Multi-Hop GigaBit Ethernet Routing for Gigabit Passive Optical System using Genetic Algorithm

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Abstract: ***Today, a high data rate is essential for a wide range of applications, including live broadcasting, online video, video conferencing, and more. This need is growing in response to consumer demand. Optical fiber communications system design and analysis are the foundations of this study. To increase the network's quality factor and adjust for the least bit error, Optisystem simulates the network topology throughout design, testing, and performance of optical networks. Using a Genetic Algorithm, this study examines how various fiber optic connection characteristics affect the reliability of digital data transfer during multi-hop routing. It was possible to run simulations with varying launch powers of transmitters, extinction ratios, rise/fall times of signals, and connection lengths. Researchers looked at the impact of different forms of network needs protection on the installation cost of networks at different degrees of topological complexity.***

Keywords: Gigabit network; Optical data transmission; EPON communication; Multi-Hop Routing, and Genetic Algorithm

1. Introduction

The IEEE 802.3-2002 standard is one of the most widely used ones for high-speed local area networks (Gigabit Ethernet). This research highlighted the characteristics that affect the data transmission quality in Gigabit Ethernet links. The deployment of particular forms of network demand protection may modify the degree of dependability of data transmission across distinct network nodes. There is a one-to-one relationship between the budget for implementing the network and the security policy. The impact of several forms of network security on the overall cost of the network was examined in this article. The code from GigaPOWERS, the first simulator to handle models with more than a billion cells, served as a foundation for this wor [1] k.

- In order to construct multi-gigabit fiber optic internet links in certain metropolitan regions, including portions of Florida, AT&T and BlackRock have joined together to establish Gigapower, LLC.
- The collaboration brings together the fiber network of AT&T with the infrastructure investment knowledge of BlackRock, allowing more Americans to have access to super-fast and dependable fiber connection.
- No details about which Florida areas will be revealed as part of the collaboration, but the goal is to broaden AT&T's presence in the state and enhance competition in the fiber-optic market. This should lead to better access and maybe lower prices for people and companies.

In a joint release, AT&T and BlackRock said that they had officially finished their joint venture to establish Gigapower, LLC. The goal of the business is to construct multi-gigabit fiber optic internet links in certain metro regions, including portions of Florida. Giving additional Americans access to extremely quick, trustworthy, high-capacity fiber" is the stated objective of the cooperation, which combines AT&T's current fiber network with BlackRock's knowledge of infrastructure investments. A modern facilities fiber network to certain metro regions in Florida "using an industrial wholesale open access platform" would be provided to internet service providers and companies as part of the collaborative initiative, according to the statement. the Internet

A lot of bandwidth is required by the ever-expanding list of innovative applications that have emerged in response to the proliferation of internet users. These include storage networks, internet data centers, computer-aided design and manufacturing (CAD/CAM), multimedia and video ordering systems, telemedicine, distance learning courses, and many more. Bandwidth requirements for the first kilometer of the access network and MAN are fairly stringent. A faster LAN port on a computer or server is required to accommodate new applications that need high-speed data transfer. The simultaneous explosion of 1000Base-T Gigabit Ethernet was a direct result of the lightning-fast progress in semiconductor technology. One standard for Gigabit Ethernet using copper cable is 1000Base-T Gigabit Ethernet, which is also known as IEEE 802.3ab. The maximum allowed length for a 1000BASE-T network segment is 100 meters (330 feet), and all segments must employ cables of category 5 or above, including Cat 5e and Cat 6. You must specify 100Base-T in addition to 10Base-T. Fast Ethernet, which is just 10Base-T operating at 10 times the bit rate, is another name for 100Base-T. Relevant item: ***10/100/1000BASE-T Ethernet SFP***. Fast Ethernet can achieve both 10 Mbps and 100 Mbps on the line since 100Base-TX standards are interoperable with 10Base-TX networks. Fast Ethernet (FE) is the next logical step after conventional Ethernet, allowing for easy updates to existing networks, since nodes with 100 Mbps capability can connect at 100 Mbps and can also interact among slower node at 10 Mbps. Upgrades to UTP connections have allowed Fast Ethernet to reach 1000 Mbps, sometimes known as Gigabit Ethernet. Today, category 1 as well as category 5e cables are capable of supporting gigabit Ethernet, which is also known as 1000Base-T. After 1000Base-T was ratified, network administrators' main worry was future-proofing their infrastructures by migrating the current population of category 5 cables to greater speed Ethernet. Although category 6 cable was the official specification for 1000Base-T Gigabit Ethernet, category 5 was the most common kind of cabling used at the time. Therefore, it is the responsibility of the IEEE to guarantee that 1000Base-T networks operating over category 5 cable systems established in accordance with ANSI/TIA/EIA 568 A requirements work. Support for historical category 5 cable is a primary objective of the IEEE 1000Base-T standard, with the hope that it will prevent the need to replace current category 5 cabling with 1000Base-T. The Task force has determined that all 100Base-TX links should be able to effortlessly accommodate 1000Base-T.

Commonly used category 5 cable or an improved variant of UTP cabling, such as category 5e, is often used to implement 1000BASE-T, which is an expansion of basic Ethernet technology to gigabit-level network speeds. Adaptive equalization along with a five-level modulation of pulse amplitude (PAM-5) technology allow 1000BASE-T to use all four cable pair for simultaneous transmission across both directions, in contrast to 10BASE-T and 100BASE-T systems, which only employ two pairs of wires. Attenuation, crosstalk, and echoes from full-duplex transmission across single wires are some of the related issues that arise when transferring a 1000 Mb/s data stream over four pairs of Category 5, or 5 twisted pair cables. A number of measures have been taken to address these issues and ensure that 1000BASE-T is a reliable and functioning networking technology. These include the PAM-5, correcting forward errors methods, and pulse shaping technologies. When using hybrid circuits for full-duplex transmissions over single wires, the specialized filters are required. When compared to binary communication, the PAM-5 offers superior bandwidth usage. In order to retrieve the transmitted signals even when there is a lot of noise and crosstalk, forward error correction algorithms provide an extra layer of coding. For the purpose of optimizing the signal-to-noise ratio, pulse shaping technologies align the spectral properties of the signal being transmitted with those of the channel. According to the suggestion in [1], invariant convolutional neural network predictors (ICNNP) employ a fixed-length encoder to encode link characteristics with variable lengths. With its robust neural network predictor, the ICNNP can adapt to shifting transmission conditions with little additional input. By training the model using a mixed method, they were able to lessen the QoT estimator's dependence on time as well as connection length. Datasets under different transmission configurations are collected by the authors to test their technique in practice. There are four benchmark algorithms, and the proposed ICNNP is the most advantageous of the bunch. When the span numbers are between 9 and 12 and the evaluation duration is prolonged from 12 to 72 hours, the standard deviation of their the model's signal-to-noise ratio stays below 0.4 dB and the prediction error stays below 0.25 dB. They also recommend an evaluation-update framework for continuous learning in order to get the most efficient and economical QoT estimation. In [2], the authors study different networking scenarios, such as intra/inter datacenter, underwater, terrestrial, along with wireless 5G/6G hauling networks, and use the available spectral as well as spatial degrees of freedom to determine the optimal utilization plan as well as significant attributes for traffic management. The existing implementations are finding it difficult to keep up with the astronomical increase in traffic on networks that are capable of handling these conditions. In order to manage the anticipated future continuous traffic growth, innovative switching technologies will be required, along with new network expansions that effectively and inexpensively provide high capacity multipliers. To get around this problem, they discuss many critical communication scenarios where space-division multiplexed systems might be helpful. According to [3], six machine learning models were considered: Decision Tree, Naive Bayes, Logistic Regression, K-Nearest Neighbor, Support Vector Machine, as well as Random Forest. The accuracy in recognizing DDoS attacks in FON was 100% using two approaches. One way used a support vector machine and three features (SOS, SSIP, and RPF). The second method used a random forest with five features (SSIP, SOS, SDFP, RPF, and SDFB). The second technique was selected for deployment over the first, which takes 14.3 s, because to its much shorter training time of 0.18 s. The goal of the aforementioned study is to shed light on many important data features by describing the tools and procedures needed for adequate network monitoring and data collecting. They also detail the many forms of data, their physical origins, and their applications. Various data handling and pre-processing techniques are discussed to effectively collect, store, show, analyze, etc., information from networks. The authors point out major difficulties with data creation, transmission, and sharing and suggest ways to fix them. With the right data sets at their fingertips, future fiber-optic networks will be able to execute intelligent data-driven operations. The benefits of optical time-domain reflection for strain monitoring in fiber optic sensor networks are the subject of that study's investigation [5]. A comprehensive review of the technology's advantages and applications in strain monitoring revealed its value in engineering practice. A variety of sectors could benefit from the technology, as shown by the case studies. There are great potential applications for strain monitoring techniques that employ optical time-domain reflections in fiber optic sensing systems in the future, and these techniques are essential for gathering data on structural safety. Studies examined the material and environmental costs of fiber line transmission [6]. In order to determine the loss amounts, the inquiry mapped out the origins of the losses, created graphs of the fiber loss based on wavelength, and more. The second part of the study entails developing simulation programs for single-mode fiber that better illustrate the dispersion. After that, a brief explanation of dispersion and its various forms is provided. These factors are among the more important ones that determine the transmission speed and distance of the fiber. Four light waves were simulated to see how dispersion and loss impacted them. Scientists have figured out how bit error rate occurs in fiber optic communication. The applications that would lessen the spread and loss of fibers were their last emphasis. The designs of a collection of optimal 2-D multiple-weight optical oblique codes employing approaches such as skew beginning, h-perfect cyclic wrapping, and imperfect difference matrices will be the focus of the combinatorial characteristics described in [7], which also details optimum 2-D OOCs. Their innovative approach to building skew starters with various weights

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facilitates the search for optimal multiple-weight optical orthogonal codes. As can be seen by their numerical examples, the proposed structure is very beneficial for optimizing the use of optical networks. The 32-use DWDM RoF system that could effectively transmit information at a rate of 1.28 Tbps was developed by the researchers of the [8] research by integrating multiple compensating techniques. There were three different frequency spacing instances included in the system performance analysis: 100, 150, and 200 GHz. Other kinds of modulation are being explored to find the most reliable method for future applications. After examining the bits error rate along with Quality Factor, we compare the findings to the previous procedure.

2. Gigapower Ethernet for Fiber Optic Networks

Optical line terminating (OLT) systems and optical network units (ONUs) or terminations (ONTs) connected via a passive optical distribution system (ODN) are the typical components of G-PON systems. In order to split the light signal into many cores, GPON is designed with a passive splitter (2, 4, 16, 32, as well as 64). A point-to-multipoint system is the basis of a passive optical network. The TDMA multiple access mechanism is used by GPON, and the ITU-T G.984.2 Recommendation specifies a notional data rate of 2488.32 Mbit/s for the OLT signals sent downstream to the ONU. Upstream, the ONU signal is sent at a notional bit rate of 1244,16 Mbit/s. High-speed phone, video, and internet services are provided via fiber-optic links using GPON, a passive optical network technology. It is a kind of network that allows service providers to connect several consumers via the use of a single optical cable.

Key Components of GPON

1) Optical Line Terminal (OLT): The GPON network's hub, located at the service provider's end, is the OLT. It controls data transfer between several Optical Networks Terminals (ONTs) after connecting to the optical fiber.
2) The ONT is the client-side hardware that establishes a connection to the OLT. Data, audio, and video services may be received and sent via the GPON network with its installation in homes or businesses.
3) the passive optical splitter is responsible for distributing an optical signal from the optical light transmitter (OLT) to many optical network terminals (ONTs). "Passive optical network" refers to a method of signal splitting that does not include powered electronics.

Research Challenges of GPON Networks

1) Transmission of Data: The OLT is a node that accepts data traffic, such as internet data, phone, and video services, from the provider's network.
2) Passive optical splitting: the optical link terminator (OLT) transports data over a single optical cable before dividing it into several pathways. Because of this, several ONTs may receive the same signal.
3) ONTs at the customer's premises get the optical signal, which is the third step in data reception. Customers' electronic devices, like smartphones, tablets, and televisions, may use the optical signal once the ONT transforms it back into electrical signals. Imagine the ONT as a sophisticated media converter.
4) Information Transfer: The ONT and the OLT exchange data via communication. Remember that GPON can handle data going both ways; it's a bidirectional technology.

3. Related Work

According to these findings, the suggested system's characteristics may be significantly improved via the symmetrical hybrid compensation. Although metal mesh is more popular, it is vulnerable to outside interference; that research attempts to show the benefits and drawbacks of fiber optics as an alternative. Researchers in the study visited businesses in Porto Velho, Rondônia, which had just switched to optical fiber for internet access. Additionally, it contains bibliographic research, particularly that which indicates a pattern in the use of fibers in commercial endeavors. The study's overarching goal is to provide light on the context in which managers weigh the pros and cons of using fiber optics instead of metal mesh. In their analysis of current communication channels, the researchers in [10] show how DFOS may integrate with recent field findings to provide a comprehensive picture of road traffic monitoring, including average speeds and the number of vehicles on the road. For future smart city applications, it is efficient to collect data on seasonal vehicle activity using a long-term wide-area road traffic surveillance system. Functions like cable self-protection as well as cable cut risk evaluation are also available in DFOS for the purpose of preventing cable cuts. Protecting telecom infrastructures is made possible by the detection and location of anomalous occurrences as well as the evaluation of cable threats. To enhance its generalizability to various situations and time-varying backdrops, DAS is initially used in the revolutionary unsupervised Spiking Neural Networks in the [11] study. After a thorough discussion of the new network's theoretical mechanism, construction, and optimization, its efficacy is confirmed through three sets of field tests. The first set uses a small dataset a using balanced, typical, and consistent data. The second set uses two bad datasets, B and C, which are full of inconsistent and atypical data. The third set uses a completely imbalanced dataset, D. When trained with a limited number of samples or an unbalanced dataset, as is common in reality, the suggested SNN employing the unsupervised learning system, spiking-timing dependant plasiticity, outperforms the standard supervised CNN in terms of stability. In their novel form of RNs, the authors of [12] suggest placing the antenna confronting the base station at a geographical distance from the antenna confronting the user end device, with the two antennas being linked through an optical fiber. So far, they have verified the design process for the proposed fiber-optic RNs and explored the theoretical required signal to self-interference proportion as a function of the optical fiber length. Researchers study the efficacy of denser cellular networks with fiber-optic RNs in terms of user throughput in that article. They describe the user performance of the networks with fiber-optic RNs as a function of distance between the base station and the RN that faces the user end device using system-level simulations. The paper [13] uses a biblio-semantic method to make conclusions on the potential of optoelectronic networks for telemedical data sharing, identifies key areas for future development, and formulates a number of open challenges. Optical amplifiers using automatic gain control and a unit for automatic control along with diagnostics of the optical cable offered remote control using state determination cable fibers; that development is based on the model of the fiber-optic communication link for the exchange of telemedical information. A handheld electronic device that uses digital image processing as well as artificial neural networks to test the cleanliness of fiber optic connections is proposed in [14]. Its goal is to make human experts' visual inspections less subjective. While such devices do exist, they are often prohibitively expensive and fail to use either image processing or artificial intelligence to provide better outcomes. An optical microscope, a digital camera adapters, a reduced-board machine, an algorithm for processing images, an algorithm for neural networks, and an LCD screen for operating the equipment and viewing the findings make up the gadget. It is designed for examination of fiber optic connectors. The study used OptiSystem 0.17 simulations based on Dense Wavelength Division Multiplexer technological advances, Erbium Doped Fiber Amplifiers, Dispersion Compensating Fibers, and single mode fibers with 50-100 km in length for its research [15].

4. Proposed WOrk

GPON Network Model: The language used to describe the network framework and the optimization issues addressed in this study. In most cases, a directed graph is used to represent the network. $\mathcal{G} = (\mathcal{V}, \mathcal{E}, \mathcal{D})$, for where the sets V, E, and D stand for the sets of nodes, undirected connections, and undirected traffic needs, respectively. V stands for the total number of nodes (i.e., V=|V|), whereas the number of connections is indicated by E (i.e., $= |\mathcal{E}|$), that is, D=|D|, and the quantity of demands by D. So, every link $e \in \mathcal{E}$ represents a pair of node {v,w} that are not necessarily ordered, and every demand follows suit. $d \in \mathcal{D}$. In our scenario, the total number of transmission networks (FSO systems) deployed on link e is provided by an integer value c(e), which specifies the capacity of link e. The maximum throughput that each one of these transmission systems can handle is M units of traffic demand, for example 10Gbps. So, Mc(e) is the entire bandwidth that a connection really realizes. When a network is operating normally, as shown by 0, this bandwidth is achieved. The optimization model presented in this research really makes the assumption that M=10Gbps.

The normal state traffic demand volumes, represented by h(d), where d is an element of D, are to be achieved. A path-flow is used to materialize every demand volume h(d) by drawing from a set of all possible pathways, where P ˆ(d,0) represents a collection of any straightforward paths, to reach the end node of a demand d. The collection of connections E(d,p) it traverses may be used to define a simple route p∈P ˆ (d,0) if it does not include loops. Unfavorable weather conditions might degrade the capacity of the network's connectivity. Basically, the transmission systems on certain connections often have their bandwidth reduced when the network encounters a weather state s∈S, where S is the set of all possible states as well as S=|S| is its cardinality. The provided link availability coefficients α(e,s) reflect this (where $0 \leq \alpha(e,s) \leq 1, e \in \mathcal{E}, s \in \mathcal{S}$), in this case the real bandwidth on connection e is often reduced as well as equal to α(e,s)M(e) in state s. We shall also use the concept of the link degradation parameter β(e,s) in what follows $\beta(e,s) = 1 - \alpha(e,s), e \in \mathcal{E}, s \in \mathcal{S}$.

Keep in mind that link e is not accessible in state s when α(e,s)=0. Therefore, the set of connections that are accessible in state s, which are the ones with α(e,s)>0 and are represented by E(s), may be a valid subset of E. (From here on out, we'll refer to the collection of states where connection e is accessible as S(e), a symmetrical idea.) P ˆ(d,s) will represent the set of pathways from P ˆ(d,0) that are accessible in state s, thereby rendering certain paths from P ˆ(d,0) unavailable. The network graph may also detach and break into separate parts. This precludes any possibility of satisfying the requirements linked to the end node in the various components. (Hereafter, D(s) shall represent the set of realizable demands, that is, demands with end nodes in the identical component.) As a general rule, while the system is in state s, we allow a reduced volume, h(d,s), to be fulfilled rather than requiring the total demand volumes h(d) to be realized. The path-flows that use the permitted sets of pathways, P(d,s), where P(d,s)⊆Pˆ(d,s), are used to actualize these reduced carrying volumes.

Various types of variables will be used in the optimization challenge solutions examined in this research. To be more specific, variables are used to indicate the optimum link capacity, $y^0 = (y_\epsilon^0, e \in \mathcal{E})$. And for path-flows, we'll use

$x^0 = \left(x_{\phi^*}^0, d \in \mathcal{D}, p \in \mathcal{P}(d,0)\right)$ (flows in the normal state)

and by $x' = \left(x_\phi^s : d \in \mathcal{D}(s), p \in \mathcal{P}(d,s)\right)$ (flows in state $s \in \mathcal{S}$)

Unless otherwise stated, all variables are assumed to be continuous in the following. When dealing with constant parameters, we shall also adhere to a notational norm that puts the indices in brackets (like$c(e), f(d,p,s), z(d,p,e)$), while the indices will show up as subscripts or superscripts for the concurrent variables. (like $y_e^0, x_{d\phi}^s, t_d^t$). Take a network that has a connection capacity vector as an example $c = (c(e), e \in \mathcal{E}$) on which a specific traffic matrix, denoted by vector, is loaded $h = (h(d), d \in \mathcal{D})$ of demand.

For any traffic unit, the shortest viable route is determined by the shortest path length, where link length is the unit of measurement. A routing method, namely an enhanced fixed alternative routing algorithm, a subset of alternate routing algorithms, is suggested in this work. With the suggested model and technique, the user knows exactly what the blocking probability is for a certain GPON route in advance, which is a huge help when trying to reduce the blocking probability.

Input Parameters for Routing

The goal of a genetic algorithm, or GA, is to decrease the number of nodes that need to be split-capable by combining various shortest pathways for the particular multicast requests.

- When a GA is first started, it uses a random seed to produce an initial population. It uses the shortest route database to choose a random mix of shortest pathways.
- We will choose individuals for the future generation based on their fitness value evaluation.

- Selection: When choosing two parents to have a new generation of people, the selection process is used.Only the most fit members of the population will survive this process of natural selection.
- Crossover: Crossover delves into the assortment of people who make up the population. To swap subroutes between two people, the path crossover operators is used. In order to implement the crossover, the origin and destination nodes of the request pathways in the people must be identical.
- Mutation: Following the crossover, the mutation method is individually performed to each offspring. Each kid has a chance to modify each node based on the mutation probability. Following a mutation, an individual's fitness value is assessed.
- Replacement: To keep the population number constant, a new individual will replace an older one or its parent if its fitness value is greater. Failure to do so results in the new person's discardal and the continuation of the old people into the next generation.
- Optimizing Routes using GA as the Shortest Path
- First, among the collection of unrouted source-to-destination pairings (SD pairs), choose one.
- Locate the least crowded route for each path P (paths that match the SD pair p). This is Step 2.
- Step 3: Use this path to route all of the traffic from point p until either point w's demand is met or the path becomes crowded.
- After all of the demands for the SD paired p have been met, go to step 4.
- 5th Step: Return to the first step until all SD pairings have been routed.

Power Link Budget

We plan the power above the necessary power threshold after calculating the power connection budget based on the network connection's requirements. The power link budgets is put into place in accordance with the standards set by the ITU-T G. 984 and is enforced by the industry. Together, the distance and receiving power cannot exceed 20" "km and -28dBm, respectively. For power budget link total damping calculations, the equation has the form of:

$$a_{t_1} = L \cdot a_S + N_c \cdot a_c + N_S . a_S + S$$

$$P_R = P_T - \left(a_{t_1} + S\right)$$

$$M = \left(P_T - P_{S!}\right) - \left(a_{t,} + S\right)$$

While the fiber-optic cables are in use, the entire attenuation happens at point $a_{t,}$ The incoming power, which can be calculated using Equation 2, is 6" "dB after reducing the power from the transmitter or the power from the outlet by complete attenuation and the safety margin. The power margin values, acquired through the emissivity value sensitive receiver devices, decreased damping, and a safety margin can be found using Equation 3, which is also the equation for the experiment. Parameter values in equations 1, 2, and 3 according to the FTTH network architects' specifications for each device.

Bit Error Rate (BER)

The BER is the rate of bit errors that happen while the digital signal is sent. At a certain bit error rate (BER), the sensitivity of a received signal is defined as its lowest optical power. Various BERs are necessary for various applications; for instance, a communication app needs BER 10^(-10) or higher, whereas some data communications need BER equal to or more than 10^{-12}. BER for an optic communication network that uses 10^{-9}. Noise, disruption, distortion, bit coordination, attenuation, multipath fading, and other factors may all impact bit error rate (BER).

Extinction Ratio

The extinction ratio, measured in decibels, is the difference in optical power values of the "0" and "1" signals. The specification states that for all eight choices, this parameter must have a value of 9 dB.

5. Results & Discussion

The Gigabit Ethernet PMD sublayer, which is dependent on physical medium, was simulated. The optical components of the signal-transmitting hardware are associated with this sublayer. All of the components involved in a transmission, including the optical fibers, connections, transmitters, and receivers, are defined by PMD.

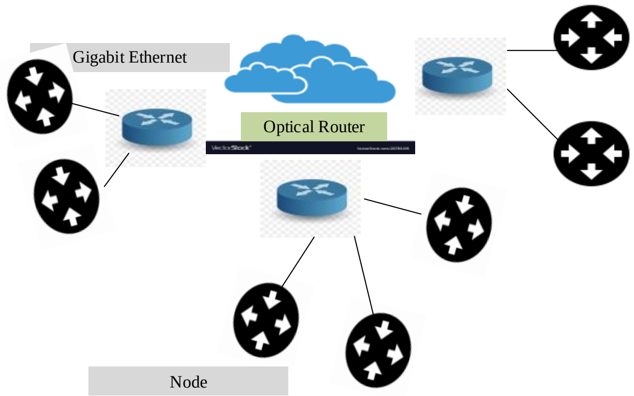

Figure 1: Network Model

Our primary objective in conducting these experiments was to determine how link characteristics (beyond their nominal levels) affect transmission quality. The amount of errors caused by the receiving segment of the connection is the digital transmission efficiency measure. The term "Bit Error Rate" (BER) describes this metric. Both receiving a "0" when the broadcast signal was a "1" and receiving a "1" when the transmitted signal was a "0" are examples of possible errors. The highest allowable BER value in the 802.3-2002 standard is 10-12. This indicates that the connection is functioning well if it receives no more than one erroneously understood bit out of every 1012 bits transferred.

Hardware Requirements:

- PROCESSOR: Pentium ® Dual Core
- RAM: 2GB
- Hard disk: 40GB
- Speed: Minimum 2.5 GHZ

Software Requirements:

- Tool: OMNeT 4.6, SUMO 0.19 and Above
- Operating System: Windows 7 ultimate[x86]- 32bit system

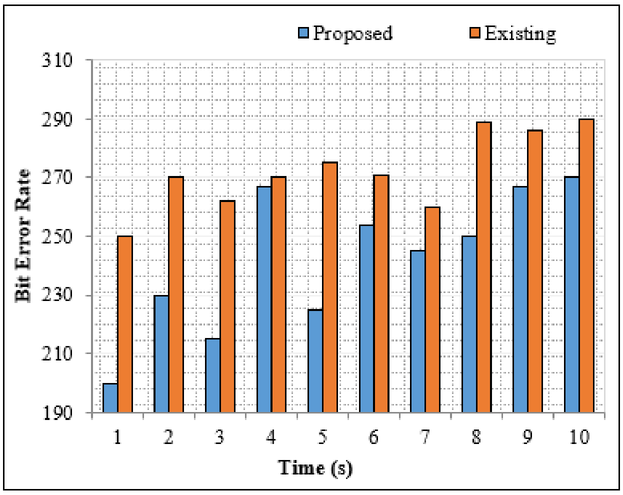

Figure 2: Performance of Bit Error Rate

6. Conclusion

In today's world, a high data rate is required for a wide variety of applications, such as live streaming, online video, video conferencing, and many more. The demand from customers is driving up the level of this need. Design and analysis of optical fiber communications systems are the fundamental building blocks of this investigation. In order to improve the quality factor of the network and make adjustments to ensure the least amount of bit error, Optisystem simulates the topology of the network during the whole process of designing, testing, and performing optical networks. The purpose of this research is to investigate, with the help of a Genetic Algorithm, the ways in which different properties of fiber optic connections influence the dependability of digital data transmission during multi-hop routing. Simulations could be done with different launch strengths of transmitters, extinction ratios, rise/fall timings of signals, and link lengths. Different combinations of these variables were allowed. In this study, researchers investigated the effect that various types of network requirements protection have on the installation costs of networks that have different levels of topology complexity.

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