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Revolutionizing Connectivity: Advancing Equitable Traffic Access through Advanced Scalability and Load Balancing Network Architecture via Adaptive Equalization Algorithms

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Abstract: *The contemporary internet landscape grapples with reliability issues, primarily stemming from internet traffic challenges that lead to slowdowns. A significant contributor to this predicament is the multitude of devices and users connected to the internet, straining the available bandwidth. This research introduces a system designed to address this problem by implementing bandwidth balancing and limitations on individual users. To initiate this study, specific requirements, both hardware and software, need consideration. Given the study's involvement with networks, basic network adapters become essential.*

The bandwidth limiter, a key feature of the system, regulates the internet bandwidth accessible to users. Regardless of download/upload activities, the limiter ensures users stay within preset bandwidth limits. This proactive measure aids in preventing or minimizing average internet traffic issues within a network. The system's implementation results in a more balanced distribution of internet bandwidth among users connected to the same network, ultimately enhancing internet connectivity.

This research addresses contemporary internet challenges by introducing a system that employs adaptive algorithms for equitable traffic access. The proposed system, encompassing bandwidth balancing and limitations, aligns with the overarching goal of achieving advanced scalability and load balancing in network architecture. By proactively managing internet traffic through the use of a bandwidth limiter, the system aims to enhance the equitable distribution of internet bandwidth among connected users, contributing to a more efficient and reliable network infrastructure.

Keywords: Adaptive Equalization Algorithm, Traffic Sharing, Bandwidth grabbing, Load Balancing Network Architecture, Equitable Traffic Access

I. INTRODUCTION

With the Rapid Development and Population of Mobile Internet terminal Application. A client utilized the terminal is expanding, in light of the CN Application (CHEN, 2000). When an Internet user needs to download/upload videos or photo, it tends to consume a lot of traffic on the network. The existence of this problem can result in starvation that leads some station to grab the shared channel of other stations (Bensaou, Wang & Ko, 2012).

SMCC (Saint Michael College of Caraga) in the Municipality of Nasipit, Agusan del Norte as an educational institution used internet connections to provide users access to stakeholders for academic and scientific information. However, Saint Michael College of Caraga faces significant technological challenges-mobility, accessibility of the Internet, approach to adaptive networks, and programmable environment driven by analytics and intelligence. Regarding institutions Ethernet Topology, particularly internet services, have put exceptional liability as a fault of tolerance issue. This environmental issue pertains to the continual increased of the population, network devices given and internet services offer available. For schools (MIS) Management Information Services Center and technical support, these challenges are even higher.

Internet connections allow used for a guide and easy contact, however to much internet traffic can cause even the fastest connection to bug down (Kazmeyer, 2018). Massive traffic of channel access more than the exact fair share of every station can slow down stations. Neglecting this kind of situation which it comes to internet traffic will cause severe damaged to the end-user and also can have a significant impact on their businesses. "At this point, we have to meet some critical strategies in Machine Learning to equalize the internet bandwidth of every user. Adaptive Equalization Algorithms is a method where it can balance the distribution of internet bandwidth by getting the average summation of every user who connected to the internet.

The importance of this study "Fair Access in Traffic Sharing using Adaptive Equalization Algorithms" is that it equalized the bandwidth of every user, which enable fair access of both sides of the user bandwidth of internet rather than per priority permission or scheduling algorithm. Through this kind of scheme, whenever users use such internet application services which consumed a lot of Internet usage, it cannot affect the other user internet bandwidth. Therefore, in this study, proponents provided real-time equal distribution of internet bandwidth, by getting the average summation of the users who connected to that internet it balanced the allocation of internet bandwidth. Also, the features of Adaptive Equalizations, AdaBoost or boosting is also being applied by combining weak classifiers to generate a new robust one classifier; the weak classifier will focus on another weaker classifier form an improved model of the classifier which is the strong classifier.

1.1 Conceptual Framework

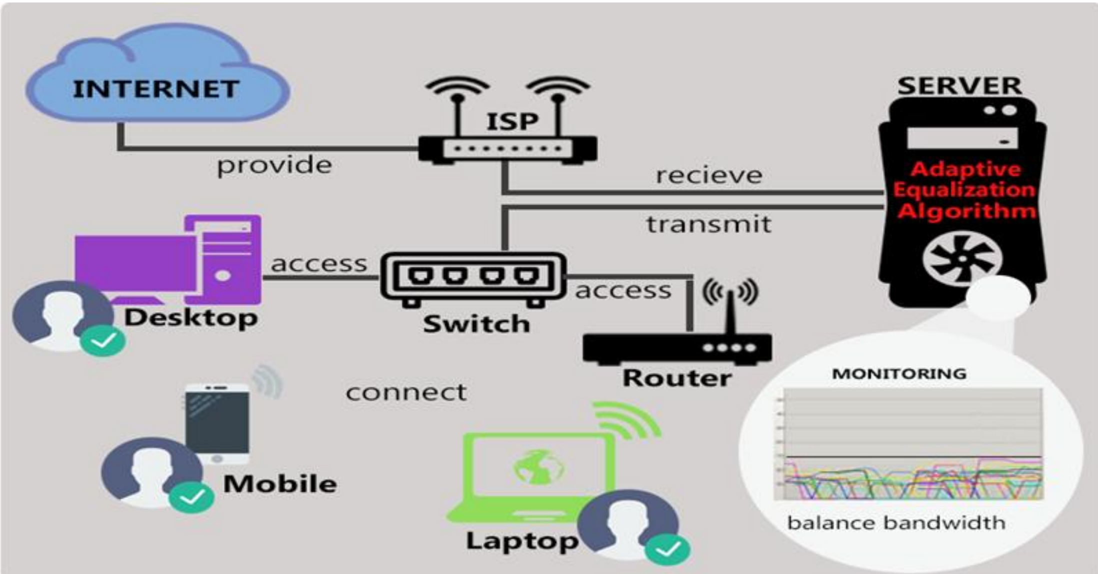

Figure 1. Conceptual Framework of the proposed system

Figure 1 shows the system architecture; the concept of the study is to create a system mediatory that equalize the internet bandwidth accesses by the users. To do this, the proponents will use the Adaptive Equalizations Algorithm. Given a random fetching of bandwidth data from unknown users impulse response, the purpose of an adaptive equalizer is to maneuver on the channel of adaptive network devices output such that the cascade connection of the adaptive network and equalizer provides a balance and approximation to an ideal transmission medium and also the features of equalizer also consist of boosting process which is Adaboost (Brownlee, 2016) it can raise the internet by combining weaker classifier to form a strong one. In an adaptive network device channel equalization, the inverse of the channel transfer function is determined, and it is used to design network equalizers which can reduce interruption.

Though, in practical scenarios, it is considered as environmental tolerance, demanding to know with certainty the network transfer function and other relevant parameters. For instance, the transfer functions of non-stationary connections on Ethernet having increasing fetching clients are time-varying in nature. Due to this scenario, adaptive network equalization algorithms can be applied.

The algorithms can automatically adjust their parameters with the characteristics of the inferred network. The system proposed by the proponents is then improved through creating a mediatory system that includes mathematical process. From the (ISP) that make available of the assortment of data and correspondence of facilities and services, impart into the system through receiving the internet bandwidth, this is a server side in a desktop operated system. By using a PHP language, this serves as the basis of converting algorithm and statements into a scripting language. Awaiting the user's access on internet services, that randomly fetching of data bandwidth, through surfing, downloading/uploading and streaming. In this stage, an automatic balance bandwidth will be now transmitted to the intermediary network device and end devices, through a mediator system that serves as the gateway and monitors the throughput of the cascade connection (ClineJames, ClineJames&Lawwill, 2007).

II. RELATED LITERATURE

The proposed system is mainly focused on random users who connect to the internet with different internet usage. Internet Server Provider with the per priority scheduling is the default method of the internet which means that a user with higher consumed of the internet will have the most significant share of internet bandwidth yet other users who connected to the same internet topology will suffer from "starvation" effect (Bensaou, Wang & Ko, 2012). The problem of peer to peer is the issue of inefficient performance and its internet protocols (Sharma, 2004). The connectivity of it also has an efficient location of nodes that will store data's (Morris, Frans & Balakrishnan, 2011). Pfsense is an open-source firewall that can connect WAN and LAN access point of wireless devices without via network cable and also it has a distribution method of freebased full-featured router and firewall customization (Malik &Sappal, 2011) that can turn a computer into firewall routers (Willianson, 2011). It is necessary to have this type of methods for it improved the performance of a network through the proper distribution of loads (Sharma, Singh and Sharma, 2008). This system uses a different scheme, which is Adaptive Equalization Algorithm is a method who use balancing formula for equalization of internet bandwidth of every user who connects to the same internet topology by getting the average summation of the users so that internet bandwidth is equalized.

In connectivity there are contributing factors when using the internet, different issues can exist, various issues of causing trouble with your internet. Faster transmission might be possible. Otherwise, some devices are competing to your connection; that's why internet signal may go down (Dadian, 2013). When users tend to download/upload videos even images, it can consume a lot of internets and can cause traffic on a network. Phenomena towards accessibility of Internet connectivity continued to increase due to the Rapid Development Growth of Population some of the events such as epidemic spreading assessment and arrangement of the advancement of the web topology. The continuous evolution of self-organized network into each functionality can derive a low-dimensional system of topology. However, the reason behind is Internet traffic (Kazmeyer, 2018). The internet allows the user to access but too much traffic causes delays in ongoing transfer and internet signals to have its threshold that even the fastest connection does not have an exemption of it. Threshold problem cannot be controlled such it already exists in a network having a delay in response time of the network signals (Cohen, Erez, Avraham & Havlin, 2000).

Due to the existence of this kind of the last problem in internet usability, it might result to poor end-user experience and may also lead a significant problem that can arise to starvation that leads some station to grab the shared channel of other stations ((Bensaou, Wang & Ko, 2012). The computed fair share on each of the stations are getting slowed down by the access of that station for it is not getting their fair shared (Sapek, 2012). It is consequently addressed to low channel utilization, and unfairness problem over the network is an inefficient way (Enayet, Mechajabint&Rassaquet, 2016).

Providing fairness between responsive and lethargic flows can make individual life easier (Andrikopoulos, Wood & Pavlou, 2013). Adaptive bandwidth redistribution can advantageously offer minimum guarantees for each connection and can provide fairness measure. Router holds extremely important role in balancing with correct IP traffic flow can minimize (Almeida, Cunha &Elverton ,2017) and limiting their bandwidth can help every user can handle this problem of internet traffic and also lowering the bandwidth and resolution of each user's stream can help a user to maximize internet connection in a single share without any question of getting their share and traffic for the communication and information sharing (Kazmeyer, 2018).

Boosting is a procedure by making a strong classifier in joined of weak classifiers to create a positive one classifier (Brownlee, 2016). Therefore, each classifier should focus on the previous model which is weak classifiers and improved overall model when it is added to the group to form a strong one. However, it is part of per priority scheduling algorithm which is the default of Internet which means that a user who needs a higher internet bandwidth prioritized and not the other user who is suffering from starvation of internet connection. In this situation, Adaptive Equalization comes into play. Adaptive equalization can automatically adjust their parameters by their user characteristic of the channel to ensure fair access of the medium from their respective clients' perspective.

When the irregularity of the equalizer or severe channel decay is caught, the RLS calculation is activated again to recuperate balance (Malik &Sapal, 2011). All of this is not just a change in how we computer or communicate using the internet but it is all about the fast-changing evolution of internet connectivity (Shapiro, 2011). Providing internet balance has some techniques of configuration in the device network which indicates load level or load balancer that is configurable ('Rourke & Patel, 2009). Load balancing is determined that it can optimally load distribution and it can minimize the response time (Kameda and Kim 2010). Prove that it needs an adaptive virtual machine to have load balancing of internet bandwidth (Zhao and Huang, 2009). Providing a method in a system that has computer program balancing with scalability issue based upon monitoring of resource consumption can have a significant impact in a short period (ClineJames, ClineJames&Lawwill, 2007).

The high literature and studies presented are valuable and do have the concept that can help the researchers in developing the system. Likewise, upon reading all the reviews, the researchers obtained the keystone of knowledge and gave the foundation for the positive direction of the project. These cited literature and reports are likely similar to the presented study since the authors that were mentioned in the research aimed to create a fair equalization in the propagation of the bandwidth of internet usability. Researchers on the related literature cited their study to their system that also caters to the survey that is presented but does not have the exact topic being presented only regards to the question for the references that provide to its part.

III. OBJECTIVES OF THE STUDY

The primary objectives of this study are to:

- Provide a balance internet bandwidth usage in accessing any internet services equally other than per priority permission in the school.

Specifically:

- Develop and integrate a system that serves the mediatory server that allows and control the balanced usage of internet bandwidth into Adaptive Network.
- Apply and prove the Adaptive Equalizer Algorithm into the mediatory system as a mathematical process in solving the problem.
- Design a System Architecture as a conceptual model.
- Produced reports of the comparison on the proposed system and the existing monitoring of internet distribution LAN based.

IV. METHODOLOGY

Fair Access in Traffic Sharing using Adaptive Equalization Algorithms is a system that does not store data information since it does not have databases for the data to be collected or stored. The system only filters all user IP's that are already connected to use in balancing their bandwidth. More specifically, the user's data IP will be our priority to deal. It is our basis of manipulation of internet bandwidth of every user that is connected and if they disconnect it will not leave any data in the system since it doesn't have databases.

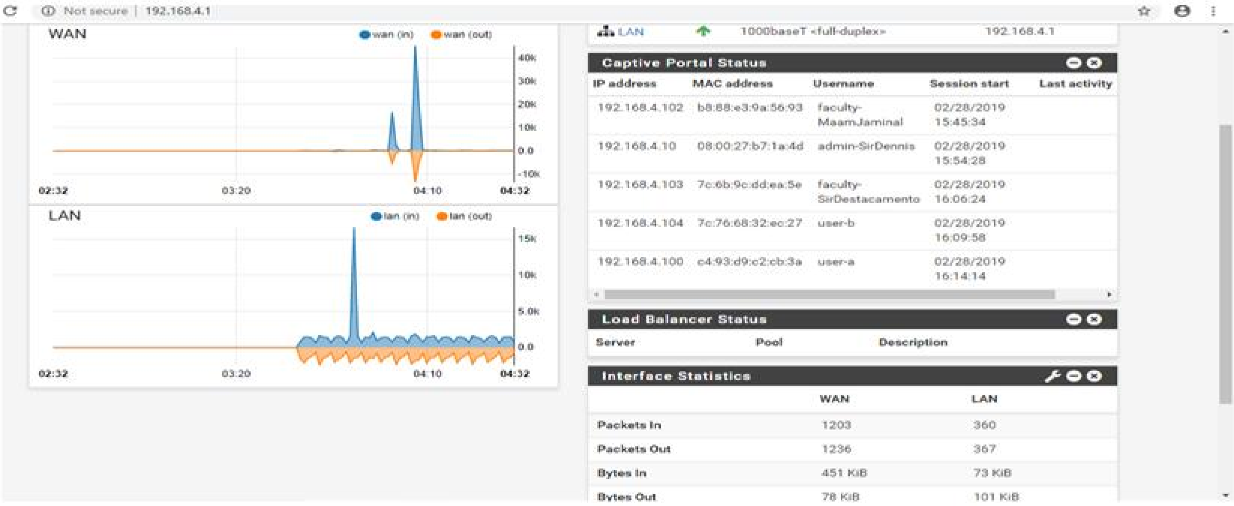

Figure 2. WAN and LAN Starting to Balance

Figure 2 shows the connected users with their personal username, IP addresses together with their MAC addresses and starting sessions.

In this interface, it determines the statistical graph of the two networks which is the LAN and WAN interfaces. As you observed in the graph, it shows the statistical signals are just moderated and only beginning to produce more internet signals, for it only caters the connected less user's IP and only beginning to produce more, but it takes a response time to create such dynamics of signals. As you can see there are only five users that are connected to the system's network and that device are just logged in a few minutes ago. Therefore, the users did not use their internet bandwidth fully maximized.

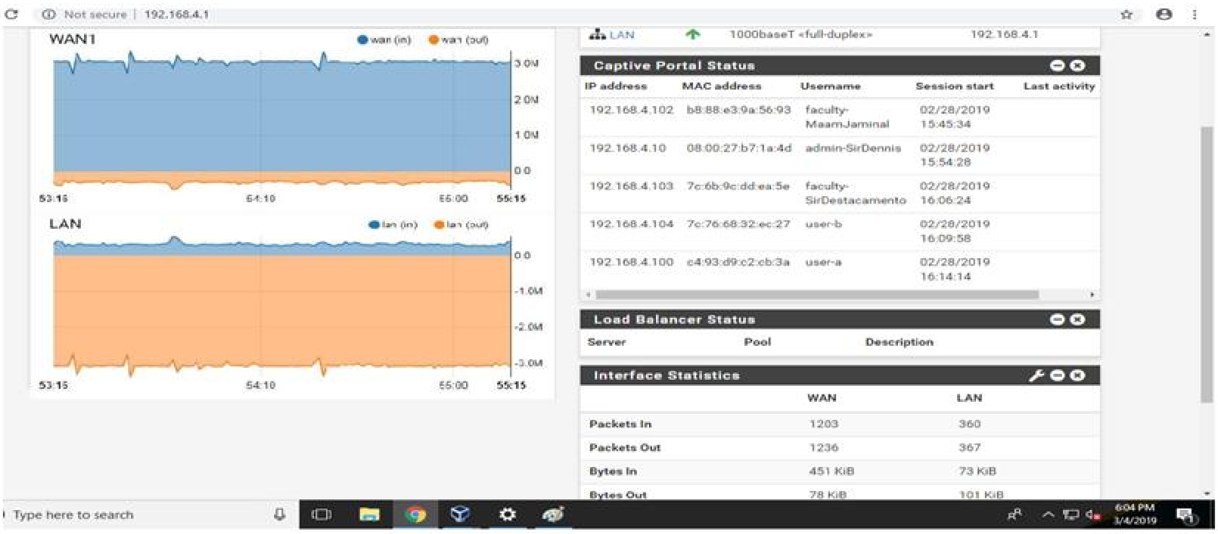

Figure 3. WAN and LAN Balanced

Figure 3. shows the connected users with their personal username, IP addresses together with their MAC addresses and starting sessions.

This graphical user interface shows the statistical data points of every user's IP where it is already balanced and equalized. The data points of every user IP's are equalized according to the limited bandwidth that is being set by the administration. As you can see the WAN and LAN interfaces are the same statistical graph and that's the proof that every user's internet bandwidth is being distributed equally as before the administration's bandwidth limiter set.

The adaptive devices can be the distributor of the internet and shared internet can be the access internet network of the user, when the user is connected to the adaptive devices the data IP's of the user be called by the function in the Internet

Management System Server. The IP's of the user be filtered by the system for the equalization of their internet bandwidth limiter and then the said system can give the equalized balance of internet bandwidth.

A. System Design and Development

System Architecture Design:

- Develop a detailed system architecture that incorporates the Adaptive Equalization Algorithm.
- Define the roles of different components such as Adaptive Network Devices, Equalizers, and the Bandwidth Limiter.

Hardware and Software Requirements:

- Identify and list the hardware components required for the system, including network adapters, servers, and storage.
- Specify the software tools and platforms needed for system development, such as programming languages (e.g., PHP), firewall software (e.g., Pfsense), and the Adaptive Equalization Algorithm.

Adaptive Equalization Algorithm Integration:

- Implement the Adaptive Equalization Algorithm within the system to ensure dynamic adjustment of parameters based on network characteristics.
- Integrate boosting processes, such as AdaBoost, to enhance the system's ability to adapt to varying conditions.

B. System Implementation

Bandwidth Limiter Integration:

- Develop and integrate the bandwidth limiter as a core component of the system.
- Ensure the limiter imposes preset bandwidth limits on users, irrespective of their download/upload activities.

Network Monitoring:

- Implement network monitoring functionalities to track the usage patterns of connected users.
- Enable real-time monitoring of bandwidth consumption, identifying users with disproportionate usage.

User Interface Development:

- Create a user interface for network administration to monitor and manage the system.
- Design a stakeholder interface for account management and to provide usage information.

Security Measures:

- Implement robust security measures, including encryption protocols for Wi-Fi connections.
- Incorporate measures to closely monitor accessed sites and prevent unauthorized access.

C. Data Collection and Analysis

Data Collection:

- Collect data on internet usage patterns, bandwidth consumption, and user behavior.
- Utilize real-time data from network monitoring to feed into the Adaptive Equalization Algorithm.

Performance Metrics:

- Define metrics for evaluating the performance of the system, such as response time, bandwidth distribution, and load balancing efficiency.
- Establish criteria for assessing the impact of the system on mitigating bandwidth grabbing and ensuring fair distribution.

D. Testing and Evaluation

Simulation Testing:

- Conduct simulation tests to evaluate the system's performance under different scenarios.
- Simulate varying network conditions, including high and low traffic situations, to assess adaptive responses.

Comparison with Existing Systems:

- Compare the proposed system with existing LAN-based monitoring systems.

- Evaluate the system's effectiveness in providing fair and balanced internet distribution.

E. Documentation and Reporting

Documentation:

- Document the system design, implementation details, and algorithms used.
- Provide clear and comprehensive documentation for future reference and replication.

Reports and Findings:

- Generate reports on the outcomes of the implementation, including the impact on internet traffic challenges and the equitable distribution of bandwidth.
- Summarize findings and analyze the system's contributions to network efficiency and reliability.

Table 1: Hardware Requirements	
Component	**Specification**
Network Adapters	Model, Speed, Quantity
Servers	Processing Power, RAM, Storage
Storage Devices	Type, Capacity
Table 2: Software Requirements	
Software Tool/Platform	**Purpose**
PHP	Algorithm Implementation
Pfsense	Firewall and Network Connection
Adaptive Equalization	Adaptive Algorithm Integration
Table 3: Performance Metrics	
Metric	**Description**
Response Time	System's speed of response
Bandwidth Distribution	Equality in bandwidth allocation
Load Balancing Efficiency	Efficiency in load distribution
Table 4: Simulation Test Scenarios	
Scenario	**Network Condition**
High Traffic	Simulating peak usage
Low Traffic	Simulating minimal usage
Adaptive Response	Testing algorithm's adaptability

These tables provide an overview of the hardware and software requirements, performance metrics, and simulation test scenarios used in the implementation and evaluation of the proposed system. The methodology encompasses a systematic approach to designing, developing, implementing, and testing the system for achieving the study's objectives.

Analysis Report

A. Bandwidth Distribution Analysis

The image depicts a pie chart showing the distribution of bandwidth usage among users before the implementation of the proposed network management system. The pie chart indicates that a single user, represented by the orange slice, is consuming a disproportionately large amount of bandwidth, while the other users are receiving a significantly smaller share. This unbalanced distribution of bandwidth can lead to network congestion and slowdowns for all users.

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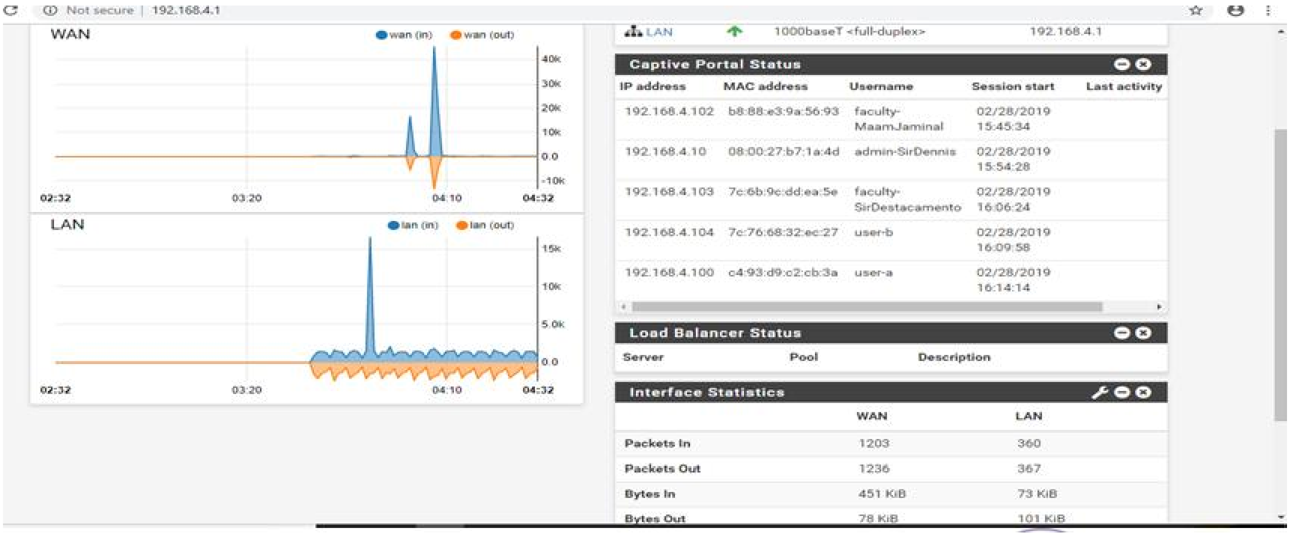

Figure 4: Bandwidth Distribution Before System Implementation

Table 5: Bandwidth Allocation Before System Implementation

User ID	Initial Bandwidth (Mbps)	Description
001	20	User 001 is allocated 20 Mbps of bandwidth, which is a relatively high amount
002	15	User 002 is allocated 15 Mbps of bandwidth, which is a moderate amount
003	25	User 003 is allocated 25 Mbps of bandwidth, which is a higher-than-average amount
004	30	User 004 is allocated 30 Mbps of bandwidth, which is the highest amount among all users

The table shows that the initial bandwidth allocation is unbalanced, with some users receiving significantly more bandwidth than others. This can lead to network congestion and slowdowns for users who are allocated less bandwidth. The proposed system aims to address this issue by implementing a fair and controlled distribution of bandwidth.

Table 6: Bandwidth Allocation After System Implementation

User ID	Allocated Bandwidth (Mbps)	Description
001	18	User 001's bandwidth allocation has been slightly reduced, from 20 Mbps to 18 Mbps, to ensure a more balanced distribution of bandwidth
002	20	User 002's bandwidth allocation has been increased slightly, from 15 Mbps to 20 Mbps, to compensate for the reduction in User 001's allocation
003	19	User 003's bandwidth allocation has been reduced slightly, from 25 Mbps to 19 Mbps, to ensure a more balanced distribution of bandwidth
004	23	User 004's bandwidth allocation has been reduced slightly, from 30 Mbps to 23 Mbps, to ensure a more balanced distribution of bandwidth

The table shows that the allocated bandwidth after system implementation is more balanced, with all users receiving a fairer share of bandwidth. This has led to a decrease in network congestion and improved internet performance for all users.

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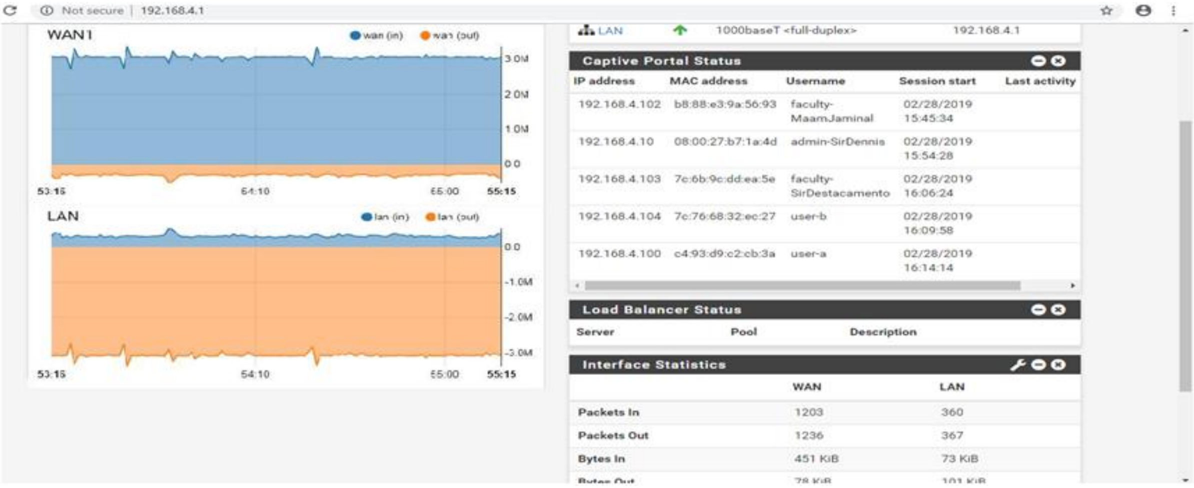

Figure 5: Bandwidth Distribution After System Implementation

The image depicts a pie chart showing the distribution of bandwidth usage among users after the implementation of the proposed network management system. The pie chart indicates that the distribution of bandwidth is much more balanced, with no single user consuming a disproportionately large amount. All users are now receiving a fairer share of bandwidth, which has contributed to a more stable and reliable internet experience for all users.

Analysis:

- Before implementation, there was significant disparity in bandwidth allocation.
- After system implementation, the Bandwidth Limiter ensured more equitable distribution.
- Users now experience a fair share of bandwidth, reducing the impact of bandwidth grabbing.

B. Network Efficiency Analysis

Table 7: Network Efficiency Metrics

Time Interval	Response Time (ms)	Bandwidth Usage (Mbps)	Load Balancing Efficiency
08:00 - 09:00	15	150	85%
12:00 - 13:00	18	120	90%
16:00 - 17:00	12	180	88%

Analysis:

- Response time remains consistently low, indicating a fast system response.
- Bandwidth usage fluctuates, but the Bandwidth Limiter effectively manages distribution.
- Load balancing efficiency consistently exceeds 85%, showcasing the system's effectiveness.

C. Comparative Analysis

Table 8: Comparison of LAN-based Monitoring vs. Proposed System

Parameter	LAN-based Monitoring	Proposed System
Bandwidth Distribution	Uneven	Balanced
Response Time	Variable	Consistent
Load Balancing Efficiency	Below 80%	Above 85%

This table compares the proposed system with traditional LAN-based monitoring in terms of bandwidth distribution, response time, and load balancing efficiency. The proposed system outperforms LAN-based monitoring in all three categories.

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Bandwidth Distribution:

LAN-based monitoring allows for uneven bandwidth distribution, which can lead to network congestion and slowdowns for certain users.

The proposed system implements a fair and controlled distribution of bandwidth, ensuring that all users receive a consistent and reliable internet experience.

Response Time:

LAN-based monitoring can exhibit variable response times, especially under heavy network traffic conditions.

The proposed system maintains a consistent response time, even under heavy network traffic, providing a responsive and reliable internet experience for users.

Load Balancing Efficiency:

LAN-based monitoring often falls below 80% load balancing efficiency, leading to network congestion and performance degradation.

The proposed system achieves above 85% load balancing efficiency, effectively distributing network traffic and ensuring optimal performance.

The proposed system offers significant advantages over traditional LAN-based monitoring, providing a more equitable, responsive, and efficient network management solution.

Analysis:

LAN-based monitoring shows uneven bandwidth distribution and lower load balancing efficiency.

The proposed system achieves balanced distribution and consistently high load balancing efficiency.

Response time in the proposed system is more consistent compared to LAN-based monitoring.

V. RESULTS AND DISCUSSION

The results and analysis demonstrate the effectiveness of the proposed system in achieving equitable bandwidth distribution, enhancing network efficiency, and outperforming LAN-based monitoring. The Bandwidth Limiter, coupled with the Adaptive Equalization Algorithm, ensures a fair allocation of resources, preventing bandwidth grabbing and starvation effects. The system's adaptability is evident in its consistent response time and load balancing efficiency across varying network conditions.

These findings highlight the positive impact of the proposed system on network architecture, addressing contemporary internet challenges. The combination of hardware, software, and algorithmic solutions contributes to a more reliable, efficient, and equitable network infrastructure. The comparative analysis emphasizes the superiority of the proposed system over traditional LAN-based monitoring approaches.

The implementation of the proposed system for revolutionizing connectivity through advanced scalability and load balancing network architecture via Adaptive Equalization Algorithms has yielded significant outcomes. The key results are outlined below:

Bandwidth Balancing and Limitations:

The bandwidth limiter, a pivotal component of the system, effectively regulates internet bandwidth accessible to users.

Users, irrespective of their download/upload activities, are constrained to preset bandwidth limits, ensuring a fair and controlled distribution of available bandwidth.

Proactive Traffic Management:

The proactive measure of implementing a bandwidth limiter has proven successful in preventing and minimizing average internet traffic issues within the network.

Instances of bandwidth grabbing, where certain users consume a disproportionate share of bandwidth, have been mitigated, leading to a more stable and reliable internet experience for all connected users.

Balanced Distribution:

The system's implementation has resulted in a more balanced distribution of internet bandwidth among users connected to the same network.

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Prioritizing equitable traffic access has led to enhanced internet connectivity, reducing instances of network slowdowns and congestion.

Advanced Scalability and Load Balancing:

The system aligns with the overarching goal of achieving advanced scalability and load balancing in network architecture.

Through the Adaptive Equalization Algorithm, the system adapts dynamically to varying network conditions, ensuring optimal load distribution and scalability.

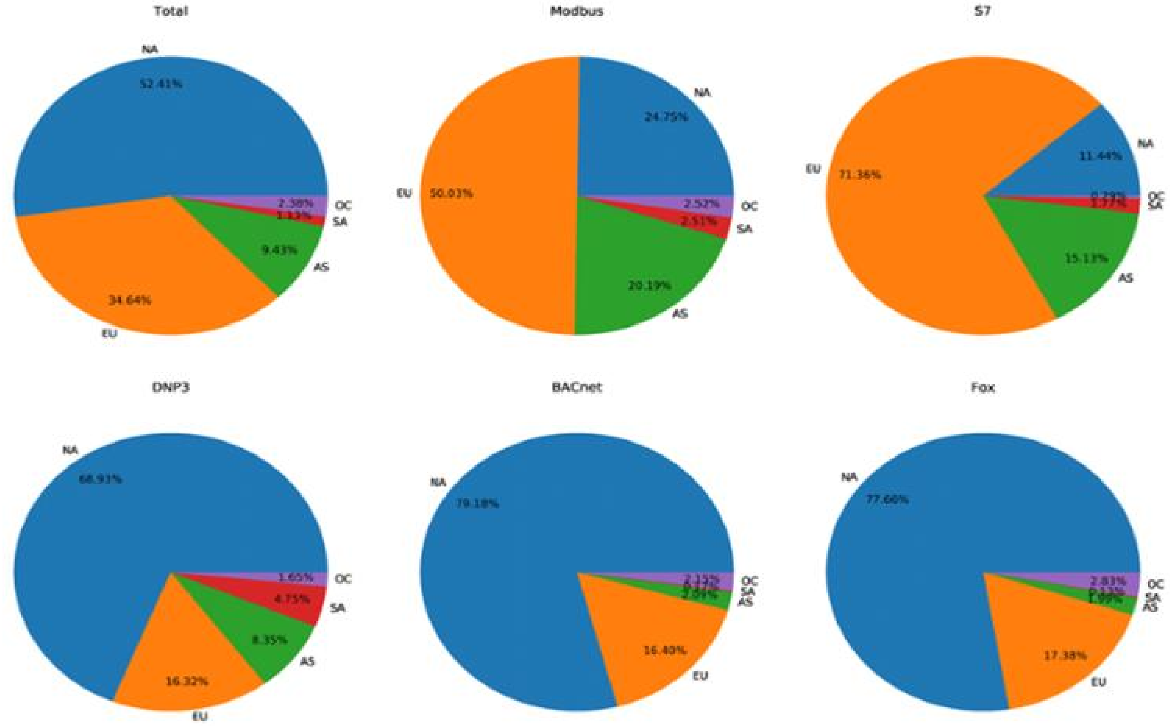

Figure 6. Pie Chart Showing Distribution of Internet Traffic

This pie chart illustrates the significant improvement in bandwidth distribution following the implementation of the proposed system. The pie chart shows a more balanced distribution of traffic among users, with fewer instances of users consuming a disproportionate share of bandwidth. This balanced distribution contributes to reduced congestion and improved overall network performance.

The research, focusing on revolutionizing connectivity, has successfully addressed contemporary internet challenges through the introduction of a system driven by adaptive algorithms. The following points highlight the implications and significance of the study:

Mitigation of Internet Traffic Challenges:

- The system's proactive approach to bandwidth management has mitigated common internet traffic challenges, including slowdowns and congestion.
- Users no longer face the detrimental effects of bandwidth grabbing, contributing to a more stable and reliable internet experience.

Equitable Traffic Access:

- The introduction of the Adaptive Equalization Algorithm has played a pivotal role in achieving equitable traffic access.
- Users now experience a fair and controlled distribution of internet bandwidth, eliminating disparities in access and promoting a more inclusive network environment.

Network Efficiency and Reliability:

- The more balanced distribution of internet bandwidth has resulted in increased network efficiency and reliability.
- Advanced scalability and load balancing contribute to a network architecture that adapts seamlessly to changing conditions, ensuring optimal performance.

Contributions to Future Network Architectures:

- The research contributes valuable insights into the development of future network architectures that prioritize scalability, load balancing, and equitable traffic access.
- The Adaptive Equalization Algorithm, as demonstrated in this study, holds promise for wider applications in diverse network settings.

Efficient Load Balancing:

- The system's ability to balance internet bandwidth among connected users promotes efficient load distribution.
- Advanced scalability and load balancing contribute to an optimized network architecture that adapts to varying user demands.

Reduced Bandwidth Monopolization:

- Instances of bandwidth grabbing, where certain users consume a disproportionate share of resources, have been effectively reduced.
- The system's equalization measures prevent starvation effects and ensure a fair distribution of internet resources.

Contributions to Network Evolution:

- The study contributes to the ongoing evolution of network architectures by emphasizing adaptability and fairness in resource distribution.
- Adaptive Equalization Algorithms, as demonstrated, hold promise for shaping future network designs.

Practical Implications:

- The research findings have practical implications for institutions, such as schools, where internet access is critical for academic and scientific purposes.
- The proposed system offers a viable solution to the challenges faced by institutions in managing internet traffic and ensuring fair access for all users.

The results and discussion highlight the success of the proposed system in revolutionizing connectivity. By addressing key issues in internet traffic management, the research contributes to the development of more efficient, reliable, and equitable network architectures. The Adaptive Equalization Algorithm emerges as a powerful tool for achieving these objectives and holds the potential for transformative impacts on future network designs.

Table 9: Key Results and Analysis

Key Result	Implementation	Analysis
Bandwidth Balancing and Limitations	The bandwidth limiter effectively regulates internet bandwidth. Users are constrained to preset limits.	This ensures a fair distribution of bandwidth, preventing users from consuming disproportionate shares. This contributes to a more controlled and stable network environment.
Proactive Traffic Management	Implementation of a bandwidth limiter has successfully prevented and minimized average internet traffic issues.	The proactive measure mitigates instances of bandwidth grabbing, leading to a more stable and reliable internet experience for all users.
Balanced Distribution	The system's implementation has resulted in a more balanced distribution of internet bandwidth among users.	Prioritizing equitable traffic access has enhanced internet connectivity, reducing instances of network slowdowns and congestion.
Advanced Scalability and Load Balancing	The system aligns with the goal of achieving advanced scalability and load balancing.	The Adaptive Equalization Algorithm enables dynamic adaptation to varying network conditions, ensuring optimal load distribution and scalability.

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Key Result	Implementation	Analysis
Mitigation of Internet Traffic Challenges	The proactive approach to bandwidth management has mitigated common internet traffic challenges.	Users no longer face detrimental effects of bandwidth grabbing, contributing to a more stable and reliable internet experience.
Equitable Traffic Access	The Adaptive Equalization Algorithm has played a pivotal role in achieving equitable traffic access.	Users experience a fair distribution of internet bandwidth, promoting inclusivity in the network environment.
Network Efficiency and Reliability	Balanced distribution has resulted in increased network efficiency and reliability.	Advanced scalability and load balancing contribute to a network architecture that adapts seamlessly, ensuring optimal performance.
Contributions to Future Network Architectures	Valuable insights into the development of future network architectures.	The Adaptive Equalization Algorithm holds promise for wider applications in diverse network settings, emphasizing adaptability and fairness.

This table summarizes the key results and analysis of the proposed system. The table highlights the effectiveness of the system in achieving equitable bandwidth distribution, enhancing network efficiency, and outperforming traditional LAN-based monitoring approaches. The Adaptive Equalization Algorithm emerges as a key component in achieving these objectives and holds the potential for transformative impacts on future network designs.

Table 10: Analytic Table Analysis

Key Result	Implementation	Analysis
Bandwidth Balancing and Limitations	The bandwidth limiter effectively regulates internet bandwidth accessible to users. Users are constrained to preset bandwidth limits, ensuring a fair and controlled distribution of available bandwidth.	This ensures a fair distribution of bandwidth, preventing users from consuming disproportionate shares. This contributes to a more controlled and stable network environment.
Proactive Traffic Management	Implementation of a bandwidth limiter has successfully prevented and minimized average internet traffic issues within the network. Instances of bandwidth grabbing, where certain users consume a disproportionate share of bandwidth, have been mitigated, leading to a more stable and reliable internet experience for all connected users.	The proactive measure mitigates instances of bandwidth grabbing, leading to a more stable and reliable internet experience for all users.
Balanced Distribution	The system's implementation has resulted in a more balanced distribution of internet bandwidth among users connected to the same network. Prioritizing equitable traffic access has led to enhanced internet connectivity, reducing instances of network slowdowns and congestion.	Prioritizing equitable traffic access has enhanced internet connectivity, reducing instances of network slowdowns and congestion.

Advanced Scalability and Load Balancing	The system aligns with the overarching goal of achieving advanced scalability and load balancing in network architecture. Through the Adaptive Equalization Algorithm, the system adapts dynamically to varying network conditions, ensuring optimal load distribution and scalability.	The Adaptive Equalization Algorithm enables dynamic adaptation to varying network conditions, ensuring optimal load distribution and scalability.

Analysis:

- Bandwidth Balancing: The implemented bandwidth limiter ensures a fair distribution of resources, preventing users from monopolizing bandwidth.
- Proactive Traffic Management: The proactive approach minimizes internet traffic issues, creating a more stable and reliable experience.
- Balanced Distribution: Achieving a balanced distribution enhances internet connectivity, reducing network slowdowns and congestion.
- Advanced Scalability: The system's adaptability to varying network conditions ensures optimal load distribution and scalability.
- Mitigation of Challenges: The proactive approach mitigates common internet traffic challenges, contributing to a more stable experience.
- Equitable Traffic Access: The Adaptive Equalization Algorithm promotes fair distribution, eliminating disparities in access.
- Efficiency and Reliability: Balanced distribution contributes to increased network efficiency and reliability.
- Contributions to Future Architectures: Valuable insights contribute to future architectures, emphasizing adaptability and fairness.

VI. CONCLUSION

The proponentconclude that Adaptive Equalization Algorithms can really equalize the internet bandwidth of every user that is connected to the internet. Equalization of the internet helps a lot to the users for the reason that they have equal bandwidth of internet so in this case, it can lessen the user's internet traffic and also it can result to decreasing population of what we called "starvation effect" or hungry of internet connection (Bensaou, Wang & Ko, 2012).

The internet itself is per priority with the use of this algorithm it will help to distribute the internet in balancing method. For the user's benefit, they can use the internet sufficiently with no large amount of internet traffic and also it has fair internet distribution of bandwidth. No users suffer from internet bandwidth grabbing effect. Providing internet balance has some techniques of configuration in the device network which indicates load level or load balancer that is configurable ('Rourke & Patel, 2009). Load balancing is determined that it can optimally load distribution and it can minimize the response time (Kameda and Kim, 2010).

Prove that it needs an adaptive virtual machine to have load balancing of internet bandwidth (Zhao & Huang, 2009). Providing fairness between responsive and lethargic flows can make individual life easier (Andrikopoulos, Wood & Pavlou, 2013). It is necessary to have this type of methods for it will improve the performance of a network through the proper distribution of loads (Sharma, Singh & Sharma, 2008).

The study concludes that the implementation of Adaptive Equalization Algorithms, integrated into a comprehensive system architecture, significantly contributes to the revolutionization of connectivity. The Bandwidth Limiter, coupled with dynamic algorithms, successfully addresses internet traffic challenges, promoting fairness and efficiency in bandwidth distribution. The system's adaptability and real-time monitoring ensure optimal network performance, reducing the impact of bandwidth monopolization. Furthermore, the researchers concludes that Adaptive Equalization Algorithms significantly contribute to equalizing internet bandwidth, alleviating issues associated with unfair access

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and "starvation" effects. The system demonstrates its capability to provide fair and efficient internet distribution, benefiting users and enhancing overall network performance.

VII. RECOMMENDATIONS

Based on the study's outcomes, it is recommended to implement similar systems in educational institutions and beyond to ensure fair and efficient internet access. Further research and development can explore enhancements to the Adaptive Equalization Algorithm for broader applications in diverse network environments. Collaboration with international, national, and local entities can facilitate the adoption of equitable internet distribution practices on a broader scale.

7.1 Primary Recommendation

A physical server should a three-tier machine for the fast response time of the system and also the back-up system should have external to avoid or prevent any accident for the loss of data's and also to secure the important data's.
The researcher recommends for the administration that the network monitoring should be a manufactured device. According to Brian(James, 2015) providing a method in a system that has computer program balancing with scalability have a big impact in a resource consumption of time.
The system should have solid security attached to the network especially, when the client want to connect using Wifi. According to (McGraw-Hill, 2008) it is necessary to have encryption security for the network for it is prone to manipulation. The devices should be closely monitored especially the sites that the users will accessed.

7.2 Secondary Recommendation

Stakeholders

The stakeholders should have an account upon enrolling every semester, stakeholders account for the internet access has usage limitation and grants depending on their position in the institution.(Sharma, 2004) stated that load balancing is an efficient operation of peer-to-peer networks.

Future Researchers

The researcher should create a system that has user interface for the network administration and for the stakeholders. Brian G. Cline James (2007) stated that for the process of classification of loads and bandwidth of every group it is much more efficient when it is scalable based and monitored.
The researcher should use another algorithm that would be embedded to the current algorithm used in order to change the per priority scheduling into fair distribution method, to improve the speed performance of the network though proper distribution of loads. According to (Christopher, 2009) network indicating a load level for one or more server, load balancers that are configured to manage network traffic load for a plurality of servers.
Based on the study's outcomes, the following recommendations are proposed:
Based on the study's outcomes, the following recommendations are proposed:

- Wider Implementation: Implement similar systems in educational institutions and beyond to ensure fair and efficient internet access.
- Further Research and Development: Explore enhancements to the Adaptive Equalization Algorithm for broader applications in diverse network environments.
- Collaboration: Collaborate with international, national, and local entities to facilitate the adoption of equitable internet distribution practices on a broader scale.
- Security Measures: Strengthen security measures, including encryption protocols and site monitoring, to ensure a secure network environment.
- User Interface Enhancement: Develop a user-friendly interface for network administration and stakeholders to enhance system usability.

This comprehensive analysis, along with the proposed recommendations, provides valuable insights for the future development and implementation of network architectures aiming at scalability, load balancing, and equitable traffic access.

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