, including node latency, access time, and overhead. Most protocols add additional information to the data packet being transmitted that instructs the network on how to route the data. This additional data, unfortunately, is just overhead, and the more data added to a transmission, the longer the queue wait.

C. Data Reliability (Redundancy)

There are various approaches to increase the likelihood that data received from one node reaches another node in a network in perfect condition. In one way, data is sent from the transmitter to the receiver through several paths. The routes can be utilised at the same time, and the receiver decides which route's data is received. The data can also be delivered over one path until that path becomes unavailable; when that path becomes unavailable, the data is sent over another path. This second sort of redundancy is required by pooled ITS networks.

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The dependability of data can be improved by including some error detection/correction information in the data packet being transmitted. FDDI adds a kind of error detection to the frame check sequence field. Because fibre optic data lines are often constructed with bit error rates of less than 1 x 10-12, the use of error detection and correction in a fibre network is debatable. If a fibre break happens during the transmission of a data packet, error detection is important. Regardless of the transmission mechanism used for communication, the data being communicated in polled ITS networks already contains a cyclical redundancy check (CRC) code, which is verified by the master and distant units. As a result, having a communications network that also includes

D. The Network Cost

The cost of the network is determined by a number of factors, including the cost of the fibre and modems used in the system. In terms of cost, the system that employs a modem with a longer latency will be more expensive since the modem must evaluate the data and determine how to handle it, which adds to the computing complexity. As a result, in order to reduce the cost of network fibre and modems, they should be considered, and a modem with a lower latency should be utilized.

E. FDDI Network Architecture

With high-resolution graphics, Computer Aided Design / Computer Aided Manufacturing
(CAD/CAM), multimedia, and other high-bandwidth applications becoming more popular,
Many desktop applications require higher transmission capacities over Local Area Networks (LANs). Many internetworks also require high capacities for LAN-to-LAN or
Interconnections between LANs and WANs (Wide Area Networks). FDDI (Fiber Distributed Data Interface) is a high-speed fibre optic token ring LAN that can link up to 1000 physical connections (stations) at distances of up to 200 km. Depending on the type of fiber-optic cable used, connected workstations can be anywhere from 2 to 60 kilometers away. Even though FDDI is not an IEEE (Institute of Electrical and Electronics Engineers) standard, it has aspects from the IEEE 802 project. FDDI, for example, utilizes frame formats identical to WEE 802.5 frame formats, while the FDDI data-link layer uses IEEE 802.2 Logical Link Control (LLC).

VI. RESULTS

Taking the preceding point into account, we came up with the results presented in Figures 4 to 14. At first, we set the maximum TTRT value to 165, the number of stations to 100, and the system's ring latency to 10, 50, 100, and 150 milliseconds. Furthermore, the link between propagation time and group velocity, as well as transmission delay and bandwidth, has been computed.

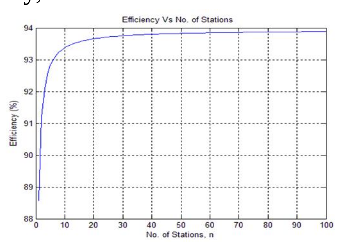

Figure 4 Efficiency Vs. No. of Stations for ring latency =10ms.

The number of stations (n) is shown by the x-axis (horizontal plane), while the system efficiency is represented by the y-axis (vertical plane) (percent).

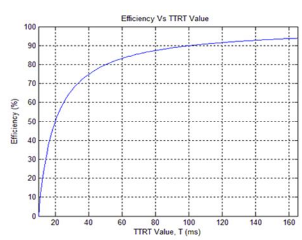

Figure 5 Efficiency Vs. TTRT Value for ring latency =10ms.

The TTRT value (T ms) is shown by the x-axis (Horizontal plane), while the system efficiency is represented by the y-axis (Vertical plane) (percent).

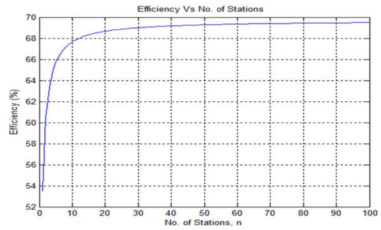

Figure 6 Efficiency Vs. No. of Stations for ring latency =50ms.

The x-axis (Horizontal plane) represents number of stations(n) and y-axis (Vertical Plane) represents System efficiency (%).

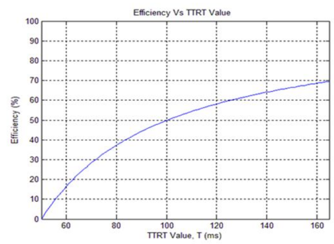

Figure 7 Efficiency Vs. TTRT Value for ring latency =50ms

The x-axis (Horizontal plane) represents TTRT value (T ms) and y-axis (Vertical Plane) represents System efficiency (%).

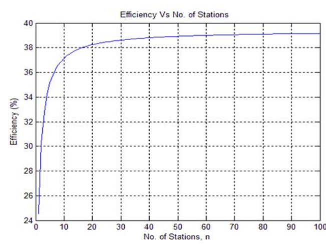

Figure 8 Efficiency Vs. No. of Stations for ring latency =100ms.

The x-axis (Horizontal plane) represents number of stations(n) and y-axis (Vertical Plane) represents System efficiency (%).

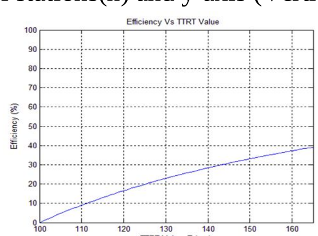

Figure 9 :Efficiency Vs. TTRT Value for ring latency =100ms.

The x-axis (Horizontal plane) represents TTRT value (T ms) and y-axis (Vertical Plane) represents System efficiency (%).

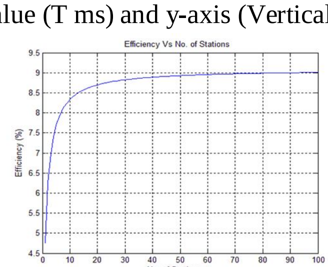

Figure 10 Efficiency Vs. No. of Stations for ring latency =150ms.

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The x-axis (Horizontal plane) represents number of stations(n) and y-axis (Vertical Plane) represents System efficiency (%).

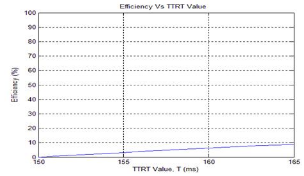

Figure 11:Efficiency Vs. TTRT Value for ring latency =150ms.

The x-axis (Horizontal plane) represents TTRT value (T ms) and y-axis (Vertical Plane) represents System efficiency (%).

Figure 12 Efficiency Vs. Ring latency for n=100 & TTRT=165

The x-axis (Horizontal plane) represents ring latency (D ms) and y-axis (Vertical Plane) represents System efficiency (%).

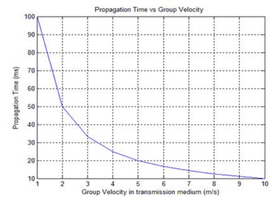

Figure 13 Propagation Time Vs. Group Velocity.

The x-axis (Horizontal plane) represents Group Velocity in transmission medium(m/s) and y-axis (Vertical Plane) represents Propagation time(ms).

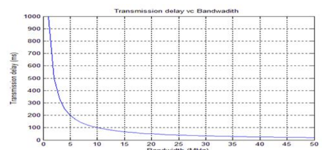

Figure 14 Transmission delay Vs. Bandwidth.

The x-axis (Horizontal plane) represents Bandwidth (MHz) and y-axis (Vertical Plane) represents Transmission Delay(ms).
Figure 12 shows that when group velocity increases, propagation time drops, whereas figure 13 shows that bandwidth decreases as transmission delay increases.
The findings given in Figures 4 to 14 demonstrate that increasing the efficiency of FDDI systems is possible if the ring latency can be controlled and kept to a minimum. As a result, we may increase the performance of the FDDI systems in this way.
The reaction time of FDDI systems is determined by the transition delay and propagation delay, as mentioned in the last chapter of the thesis. The findings provided in Figures 13 and 14 demonstrate that increasing bandwidth reduces transition latency while decreasing propagation delay/time.
The FDDI network's data dependability can also be improved by including error detection and repair information in the data packets being transmitted. In the frame check sequence field, FDDI includes a kind of error detection. The cost of the network is determined by a number of factors, including the cost of fibre and modems used in the network. As a result, we can manage the network's cost by managing the cost of the fibre and modems that are used. Another approach to cut costs is to use modems with extremely short latency times. We can examine the performance of FDDI networks in this way, and create an FDDI network that is more efficient, more reliable, and less expensive.

VII. CONCLUSION

Token Rings and Fiber Distributed Data Networks, or FDDI, are constructed with two data transmission pathways to offer redundancy in the event that one of the two fails. FDDI is meant to function over fibre and may be implemented as a faster version of a token ring. This standard is primarily intended for peer-to-peer communications, although it may be used for polled traffic modems as well. The token ring's core idea is that access to the communications ring is restricted to one modem at a time: The message is sent around the ring by a single modem. The modem then takes away the data from the ring and needs to pass oversight (the token) to the next modem in line once the message has completed its journey around the ring. This strategy appears to be a viable option for data distribution. We investigated the performance of FDDI systems in relation to numerous factors in this research. The results presented in the previous chapter demonstrate that the FDDI network's efficiency may be improved by managing and decreasing ring latency. The transition and propagation delays can be reduced to enhance reaction time. The findings provided in Figures 13 and 14 demonstrate that raising the bandwidth reduces the transition delay and increasing the group velocity reduces the propagation delay/time.

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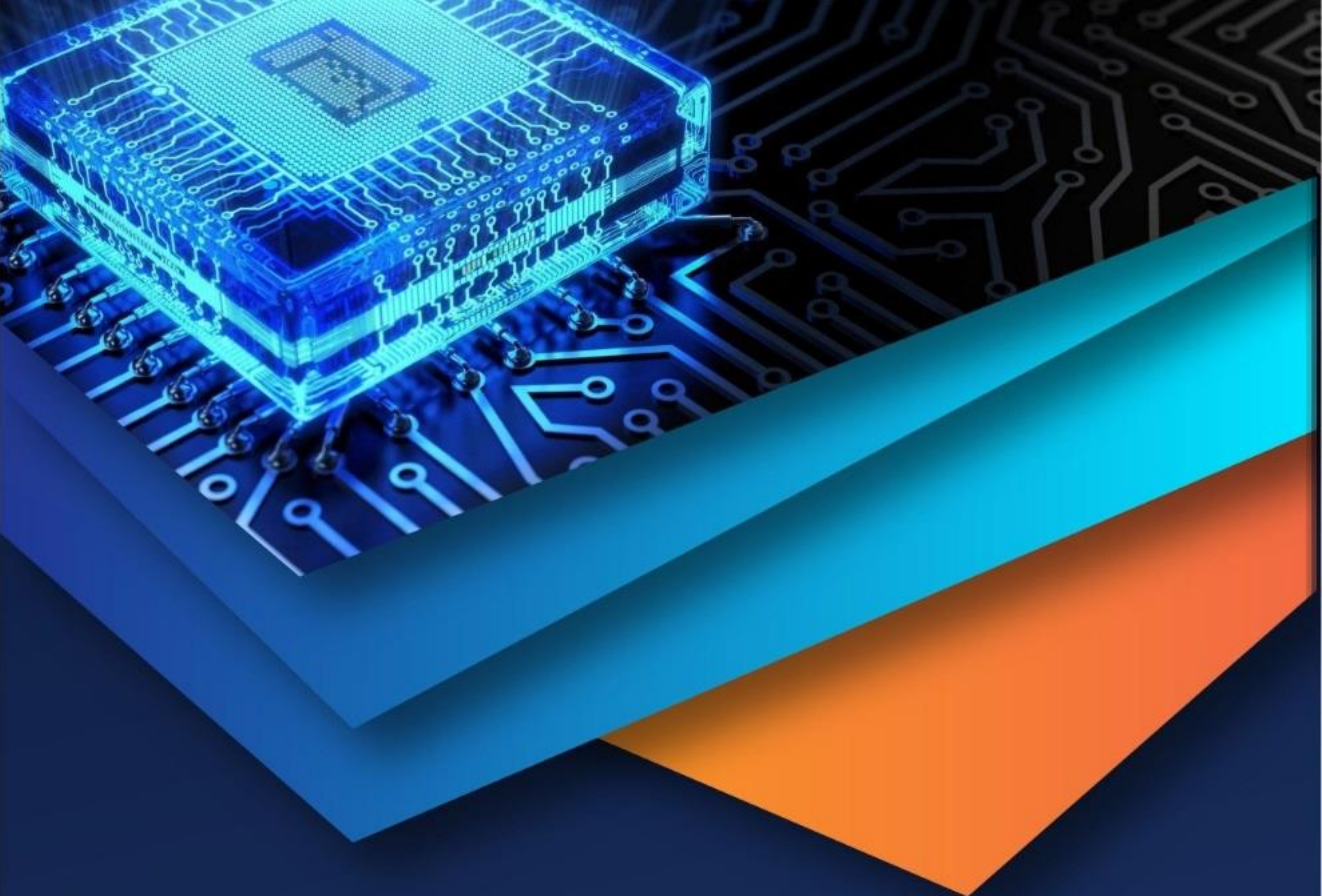

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