International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

Analyzing Ip Phone Data In Cisco Packet Tracer: A Comparative Study Of Different Network Topologies Using Machine Learning And Network Analysis Methods

Bondalapati Pavan Kumar, Kallakuri Sai Vaishnavi, Kadambari Gayathri Phani Sri Nitya, Peddireddy Pallavi Durga, Lakshmi Ramani Burra, Praveen Tumuluru

Submitted: 26/01/2024 **Revised**: 04/03/2024 **Accepted**: 12/03/2024

Abstract: In the contemporary business landscape, communication networks are indispensable for seamless operations. IP phones are pivotal in facilitating effective voice communication. This study delves into analyzing network data using IP phones within different topologies in Cisco Packet Tracer. By Leveraging data mining and machine learning techniques, it seeks to expose valuable insights into network performance, traffic patterns, and potential vulnerabilities. These findings hold significant promise for network optimization, performance enhancement, and fortified security measures. This research provides advantages to network administrators and data scientists and contributes to the overall reliability and efficiency of IP phone networks, ensuring they are well-equipped to meet the demands of the modern digital era.

Keywords: *Communication networks, IP Phones, Cisco Packet Tracer, Data Science Techniques, Network optimization.*

1. INTRODUCTION

In the contemporary business landscape, marked by rapid technological advancements, adopting IP phones has ushered in a paradigm shift in how organizations conduct their operations. The seamless integration of Voice over Internet Protocol (VoIP) technology, embodied by IP telephony, has enhanced connectivity and become the cornerstone of modern communication systems. While instrumental in boosting productivity, this transformation brings forth new challenges related to effectively managing IP phone performance, reliability, and security within the intricate network setups that businesses rely upon.

This research embarks on a critical exploration to unravel the complexities of IP phone data within diverse network configurations. By leveraging the powerful simulation environment Cisco Packet Tracer provides, we aim to employ advanced data science techniques to extract actionable insights. These insights, in turn, promise to shed light on the multifaceted aspects of network performance, traffic patterns, and potential vulnerabilities associated with IP phone usage.

Recognizing the dynamic nature of business communication, where IP phones are integral components deployed across a spectrum of network setups, each presenting its unique challenges, our study underscores the imperative of utilizing data science as a strategic toolset. Our goal is to unlock the latent potential hidden within the vast amounts of IP phone data through the meticulous application of data mining and machine learning analysis, coupled with a thorough examination of network traffic patterns. This comprehensive analysis seeks to provide nuanced insights that optimize network performance levels, identify traffic patterns, and fortify security measures.

The significance of our research is accentuated by the pervasive influence of digital communication in today's corporate environment. In this context, Cisco Packet Tracer emerges as an ideal platform, offering a dynamic simulation environment that allows for controlled experiments and in-depth analyses of IP phone data in various network setups. The findings derived from these simulations are poised to bridge the gap between theoretical insights and practical applications, offering tangible benefits to real-world network management scenarios.

In summary, our research embarks on a journey to harness the power of data science for a thorough examination of IP phone data within diverse network topologies. The overarching goal is to deepen our understanding of network performance, traffic patterns, and security considerations—contributing valuable

[1] *Koneru Lakshmaiah Education Foundation – INDIA*
ORCID ID : 0009-0001-8951-2031
[2] *Koneru Lakshmaiah Education Foundation – INDIA*
ORCID ID : 0009-0008-9695-7371
[3] *Koneru Lakshmaiah Education Foundation – INDIA*
ORCID ID : 0009-0002-1843-6470
[4] *Koneru Lakshmaiah Education Foundation – INDIA*
ORCID ID : 0009-0006-5823-8662
[5] *Koneru Lakshmaiah Education Foundation – INDIA*
ORCID ID : 0000-0002-2969-6262
[6] *Koneru Lakshmaiah Education Foundation – INDIA*
ORCID ID :0000-0001-9426-205X

knowledge to the growing field of optimizing efficiency and security within IP phone networks. In an era where digital communication is the lifeblood of business operations, this study offers actionable insights for network administrators and data scientists. It provides a roadmap for organizations seeking to optimize their IP phone infrastructure in the face of continually evolving security threats.

2. LITERATURE SURVEY

In the contemporary landscape of computer networks and embedded systems, the Cisco Packet Tracer has emerged as a pivotal tool for simulating and experimenting with network configurations. Widely adopted in educational settings, Packet Tracer facilitates hands-on learning, allowing students to design networks, configure devices, and simulate various Ethernet protocols in real-time scenarios [1][7][8].

The design of network topologies plays a crucial role in shaping the performance and reliability of communication systems. This literature review meticulously examines six network topologies—bus, star, ring, mesh, tree, and hybrid—providing a comprehensive evaluation of their advantages and disadvantages. This knowledge equips network engineers and designers with insights essential for developing networks that align with the evolving demands of our interconnected digital world [2][9][10].

Voice over Internet Protocol (VoIP) technology, exemplified by IP phones, has garnered significant attention in telecommunications. This section delves into the challenges and advancements in VoIP, emphasizing the growing demand for high-quality voice transmission over IP networks. Researchers have focused on ensuring Quality of Service (QoS) for VoIP applications, addressing factors such as bandwidth requirements, end-to-end delay, jitter, and packet loss [3][11][12][13].

The successful implementation of IP phones at Nakhon Pathom Rajabhat University (NPRU) is a practical case study. This deployment seamlessly integrated IP phones with the existing analog phone infrastructure, overcoming shortages and reducing damage to analog telephone cards. The combination of IP phones, analog phones, and Analog Terminal Adapters (ATAs) ensured optimal performance, connecting VoIP users to the campus phone network while maintaining voice quality and user-friendliness [4][11][12].

Machine learning techniques play a pivotal role in analyzing the vast data generated in network configurations. This section highlights three key machine learning types—Classification, Clustering, and Regression—and their applications in extracting information and patterns from large datasets. The emphasis is on their significance in the knowledge discovery process and their potential to address real-world challenges [5][14][15][16].

In the context of Cisco Packet Tracer, the analysis of data extracted from simulated network topologies is crucial. This research evaluates the effectiveness of routing protocols in an IPv6 setting, considering metrics such as data transfer rate and convergence time. The results obtained through simulations provide insights into the efficiency and suitability of these routing protocols for handling network traffic in IPv6 networks [6][9][10][17].

In summary, this literature survey not only provides an overview of key tools and technologies but also establishes their interconnectedness and relevance to the specific objectives of our research[18][19]. By critically evaluating each aspect and incorporating recent developments, this study aims to contribute to the evolving landscape of computer networks and communication systems[20][21][22].

3. METHODOLOGY

The process typically progresses through the following steps.

Build Topology: Creating a network infrastructure model in Cisco Packet Tracer involves building a topology that mimics real-life networking situations. It includes designing and setting up network devices like routers, switches, and end-user devices and establishing connections between them. Users can define network properties, IP addresses, and routing protocols to simulate diverse network environments. This simulated topology is a valuable resource for network design problem-solving and testing, providing users with hands-on experience working with Cisco networking equipment in a virtual environment.

Initialize IP Phones: Setting up IP phones in Cisco Packet Tracer begins with configuring their IP addresses, which can be done manually or through a server if available. These IP phones are connected to network switches and may require additional configurations for call control depending on the VoIP system in use. Configuring IP phones in a Packet Tracer network allows the simulation of VoIP communication and testing scenarios, providing essential knowledge about voice-over IP technologies and ensuring call functionality in a controlled environment.

Make Calls: To make calls using IP phones in Cisco Packet Tracer, users need to dial the extension or IP address of the target phone, similar to traditional phone systems. Once the call is initiated, the VoIP system processes the request, establishing a connection between the caller and the recipient's IP phone. Communication can occur through audio or video, and users can test features like call hold, transfer, and conference calls. This practical experience in Packet Tracer enables network administrators and students to learn to configure, manage, and troubleshoot VoIP systems within a controlled environment.

Fig-1 Steps to analyze the data collected from the topologies in the Cisco packet tracer.

Data Collection: Collecting data from IP phones in Cisco Packet Tracer involves gathering information on call activity, network performance, and device status. The system provides call duration, quality, history, and network traffic statistics. This data is crucial for monitoring and troubleshooting the health and performance of the VoIP network. Network administrators can use this information to identify and resolve issues, ensuring effective communication and optimizing network functionality. Packet Tracer is a platform for acquiring knowledge on collecting and interpreting data effectively—knowledge essential for maintaining and enhancing VoIP systems.

Data Preprocessing: Data preprocessing is critical to data analysis and machine learning. It encompasses cleaning, transforming, and organizing data to make it suitable for analysis and modelling purposes. These tasks involve handling missing values, removing duplicates, scaling features, encoding variables, and more. Preprocessing ensures the data is consistent and well-structured, enabling algorithms to derive insights and predictions. It is a pivotal step in data preparation that significantly influences the quality and accuracy of results across data-driven tasks.

Feature Selection: When building a machine learning model, selecting features for the training process is crucial. This involves choosing informative variables from your dataset while disregarding unnecessary or redundant ones. Feature selection plays a role in simplifying the model, reducing overfitting, and improving its performance and interpretability. Different feature selection techniques exist, including filter, wrapper, and embedded methods—each with advantages and trade-offs. The ultimate goal is to balance the number of features used and the model's predictive ability, thus enhancing its capability to make accurate predictions or classifications.

Machine Learning Model: Training a machine learning model involves teaching it to recognize patterns and make predictions based on input data. The model learns how different features relate to the desired output during this process. Typically, a labelled dataset is used, providing both the input data and the correct corresponding output. The model adjusts its parameters through optimization techniques to minimize the difference between its predictions and target values. The training objective is for the model to apply its learning to data accurately, enabling it to make precise predictions or classifications in real-world scenarios. After training, the model can be evaluated, fine-tuned, and deployed to predict new data.

Predict the Features: Making predictions about characteristics or attributes of unseen data is often referred to as feature prediction. It involves utilizing a trained machine learning model to estimate these features, encompassing a range of variables such as stock prices, identifying specific objects in images, or translating natural language. Applying the model to data can generate predictions based on the patterns and relationships it learned during training. Accurate feature predictions have applications ranging from forecasting business trends to providing personalized recommendations in recommendation systems.

Configuring IP Phones within the topology using Cisco Packet Tracer.

Setting up IP phones entails configuring device parameters and network settings to facilitate communication over an IP-based network. This setup involves specifying the phone's IP address, subnet mask, gateway, and other settings, including DNS servers. It is crucial to ensure the accurate configuration of IP phones to enable network connectivity, VoIP calling capabilities, and service access. Precise configuration is instrumental in deploying IP phone systems for seamless organizational communication.

a. Commands: Configuring Interface in the router

->en

->conf t

->int fa0/0

->ip add <ip address> <ip address>

->no sh

->ex

->do wr

b. Commands: Configuring DHCP Server in the router

->service dhcp

->ip dhcp pool <name>

->network <ip address> <ip address>

->default-router <ip address>

c. Commands: Configuring IP

->option 150 ip <ip address>

->exit

->do wr

d. Commands: Configuring call manager express in the router

->telephony-service

->max-dn 4

->max-ephones 4

->ip source-address <ip add> port <num>

->auto assign <number> to <number>

->exit

e. Commands: Configuring Voice VLAN in the switch

->en

->conf t

->int range fa0/<range>

->switchport mode access

->switchport voice vlan 1

->exit

->do wr

f.Commands: Assigning IP address to IP phones in router

->en

->conf t

->

->ephone-dn 1

->number <phone number>

->ex

->

->ephone-dn 1

->number <phone number>

->ex

4. RESULTS AND DISCUSSION

A. Star Topology

Fig-2 illustrates the outcomes of implementing IP phones within a star topology. Critical data metrics, including call duration, call quality, latency, jitter, and packet loss, are extractable from the network configuration in Cisco Packet Tracer. The specifics of this data are presented in Table 1.

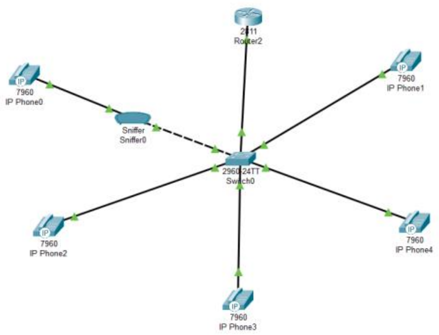

Fig.2 Star topology of IP Phones

Fig. 3 depicts the distribution of packet types transmitting more frequently within the Star Topology. This information sheds light on the network's nature and volume of packet traffic. Furthermore, Fig.4 provides insights into the average time packets traverse from one location to another within the Star Topology. These visualizations offer a comprehensive view of the network's performance and behaviour, allowing for a detailed analysis of IP phone communication in the context of the star topology configuration.

Table 1. Data extracted from Star Topology

Call ID	Caller IP	Receiver IP	Start Time	End Time	Call Duration (sec)	Call Quality	Latency (ms)	Jitter (ms)	Packet Loss (%)
1	192.168.1.2	192.168.1.3	########	########	300	4.5	50	20	1
2	192.168.1.4	192.168.1.5	########	########	300	3.8	80	40	2
3	192.168.1.1	192.168.1.2	########	########	150	4.2	40	10	0.5
4	192.168.1.5	192.168.1.1	########	########	135	4	60	15	1
5	192.168.1.3	192.168.1.4	########	########	165	3.5	70	30	2

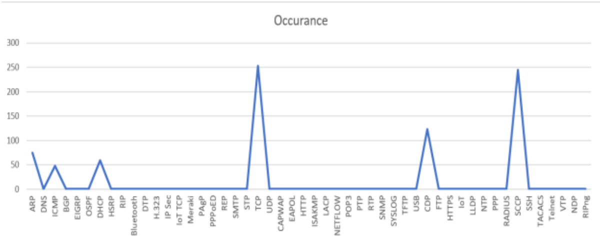

Fig.3 Traffic analysis in the Star Topology

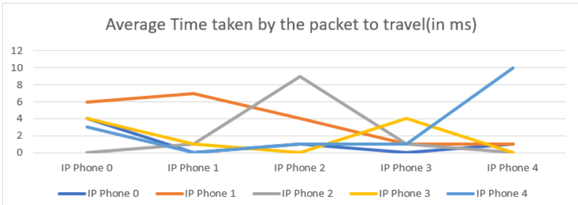

Fig.4 Average time taken in the Star Topology

B. Ring Topology

Fig.6 depicts the outcomes of implementing IP phones within a ring topology. Pertinent data metrics, encompassing call duration, call quality, latency, jitter, and packet loss, are retrievable from the network configuration within the Cisco Packet Tracer. The comprehensive representation of this data is presented in Table 2.

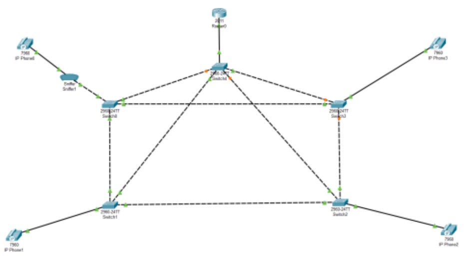

Fig.6 Ring topology of IP Phones

Fig.7 shows the distribution of packet types that exhibit higher transmission frequency within the Ring Topology. This visual insight provides an understanding of the predominant packet traffic types in the network configuration. Additionally, Fig.8 visually represents the average time packets traverse from one location to another within the Ring Topology. These graphical representations collectively contribute to a nuanced analysis of IP phone communication within the context of the ring topology configuration.

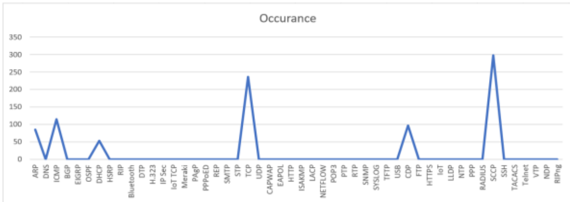

Fig.7 Traffic Analysis in the Ring Topology

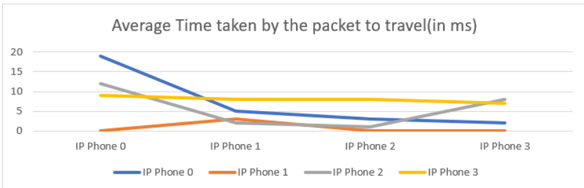

Fig.8 Average time taken in the Ring Topology

C. Mesh Topology

Figure 9 illustrates the outcomes of implementing IP phones within a mesh topology. Essential data metrics, encompassing call duration, call quality, latency, jitter, and packet loss, are extractable from the network configuration within the Cisco Packet Tracer. The comprehensive representation of this data is presented in Table 3.

Table 2. Data extracted from Ring Topology

Call ID	Caller IP	Receiver IP	Start Time	End Time	Call Duration (sec)	Call Quality	Latency (m	Jitter (ms)	Packet Loss (%)

							s)		
1	192.168.1.2	192.168.1.3	01-08-2023 09:00	01-08-2023 09:05	300	4.5	50	20	1
2	192.168.1.4	192.168.1.1	01-08-2023 09:10	01-08-2023 09:15	320	3.7	80	40	2
3	192.168.1.1	192.168.1.2	01-08-2023 09:20	01-08-2023 09:22	180	4.1	40	15	0.5
4	192.168.1.3	192.168.1.4	01-08-2023 09:30	01-08-2023 09:32	150	3.8	60	1	0.5

Table 3. Data extracted from Mesh Topology

Call ID	**Caller IP**	**Receiver IP**	**Start Time**	**End Time**	**Call Duration (sec)**	**Call Quality**	**Latency (ms)**	**Jitter (ms)**	**Packet Loss (%)**
1	192.168.1.2	192.168.1.3	01-08-2023 10:00	01-08-2023 10:03	180	4.2	70	15	1
2	192.168.1.3	192.168.1.4	01-08-2023 10:10	01-08-2023 10:12	150	4.6	40	10	0.5
3	192.168.1.1	192.168.1.2	01-08-2023 10:20	01-08-2023 10:25	300	3.9	80	30	2
4	192.168.1.4	192.168.1.1	01-08-2023 10:30	01-08-2023 10:35	300	3.5	60	25	1

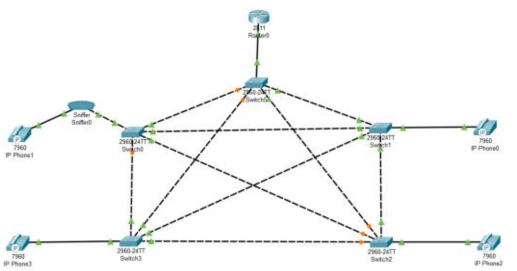

Fig.9 Mesh topology of IP Phones

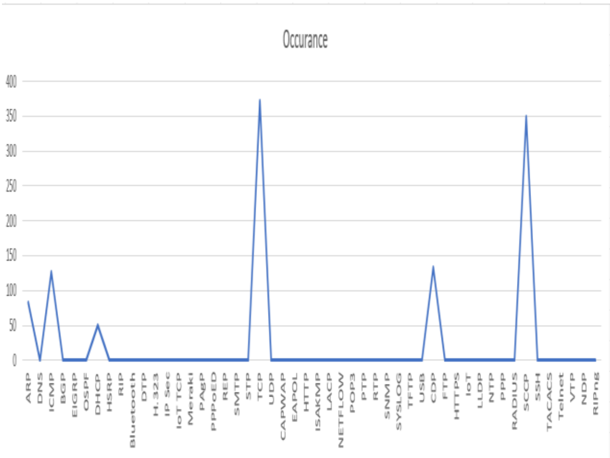

Fig.10 Traffic Analysis in the Mesh Topology

Fig.10 depicts the distribution of packet types with higher transmission frequency within the Mesh Topology. This visual insight provides an understanding of the predominant packet traffic types in the network configuration. Furthermore, Fig.11 illustrates the average time packets traverse from one location to another within the Mesh Topology. These graphical representations collectively contribute to a nuanced analysis of IP phone communication within the context of the mesh topology configuration.

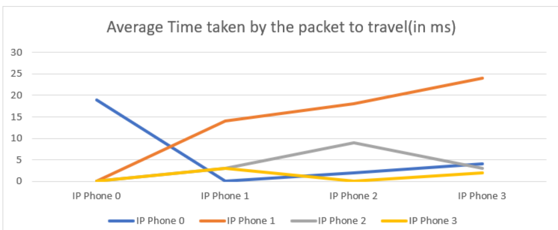

Fig.11 Average time taken in the Mesh Topology

D. Bus Topology

Fig.12 illustrates the outcomes of implementing IP phones within a bus topology. Critical data metrics, covering call duration, call quality, latency, jitter, and packet loss, can be extracted from the network configuration within the Cisco Packet Tracer. The comprehensive representation of this data is presented in Table 4.

Table 4. Data extracted from Bus Topology

Call ID	**Caller IP**	**Receiver IP**	**Start Time**	**End Time**	**Call Duration (sec)**	**Call Quality**	**Latency (ms)**	**Jitter (ms)**	**Packet Loss (%)**
1	192.168.1.2	192.168.1.3	01-08-2023 11:00	01-08-2023 11:05	300	4.3	50	15	1
2	192.168.1.4	192.168.1.1	01-08-2023 11:10	01-08-2023 11:15	300	3.8	60	20	1
3	192.168.1.3	192.168.1.4	01-08-2023 11:20	01-08-2023 11:25	300	3.6	70	25	2
4	192.168.1.1	192.168.1.2	01-08-2023 11:30	01-08-2023 11:35	300	3.9	80	30	2

Table 5. Data extracted from Tree Topology

Call ID	Caller IP	Receiver IP	Start Time	End Time	Call Duration (sec)	Call Quality	Latency (ms)	Jitter (m30s)	Packet Loss (%)
1	192.168.1.1	192.168.1.2	01-08-2023 12:00	01-08-2023 12:05	300	4.6	40	10	0.5
2	192.168.1.2	192.168.1.3	01-08-2023 12:10	01-08-2023 12:15	300	4.1	60	20	1
3	192.168.1.3	192.168.1.4	01-08-2023 12:20	01-08-2023 12:25	300	3.7	80	30	2
4	192.168.1.4	192.168.1.5	01-08-2023 12:30	01-08-2023 12:35	300	3.9	70	25	2
5	192.168.1.5	192.168.1.6	01-08-2023 12:40	01-08-2023 12:45	300	4.2	50	15	1
6	192.168.1.6	192.168.1.7	01-08-2023 12:50	01-08-2023 12:55	300	3.8	60	20	1
7	192.168.1.7	192.168.1.8	01-08-2023 13:00	01-08-2023 13:05	300	3.6	70	25	2
8	192.168.1.8	192.168.1.9	01-08-2023 13:10	01-08-2023 13:15	300	4.5	40	10	0.5
9	192.168.1.9	192.168.1.10	01-08-2023 13:20	01-08-2023 13:25	300	4.3	50	15	1
10	192.168.1.10	192.168.1.11	01-08-2023 13:30	01-08-2023 13:35	300	3.7	80	30	2
11	192.168.1.11	192.168.1.12	01-08-2023 13:40	01-08-2023 13:45	300	4.6	40	10	0.5
12	192.168.1.12	192.168.1.13	01-08-2023 13:50	01-08-2023 13:55	300	3.9	70	25	2
13	192.168.1.13	192.168.1.14	01-08-2023 14:00	01-08-2023 14:05	300	4.2	50	15	1
14	192.168.1.14	192.168.1.15	02-08-2023 14:10	01-08-2023 14:15	300	3.8	60	20	1
15	192.168.1.15	192.168.1.1	03-08-2023 14:20	01-08-2023 14:25	300	3.9	70	25	2

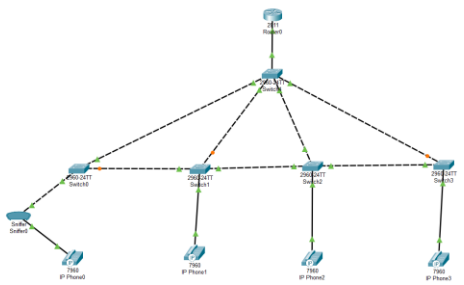

Fig.12 Bus topology of IP Phones

Fig.13 depicts the distribution of packet types with higher transmission frequency within the Bus Topology. This visual insight provides an understanding of the predominant packet traffic types in the network configuration. Additionally,

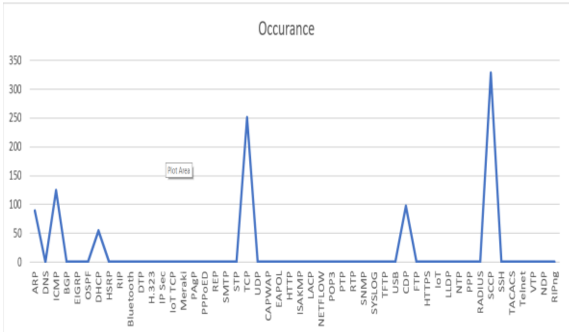

Fig.13 Traffic Analysis in the Bus Topology

Fig.14 illustrates the average time packets traverse from one location to another within the Bus Topology. These graphical representations collectively contribute to a nuanced analysis of IP phone communication within the context of the bus topology configuration.

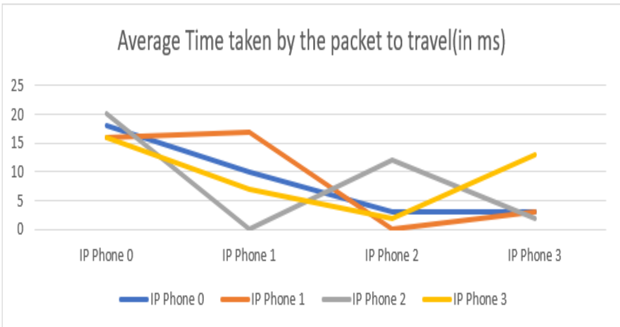

Fig.14 Average time taken in the Bus Topology

E. Tree Topology

Fig.15 presents the outcomes of implementing IP phones within a tree topology. Essential data metrics, encompassing call duration, call quality, latency, jitter, and packet loss, can be extracted from the network configuration within Cisco Packet Tracer. A comprehensive representation of this data is depicted in Table 5.

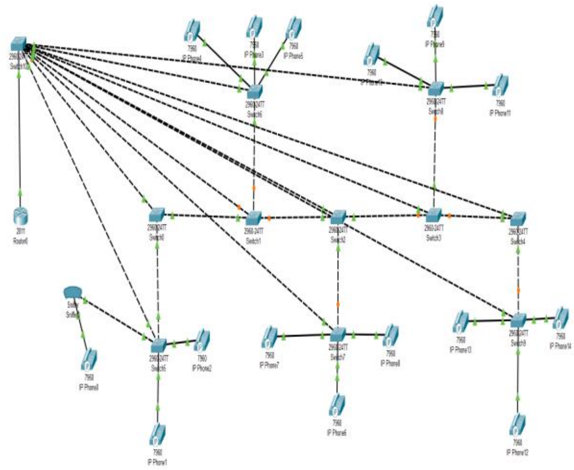

Fig.15 Tree topology of IP Phones

In Fig.16, the distribution of packet types with higher transmission frequency within the Tree Topology is showcased. This visual insight provides an understanding of the predominant packet traffic types in the network configuration. Furthermore, Fig.17 offers a graphical representation of the average time taken by packets to traverse from one location to another within the Tree Topology. These graphical representations collectively contribute to a nuanced analysis of IP phone communication within the context of the tree topology configuration.

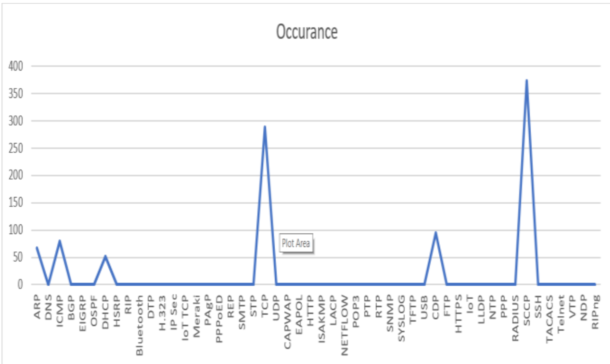

Fig.16 Traffic analysis in the Tree Topology

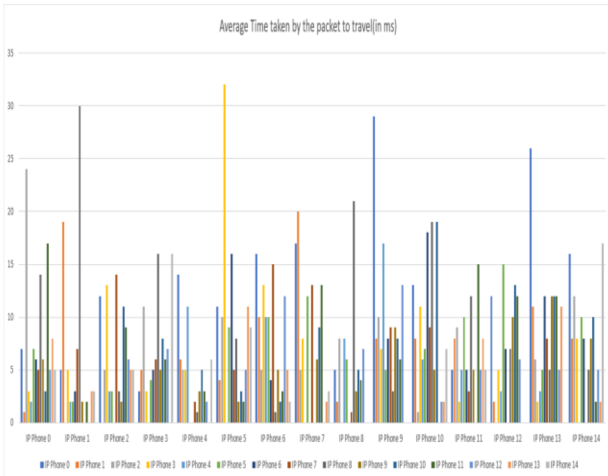

Fig.17 Average time taken in the Tree Topology

F. Hybrid Topology

Fig-18 represents the outcome of implementing IP phones within a hybrid topology. Essential data metrics, encompassing call duration, call quality, latency, jitter, and packet loss, can be extracted from the network configuration within Cisco Packet Tracer. A comprehensive representation of this data is depicted in Table 6.

In Fig.19, the distribution of packet types with higher transmission frequency within the Hybrid Topology is showcased. This visual insight provides an understanding of the predominant packet types in the network configuration. Furthermore, Fig.20 offers a graphical representation of the average time taken by packets to traverse from one location to another within hybrid topology. These graphical representations collectively contribute to a nuanced analysis of IP phone communication within the context of the hybrid configuration.

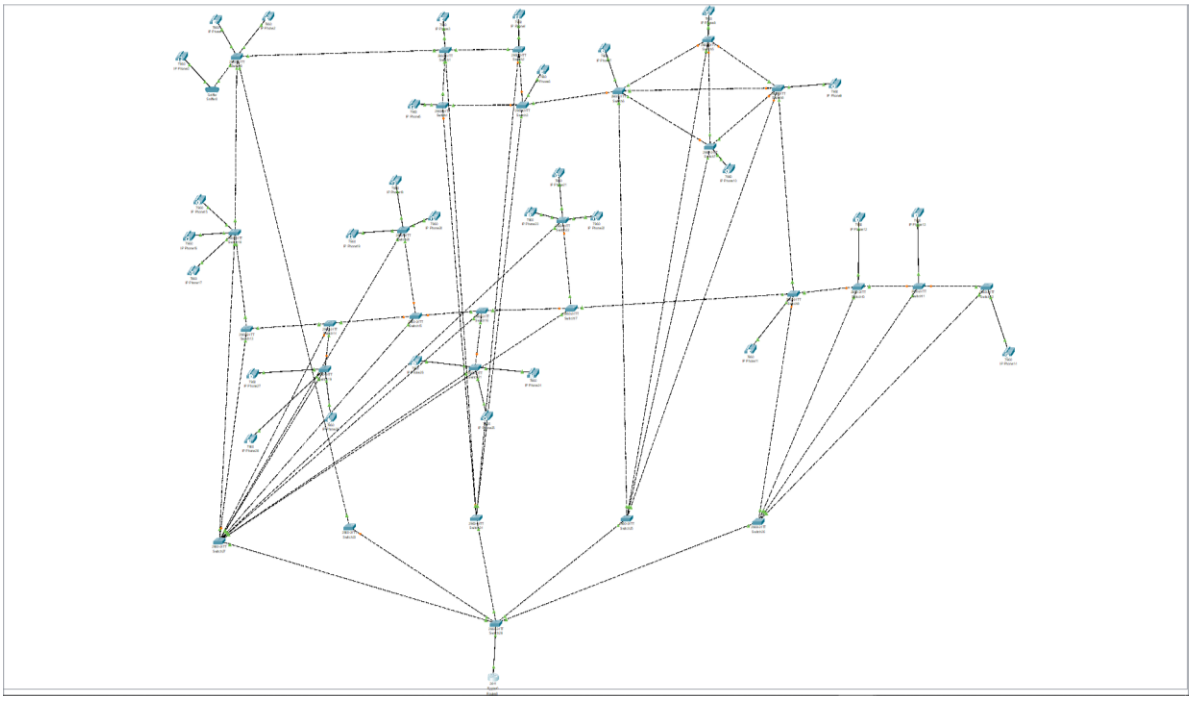

Fig-18 Hybrid topology of IP Phones

Table 6 Data extracted from Hybrid Topology

Call ID	Caller IP	Receiver IP	Start Time	End Time	Call Duration (sec)	Call Quality	Latency (ms)	Jitter (m30s)	Packet Loss (%)
1	192.168.1.1	192.168.1.2	01-08-2023 15:00	01-08-2023 15:03	180	4.3	80	20	1
2	192.168.1.2	192.168.1.3	01-08-2023 15:10	01-08-2023 15:12	150	3.7	60	30	2
3	192.168.1.3	192.168.1.4	01-08-2023 15:20	01-08-2023 15:22	120	4.1	40	10	0.5
4	192.168.1.4	192.168.1.5	01-08-2023 15:30	01-08-2023 15:31	90	3.8	70	25	2
5	192.168.1.5	192.168.1.6	01-08-2023 15:40	01-08-2023 15:42	120	3.5	60	15	1
6	192.168.1.6	192.168.1.7	01-08-2023 15:50	01-08-2023 15:51	90	3.9	80	20	2
7	192.168.1.7	192.168.1.8	01-08-2023 16:00	01-08-2023 16:01	90	4.5	50	15	0.5
8	192.168.1.8	192.168.1.9	01-08-2023	01-08-2023	90	4.2	70	25	1

			16:10	16:11					
9	192.168.1.9	192.168.1.10	01-08-2023 16:20	01-08-2023 16:22	120	3.6	40	10	2
10	192.168.1.10	192.168.1.11	01-08-2023 16:30	01-08-2023 16:32	150	3.8	50	15	1
11	192.168.1.11	192.168.1.12	01-08-2023 16:40	01-08-2023 16:41	90	4.1	60	20	0.5
12	192.168.1.12	192.168.1.13	01-08-2023 16:50	01-08-2023 16:51	90	3.7	70	25	2
13	192.168.1.13	192.168.1.14	01-08-2023 17:00	01-08-2023 17:01	90	4.2	40	10	1
14	192.168.1.14	192.168.1.15	01-08-2023 17:10	01-08-2023 17:11	90	4.3	50	15	0.5
15	192.168.1.15	192.168.1.16	01-08-2023 17:20	01-08-2023 17:22	120	3.9	60	20	1
16	192.168.1.16	192.168.1.17	01-08-2023 17:30	01-08-2023 17:31	90	3.6	70	25	2
17	192.168.1.17	192.168.1.18	01-08-2023 17:40	01-08-2023 17:41	90	3.9	70	25	1
18	192.168.1.18	192.168.1.19	01-08-2023 17:50	01-08-2023 17:51	90	3.7	60	20	2
19	192.168.1.19	192.168.1.20	01-08-2023 18:00	01-08-2023 18:01	90	4	50	15	1
20	192.168.1.20	192.168.1.21	01-08-2023 18:10	01-08-2023 18:11	90	4.2	70	25	0.5
21	192.168.1.21	192.168.1.22	01-08-2023 18:20	01-08-2023 18:21	90	3.6	40	10	2
22	192.168.1.22	192.168.1.23	01-08-2023 18:30	01-08-2023 18:31	90	3.8	50	15	1
23	192.168.1.23	192.168.1.24	01-08-2023 18:40	01-08-2023 18:42	120	4.1	60	20	0.5
24	192.168.1.24	192.168.1.25	01-08-2023 18:50	01-08-2023 18:52	120	3.7	70	25	2
25	192.168.1.25	192.168.1.26	01-08-2023 19:00	01-08-2023 19:01	90	4.2	40	10	1
26	192.168.1.26	192.168.1.27	01-08-2023 19:10	01-08-2023 19:11	90	4.3	60	20	0.5
27	192.168.1.27	192.168.1.28	01-08-2023 19:20	02-08-2023 19:22	120	3.9	70	25	2
28	192.168.1.28	192.168.1.29	01-08-2023 19:30	03-08-2023 19:31	90	3.6	40	10	1
29	192.168.1.29	192.168.1.30	01-08-2023 19:40	01-08-2023 19:41	90	4	60	20	0.5
30	192.168.1.30	192.168.1.1	01-08-2023 19:50	01-08-2023 19:52	120	3.7	70	25	2

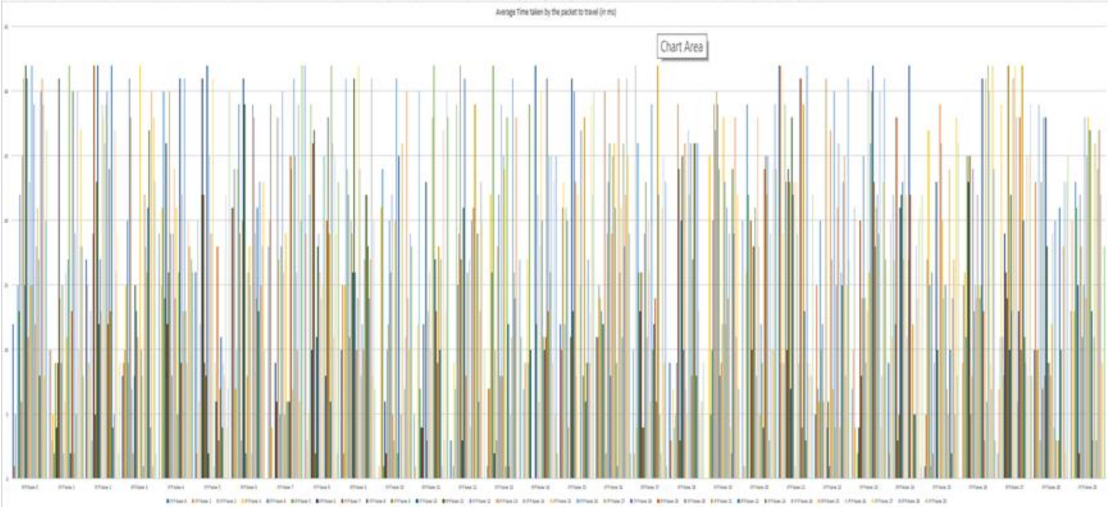

Fig-20 Average time taken in the Hybrid Topology

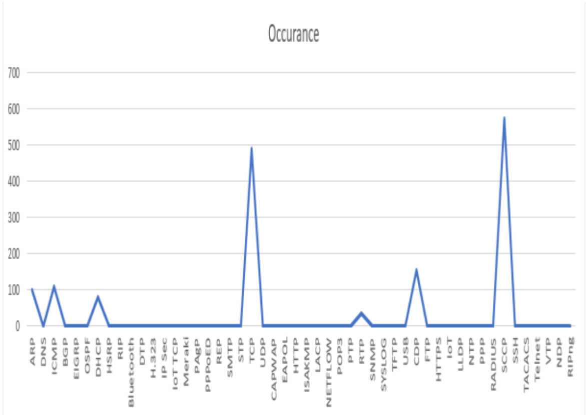

Fig-19 Traffic analysis in the Hybrid Topology

5. Conclusion

To sum up this study thoroughly examines IP phone data, in network topologies using Cisco Packet Tracer. Employs different data science techniques. By collecting and preprocessing data and applying machine learning models this study provides information, about how IP phones perform and behave in network situations. Beyond expanding our understanding of VoIP technology this analysis emphasizes the role of data science methods in analyze and break down complex networking environments. The implications of these findings extend to enhancing IP phone systems providing a foundation for optimizing network designs and improving VoIP services in the future. As communication technology continues to evolve this research significantly contributes to the field of network analysis. In addition to adding to existing knowledge this work serves as a guide for network administrators and professionals in a journal paper context. Moving forward future work involves extending the analysis to real world network environments exploring machine learning models and staying updated with emerging technologies to ensure the relevance and applicability of the study, in dynamic communication systems.

References

[1] R. Demeter et al., "A quantitative study of using Cisco Packet Tracer simulation software to improve IT students' creativity and outcomes," 2019 10th IEEE International Conference on Cognitive Infocommunications (CogInfoCom), Naples, Italy, 2019, pp. 353-358, doi: 10.1109/CogInfoCom47531.2019.9089920.

[2] Q. Liu and Q. Liu, "A Study on Topology in Computer Network," 2014 7th International Conference on Intelligent Computation Technology and Automation, Changsha, China, 2014, pp. 45-48, doi: 10.1109/ICICTA.2014.18.

[3] Toral-Cruz and D. Torres-Romin, "IP telephony: an overview," (ICEEE). 1st International Conference on Electrical and Electronics Engineering, 2004., Acapulco, Mexico, 2004, pp. 23-28, doi: 10.1109/ICEEE.2004.1433842..

[4] N. Chirdchoo, W. Cheunta, K. Saelim and P. Kovintavewat, "Design and implementation of a VoIP system for campus usage: A case study at NPRU," 2013 13th International Symposium on Communications and Information Technologies (ISCIT), Surat Thani, Thailand, 2013, pp. 216-221, doi: 10.1109/ISCIT.2013.6645852..

[5] S. R. Guruvayur and R. Suchithra, "A detailed study on machine learning techniques for data mining," 2017 International Conference on Trends in Electronics and Informatics (ICEI), Tirunelveli, India, 2017, pp. 1187-1192, doi: 10.1109/ICOEI.2017.8300900.

[6] Sharmin, Moshammad & Hossain, Md. Anwar. (2019). Analysis and Comparative Study for Developing Computer Network in Terms of Routing Protocols Having IPv6 Network Using Cisco Packet Tracer. 7. 16-29. 10.11648/j.se.20190702.11

[7] Abdul rashid, Nazre & Othman, Md & Johan, Rasyidi & Sidek, Salman. (2019). Cisco Packet

Tracer Simulation as Effective Pedagogy in Computer Networking Course. International Journal of Interactive Mobile Technologies (iJIM). 13. 4.

[8] Kumar, Anil & Ed, Kavyashree. (2022). Study on Network Simulation using Cisco Packet Tracer.

[9] Lim, Francis. (2016). A Review-Analysis of Network Topologies for Microenterprises. 175-180. 10.14257/astl.2016.135.42.

[10] Ayad Hameed Mousa, Nibras Talib Mohammed, Enas Ali Mohammed; EFCNT: An evaluation framework for computer's network topologies. *AIP Conf. Proc.* 22 August 2019; 2144 (1): 050010.

[11] Klimo, Martin & Kovacikova, Tatiana & Segeč, Pavel. (2004). Selected issues of IP telephony. Komunikacie. 6. 63-70. 10.26552/com.C.2004.4.63-70.

[12] Pourqasem, Javad & Karimi, Sina & Edalatpanah, S A.. (2012). A survey of voice over internet protocol (VOIP) technology. International Computer Mathematical Science and Applications. 6.

[13] Sunil Kumar, Mr. Kratika Sharma, 2016, A Review Paper on Voice over Internet Protocol, International Journal Of Engineering Research & Technology (IJERT) V-Impact – 2016 (Volume 4 – Issue 32)

[14] Bokonda, Loola & Khadija, Ouazzani Touhami & Souissi, Nissrine. (2020). Predictive analysis using machine learning: Review of trends and methods. 10.1109/ISAECT50560.2020.9523703.

[15] Yogesh, Singh & Bhatia, Pradeep & Sangwan, Om. (2007). A REVIEW OF STUDIES ON MACHINE LEARNING TECHNIQUES. International Journal of Computer Science and Security. 1.

[16] Khan, N.U.; Wan, W.; Riaz, R.; Jiang, S.; Wang, X. Prediction and Classification of User Activities Using Machine Learning Models from Location-Based Social Network Data. *Appl. Sci.* **2023**, *13*, 3517.

[17] Tudoroiu, A.. (2023). Study of Different Network Topologies Using Cisco Packet Tracer. The Scientific Bulletin of Electrical Engineering Faculty. 23. 31-33. 10.2478/sb eef-2023-0005.

[18] Y Sreeraman, et al. "APMWMM: Approach to Probe Malware on Windows Machine using Machine Learning." 2022 International Conference on Applied Artificial Intelligence and Computing (ICAAIC). IEEE, 2022.

[19] KK Sushanth, et al. "DPMLT: Diabetes prediction using machine learning techniques." 2022 International Conference on Electronics and Renewable Systems (ICEARS). IEEE, 2022.

[20] M Loukya, et al. "Comparative Analysis of Customer Loan Approval Prediction using Machine Learning Algorithms." 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS). IEEE, 2022.

[21] CP Lakshmi, et al. "A review of Machine Learning techniques for breast cancer diagnosis in medical applications." 2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud)(I-SMAC). IEEE, 2019.

[22] Saibaba, Ch MH, et al. "Prediction of Public Mental Health by using Machine Learning Algorithms." 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS). IEEE, 2022.