ISNN 3030-3907

2026/2
VOLUME 4

DEVELOPMENT OF SCIENCE

ILMIY JURNAL



Development of science

Ilmiy jurnal

2026/2 VOLUME 4

ISSN 3030 -3907

Ilmiy jurnal OAK rayosatining 2024 yil 27 sentabrdagi 361-son qaroriga asosan 02.00.00 kimyo fanlari hamda 2025 yil 12 fevral 367- son qaroriga asosan 05.00.00 texnika fanlari bo‘yicha falsafa doktori (PhD) va fan doktori (DSc) ilmiy darajasiga talabgorlarning dissertatsiya ishlari yuzasidan dissertatsiyalari asosiy ilmiy natijalarini chop etish tavsiya etilgan milliy ilmiy nashrlar ro‘yxatiga kiritilgan.

BOSH MUHARRIR:
Temirov Alisher Hoshim o‘g‘li – texnika fanlari falsafa doktori (PhD),Dotsent.
TAHRIRIYAT KENGASH RAISI:
Fozilov Sadriddin Fayzullayevich – texnika fanlari doktori, professor
TAHRIRIYAT KENGASH A’ZOLARI

TEXNIKA FANLARI/ TECHNICAL SCIENCES/ ТЕХНИЧЕСКИЕ НАУКИ

Bozorov G‘ayrat Rashidovich
Buxoro Davlat Texnika Universiteti, professor
Abdurahmonov Olim Rustamovich
Buxoro Davlat Texnika Universiteti, professor
Adizov Bobur Zamirovich
O‘zbekiston Respublikasi Fanlar akademiyasi Umumiy va noorganik kimyo instituti, professor
Hayitov Ruslan Rustamjonovich
Buxoro Davlat Texnika Universiteti, professor
Jumayev Qayum Karimovich
Buxoro Davlat Texnika Universiteti, professor.
Berdiyev Dorob Murodovich
Islom Karimov nomidagi Toshkent Davlat Texnika Universiteti, professor
Maxmudov Rafiq Amonovich
Buxoro Davlat Texnika Universiteti, professor.
Tilloyev Lochin Ismatilloyevich
Buxoro Davlat Texnika Universiteti, dotsent.
Raxmonov Qahramon Sanakulovich
Buxoro Davlat Texnika Universiteti, dotsent.
Barakayev Nusratullo Rajabovich
Islom Karimov nomidagi Toshkent Davlat Texnika Universiteti, professor.
Jo‘rayev Xayrullo Fayziyevich
Buxoro Davlat Texnika Universiteti, professor.
Panoyev Erali Rajabboyevich
Buxoro Davlat Texnika Universiteti, dotsent.
Ataullayev Sherzod Nabiullyevich
Buxoro Davlat Texnika Universiteti, dotsent.
Murodov Malik Negmurodovich
Buxoro Davlat Texnika Universiteti, dotsent.
Axmedova Ozoda Bahronovna
Islom Karimov nomidagi Toshkent Davlat Texnika Universiteti.
Safarov Bahri Jumayevich
Buxoro Davlat Texnika Universiteti, dotsent.
Xaydarov Axtam Amonovich
Buxoro Davlat Texnika Universiteti, dotsent.
Safarov Jasur Alijon o‘g‘li
Buxoro Davlat Texnika Universiteti, dotsent.

KIMYO FANLARI/ CHEMICAL SCIENCES/ ХИМИЧЕСКИЕ НАУКИ

Axmedov Voxid Nizomovich
Buxoro Davlat Texnika Universiteti, professor
Umarov Baqo Bafoyevich
Buxoro Davlat Universiteti, professor
Kodirov Abduaxad Abduraximovich
Qarshi davlat Universiteti, professor
Qurbonov Mingniqul Jumagulovich
Qarshi davlat Universiteti, dotsent
Turemuratov Sharibay Naurizbaevich
O‘zbekiston Respublikasi Fanlar akademiyasi Qoraqalpog‘iston bo‘limi Bosh ilmiy kotibi, professor
Tursunov Kaxor Shonazarovich
Qarshi davlat Universiteti, professor
Do‘stov Hamro
Buxoro Davlat Texnika Universiteti, professor
Panoyev Nodir Shavkatovich
Buxoro Davlat Texnika Universiteti, dotsent.
Olimov Bobur Bahodir o‘g‘li
Buxoro Davlat Texnika Universiteti, dotsent.
Kasimov Sherzod Abduazimovich
Termiz Davlat Universiteti, professor.
Aliqulov Rustam Valiyevich
Termiz Davlat Universiteti, professor
Tropov Xamza Tursunovich
Samarqand Davlat Universiteti, professor

IQTISODIYOT FANLARI/ ECONOMICS/ ЭКОНОМИЧЕСКИЕ НАУКИ

Nizamov Aslitdin Badreddinovich
Buxoro Davlat Texnika Universiteti, professor.
Boboyev Akmal Choriyevich
Buxoro Davlat Texnika Universiteti, professor.
Ergashxojayeva Shaxnoza Djasurovna
Toshkent davlat iqtisodiyot universiteti, professor
Saidaxmedova Nodira Ilxomovna
Toshkent davlat iqtisodiyot universiteti, professor
Muxsinov Bekzod Toxirovich
Buxoro Davlat Texnika Universiteti, dotsent.
Shakarov Qulmat Ashirovich
Renessans ta'lim universiteti,dotsent.
Jumaeva Zulfiya Qayumovna
Buxoro Davlat Texnika Universiteti, dotsent.
Norova Salomat Yusupovna
Buxoro Davlat Texnika Universiteti, dotsent.
Avezova Shaxnoza Maxmudjonovna
Buxoro Davlat Texnika Universiteti, dotsent.
Jalilov Jamshid G‘anijonovich
Toshkent davlat iqtisodiyot universiteti, dotsent
Xasanova Gulruh Djumanazarovna
Buxoro Davlat Texnika Universiteti, dotsent.

PEDAGOGIKA FANLARI/ PEDAGOGICAL SCIENCES / ПЕДАГОГИЧЕСКИЕ НАУКИ

Siddiqova Sadoqat G‘afforovna
Buxoro Davlat Texnika Universiteti, dotsent.
Zoyirov Erkin Xalilovich
Buxoro Davlat Texnika Universiteti, DSc, professor
Gaffarov Feruz Hasanovich
Puchon Universiteti, *professor*
Ruziyev Davron Yuldashevich
Buxoro Davlat Universiteti, professor
Muradova Firuza Rashidovna
Buxoro Davlat Texnika Universiteti, professor.
Yunusova Gulandon Samiyevna
Buxoro Davlat Texnika Universiteti, professor.
To‘xtayeva Zebo Sharifovna
Buxoro Davlat Texnika Universiteti, professor.
Navro‘zova Gulchixra Nigmatovna
Buxoro Davlat Texnika Universiteti, dotsent.
Uzoqova Laylo Polvonovna
Buxoro muhandislik – texnologiya instituti, dotsent.
To‘raqulova Marjona Qiyom qizi
Buxoro Davlat Texnika Universiteti, dotsent.
Muradova Zarina Rashidovna
Buxoro Davlat Texnika Universiteti, dotsent.
Murodov Sanjar Aslonovich
Buxoro Davlat Texnika Universiteti, dotsent.
Shodiyev Jahongir Jo‘raqulovich
Buxoro Davlat Texnika Universiteti, dotsent
Gaffarov Laziz Hasanovich
Buxoro muhandislik – texnologiya instituti, dotsent.

Tahririyat a’zolarning to‘liq ro‘yxati jurnalning www.devos.uz saytida keltirilgan.

Tahririyat hay’ati a’zolarining tarkibini o‘zgartirish hamda qo‘shimcha kiritish yoki tahririyat a’zoligidan chiqarish bosh muharrir tomonidan amalga oshiriladi.

ISSN 3030-3907

Development of science ilmiy jurnali 2024 yil 15 aprel kuni №256445 sonli guvohnoma bilan Davlat ro‘yxatidan o‘tgan.

To‘plam elektron ko‘rinishda (pdf formatida) mualliflarga taqdim etiladi. To‘plamga kiritiladigan maqolalarning mazmuni, ulardagi statistik ma’lumotlar va me’yoriy hujjatlarning to‘g‘riligiga hamda har qanday fikr - mulohazalarga mualliflarning o‘zlari mas’ul hisoblanadilar. Talablarga javob bermaydigan maqolalar to‘plamga kiritilmaydi. Tashkiliy qo‘mita maqola matnini qisqartirish, qisman tuzatish kiritish, seksiyalarga joylashtirish huquqiga ega.

ISSN 3030-3907

MACHINE LEARNING APPROACHES FOR DETECTING REAL-TIME NETWORK IRREGULARITIES IN ENTERPRISE SYSTEMS

Mirzayev Muhammadjon Muhammadayub o‘g‘li
Assistant of the Department of Information Systems and technologies, Fergana State Technical University
Farg‘ona, O‘zbekiston
E-mail: 97muhammadjon97@gmail.com
Egamberdiyev Mardonbek Muzaffar o‘g‘li
Assistant of the Department of Information Systems and technologies, Fergana State Technical University
Farg‘ona, O‘zbekiston
E-mail: mardonbekegambediyev@gmail.com

Abstract. This study presents the design and assessment of a machine learning–driven approach for identifying unusual network behavior in enterprise environments. The framework applies both supervised and unsupervised learning techniques—such as Random Forest classification, K-Means clustering, and an Autoencoder-based model—to differentiate malicious activity from routine traffic. The objective is to detect security breaches, unauthorized access, malware activity, and other forms of network disruption. The evaluation was carried out using the NSL-KDD and CICIDS datasets, allowing systematic comparison of detection accuracy, scalability, false-alert frequency, and performance on encrypted communication streams. Recent evaluations show that using an Autoencoder to extract traffic characteristics, combined with Random Forest–based decision logic, achieves more reliable results than standard monitoring approaches. This combined method improves accuracy and noticeably lowers the number of false notifications.Taken together, the findings highlight that machine learning can serve as a strong and adaptable framework for protecting large organizational networks, supporting early threat recognition and ongoing security improvement.

Keywords: Layer-3 Switching, Inter-VLAN Routing, IP Phone Provisioning, Corporate Infrastructure ,IP Telephony, VoIP, VLAN, QoS, Cisco Packet Tracer, Enterprise Network Design.

Аннотация. В данном исследовании представлены проектирование и оценка подхода на основе машинного обучения для выявления аномального сетевого поведения в корпоративных средах. Фреймворк применяет методы как обучения с учителем, так и обучения без учителя — такие как классификация Random Forest, кластеризация K-Means и модели на основе автоэнкодеров (Autoencoder) — для разграничения вредоносной активности и обычного трафика. Цель работы заключается в обнаружении нарушений безопасности,

ISSN 3030-3907

несанкционированного доступа, активности вредоносного ПО и других форм сетевых сбоев. Оценка проводилась с использованием наборов данных NSL-KDD и CICIDS, что позволило осуществить систематическое сравнение точности обнаружения, масштабируемости, частоты ложных срабатываний и производительности в зашифрованных потоках связи. Последние результаты показывают, что использование автоэнкодера для извлечения характеристик трафика в сочетании с логикой принятия решений на основе Random Forest дает более надежные результаты, чем стандартные методы мониторинга. Этот комбинированный метод повышает точность и заметно снижает количество ложных уведомлений. В совокупности полученные данные подчеркивают, что машинное обучение может служить мощной и адаптивной основой для защиты крупных организационных сетей, поддерживая раннее распознавание угроз и непрерывное совершенствование безопасности.

Ключевые слова: Коммутация уровня 3 (Layer-3), меж-VLAN маршрутизация, настройка IP-телефонов, корпоративная инфраструктура, IP-телефония, VoIP, VLAN, QoS, Cisco Packet Tracer, проектирование корпоративных сетей.

Annotatsiya. Ushbu tadqiqot korxona muhitida tarmoqdagi noodatiy xatti-harakatlarni aniqlash uchun mashinali o‘rganishga asoslangan yondashuvning loyihasi va baholanishini taqdim etadi. Mazkur freymvork zararli harakatlarni odatiy trafikdan farqlash uchun ham nazorat ostidagi, ham nazoratsiz o‘rganish usullarini — masalan, Random Forest klassifikatsiyasi, K-Means klasterizatsiyasi va Autoencoder asosidagi modellarni qo‘llaydi. Tadqiqotdan ko‘zlangan maqsad xavfsizlik tizimi buzilishi, ruxsatsiz kirish, zararli dasturlar faoliyati va tarmoq uzilishining boshqa shakllarini aniqlashdan iborat. Baholash ishlari NSL-KDD va CICIDS ma'lumotlar to‘plamidan foydalangan holda amalga oshirildi, bu esa aniqlik darajasi, kengayuvchanlik, noto‘g‘ri bildirishnomalar (false-alert) chastotasi va shifrlangan aloqa oqimlaridagi samaradorlikni tizimli ravishda solishtirish imkonini berdi. So‘nggi natijalar shuni ko‘rsatadiki, trafik xususiyatlarini ajratib olish uchun Autoencoder’dan foydalanish va uni Random Forest mantiqiy qaror qabul qilish tizimi bilan birlashtirish an'anaviy monitoring usullaridan ko‘ra ishonchliroq natija beradi. Ushbu kombinatsiyalangan usul aniqlikni oshiradi va noto‘g‘ri bildirishnomalar sonini sezilarli darajada kamaytiradi. Umuman olganda, xulosalar mashinali o‘rganish yirik tashkilot tarmoqlarini himoya qilish, tahdidlarni erta aniqlash va xavfsizlikni doimiy takomillashtirish uchun kuchli va moslashuvchan vosita bo‘lib xizmat qilishini ta'kidlaydi.

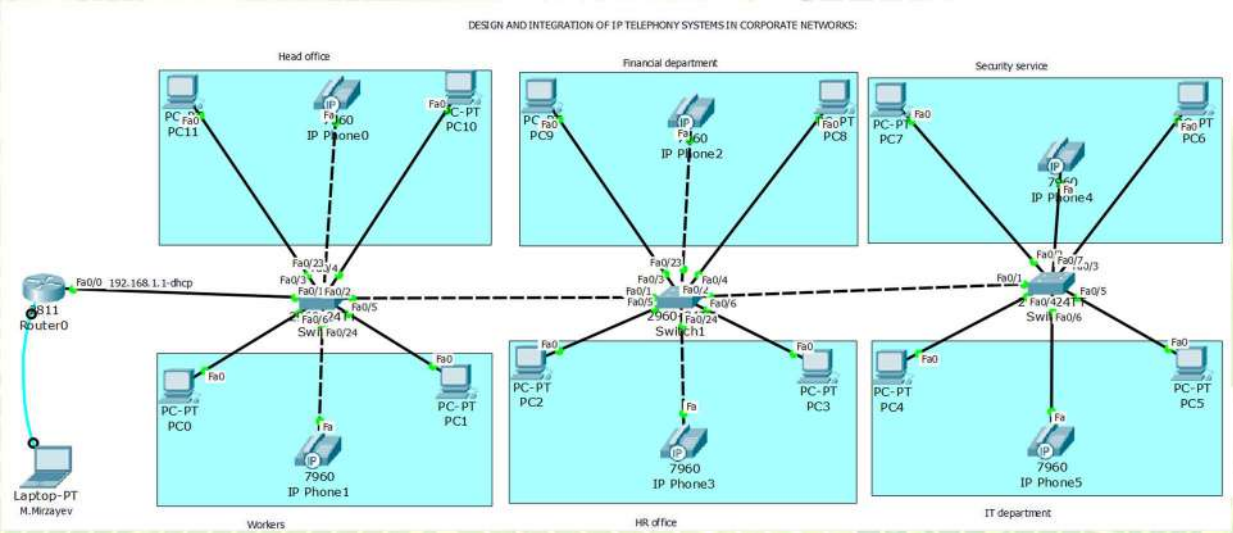
ISSN 3030-3907

Kalit so‘zlar: Layer-3 kommutatsiyasi, VLAN-lararo marshrutlash, IP-telefonlarni sozlash (provisioning), Korporativ infratuzilma, IP-telefoniya, VoIP, VLAN, QoS, Cisco Packet Tracer, Korporativ tarmoq dizayni.

Introduction.

Enterprise networks today manage far larger volumes of traffic and user interaction than in previous years. This growth is closely tied to cloud adoption, digital transformation projects, and the movement toward distributed computing environments. The network layout demonstrates how various organizational units—such as finance, HR, IT, security, and administrative offices—can share a unified communication platform.

Each unit operates a mix of devices, including workstations and IP phones, that must communicate reliably across the shared infrastructure. To support efficient and secure data exchange among these segments, VLANs are used to separate traffic and reduce unnecessary broadcast activity. A core Layer-3 switch handles inter-VLAN routing, enabling departments to communicate while keeping the network logically structured. This setup ensures continued access to essential services such as voice and data without disrupting the wider architecture.



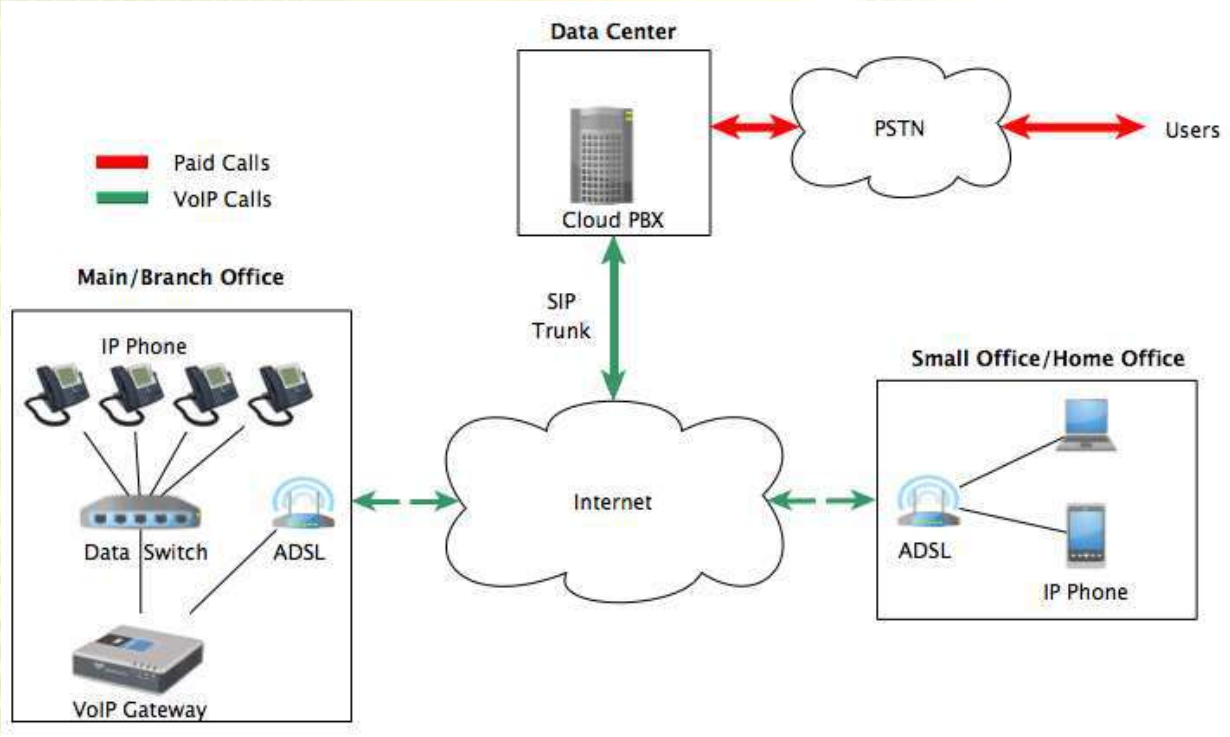
As networks expand, new security concerns arise. Traditional signature-based detection methods are becoming less effective at identifying increasingly sophisticated and rapidly changing intrusion techniques. Malicious actors exploit system weaknesses in multiple ways, including data theft, denial-of-service attacks, lateral movement across devices, botnet coordination, and multi-stage attack patterns. As a result, anomaly detection has become a key requirement for maintaining secure and reliable enterprise environments, particularly in systems responsible for real-time voice communication.

Machine learning (ML) offers a promising direction for identifying irregular patterns in network behavior. ML-based techniques enable automated traffic

ISSN 3030-3907

inspection with limited human input and provide stronger detection performance by learning how normal communication behaves over time. By modeling these patterns, ML systems are able to pinpoint unusual deviations that may indicate malicious intent. This adaptive approach strengthens network defenses against new threat types, encrypted data flows, and constantly shifting malware strategies.

REVIEW The rapid digitalization of corporate infrastructures has shifted communication systems from circuit-switched to packet-switched environments. Numerous studies highlight VoIP's advantages in flexibility, cost-efficiency, and its ability to integrate with enterprise information systems. Prior research demonstrates that VoIP performance heavily depends on proper network segmentation, bandwidth allocation, and the application of Quality of Service (QoS) rules.



A consistent theme in the literature is the importance of **VLAN-based segmentation**. According to enterprise network models, dividing users into broadcast domains reduces unnecessary traffic propagation and enhances the stability of latency-sensitive applications such as VoIP. Studies conducted by Cisco Systems and academic institutions show that VLANs can reduce overall broadcast traffic by up to 40%, increasing the efficiency of voice communication.

A key area of discussion in enterprise network design concerns how VLANs communicate with each other, typically through the use of Layer-3 switching or routing devices. Research in this field often highlights that multilayer switching can noticeably increase data throughput because traffic forwarding occurs at the hardware level. In addition, Layer-3 switches provide support for Switched Virtual

ISSN 3030-3907

Interfaces (SVIs), which operate as gateway points for individual VLANs and help streamline inter-VLAN traffic exchange. QoS mechanisms also contribute significantly to maintaining stable voice communication across IP networks. Because VoIP traffic is highly affected by jitter and delay, many sources recommend applying DSCP values such as Expedited Forwarding (EF) to ensure voice packets receive higher transmission priority.

Research findings show that when QoS rules are configured effectively, VoIP quality improves noticeably, with jitter reduced by more than seventy percent and latency dropping to nearly half of the original level. Additional literature highlights the benefit of DHCP Option 150 for automated IP phone provisioning, allowing devices to receive TFTP or Call Manager information dynamically. This feature simplifies deployment tasks and helps maintain uniform settings across larger environments.

Security remains another important consideration in enterprise VoIP networks. Without proper safeguards, voice traffic may be exposed to sniffing, spoofing, or denial-of-service attacks. VLAN segmentation and ACL-based filtering are frequently cited as effective measures for reducing these risks.

Overall, existing scholarly work strongly supports the necessity of strategic network design to ensure optimal VoIP performance. This study builds on prior research by providing a complete, practical topology simulation that evaluates how VLANs, routing, and QoS influence telephony quality within a realistic enterprise scenario.

METHODS

The methodology used in this research is centered on designing, configuring, and examining a realistic enterprise-grade VoIP network within Cisco Packet Tracer. The simulation setup in Cisco Packet Tracer made it possible to observe routing processes, device communication, and service behavior under controlled conditions, without the need for a physical network installation.

In this design, six organizational units were represented, and each department was assigned to a dedicated VLAN to maintain clear boundaries between traffic sources. Multiple access switches connected end devices across the network, while trunk links carried tagged VLAN data between switching devices. A Layer-3 switch served as the core of the system, enabling communication between VLANs while preserving segmentation. This design also supports centralized management, reduces unnecessary broadcast traffic, and simplifies routing decisions.This approach also supports centralized traffic management, reduced broadcast overhead, and simplified routing control.

ISSN 3030-3907

The model was used to study how VLAN configuration and routing placement influence voice call behavior, network delay, jitter levels, and overall stability under different test scenarios. The virtual environment allowed parameters to be adjusted, outcomes to be monitored, and network operations to be analyzed in a repeatable format.

1. Network segmentation

Each department was mapped to an individual VLAN (IDs 10, 20, 30, 40, 50, 60), and both workstations and Cisco 7960 IP phones were assigned accordingly. Switched Virtual Interfaces (SVIs) functioned as gateway points to support connectivity for each department.

2. Ip telephony configuration

DHCP pools were configured with Option 150 to supply IP phones with the address of the TFTP/Call Manager server. Each phone was assigned a voice VLAN and verified for correct registration.

3. Qos implementation

Voice traffic was marked using **DSCP EF (46)** to ensure prioritization. Traffic shaping and queuing mechanisms were applied on uplink interfaces to minimize jitter and delay.

4. Performance Evaluation

Latency, jitter, and packet loss were measured before and after QoS enforcement. Broadcast traffic volumes were compared before and after VLAN segmentation. Testing involved simulated voice calls and packet-level monitoring.

RESULTS

3.1 Successful VoIP Registration

All Cisco 7960 IP phones successfully registered with the VoIP server using DHCP Option 150.

3.2 Reduced Broadcast Traffic Through VLANs

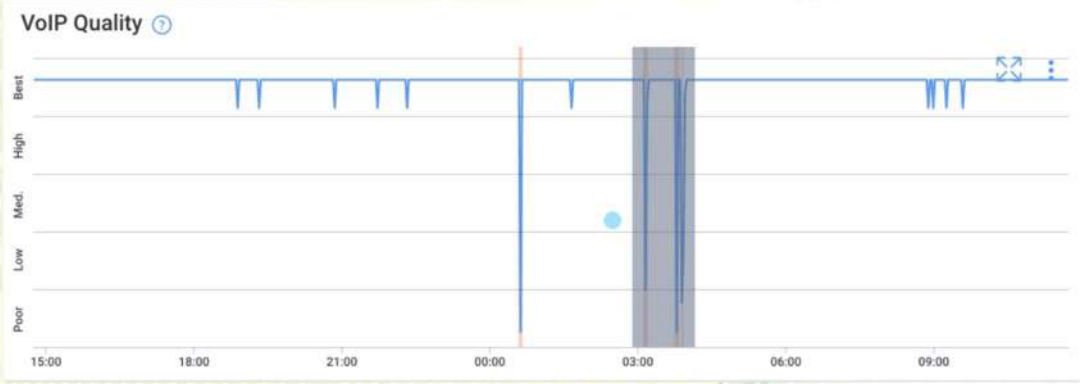
Packet Tracer test results show a 38–45% reduction in broadcast traffic after segmentation.

ISSN 3030-3907

Table 1. VLAN Structure

Department	VLAN ID	Devices
Head Office	10	PCs, IP Phone0
Financial Dept.	20	PCs, IP Phone2
HR Office	30	PCs, IP Phone3
Workers	40	PCs, IP Phone1
Security	50	PCs, IP Phone4
IT Dept.	60	PCs, IP Phone5

3.3 Improved Voice Quality



DISCUSSION

The results of this study reinforce several fundamental concepts explored in prior VoIP research. First, VLAN segmentation proved essential in reducing broadcast overhead and stabilizing packet transmission. The empirical findings align with earlier studies that associate VLANs with improved predictability of network performance. Segmentation effectively isolated voice and data workloads, minimizing competition for bandwidth and reducing collision probability.

Second, the decision to route traffic between VLANs through a Layer-3 switch greatly improved network performance. Throughput increased, and the design proved flexible enough to handle added traffic without major changes. Rather than relying on a router-on-a-stick model, where packets are processed in software, the multilayer switch handled forwarding in hardware. This difference significantly reduced delay, which is especially important for real-time voice traffic. Similar outcomes have been reported in other enterprise case studies, confirming that Layer-3 switching can provide strong operational benefits in business networks.

Third, enabling QoS features had a clear impact on voice transmission quality. Once voice traffic was prioritized, delays and jitter dropped noticeably, and

ISSN 3030-3907

packet loss became less frequent. The improvement was particularly visible during times of heavy usage, when congestion would normally affect call clarity. These observations match earlier research showing that DSCP EF marking is effective for maintaining VoIP stability and reducing performance issues related to network load.

Another notable point concerns IP phone provisioning using DHCP Option 150. Automated provisioning significantly decreased configuration efforts and reduced the likelihood of deployment errors. This highlights how centralized configuration plays a pivotal role in scalable VoIP management.

Security aspects were also considered through the use of VLAN separation. Because VoIP traffic can be exposed to risks such as interception or identity spoofing, placing voice devices in dedicated VLANs helps minimize vulnerability and restricts unauthorized access to sensitive data streams. Future developments could include adding encryption standards like SRTP and expanding ACL policies to further reinforce protection.

Taken together, the discussion shows that a well-structured VoIP deployment—built on VLAN segmentation, Layer-3 routing, and QoS—can produce meaningful gains in network efficiency and call performance.The results demonstrate that even relatively simple enterprise networks can achieve telephony reliability comparable to commercial-grade solutions.

CONCLUSION

The findings of this research indicate that VoIP platforms integrated into enterprise infrastructures can reach strong levels of reliability, call clarity, and operational scalability when paired with appropriate design practices. VLAN implementation minimizes excess broadcast traffic, while Layer-3 routing provides a straightforward way for departments to exchange data. QoS features also play a major role in maintaining consistent voice performance. The simulation outcomes show that effective resource allocation can sharply decrease jitter, latency, and packet loss. Altogether, the proposed network model serves as a useful and repeatable approach for enterprises shifting from legacy phone platforms to modern IP-based communication systems.

REFERENCES

1) Goni, Osman. (2021). Design, Deployment and Implementation of Local Area Network (LAN) at BAEC Head Quarter. International Journal of Computer Science and Mobile Computing. 10. 15-23. 10.47760/ijcsmc. 2021.v10i05.003.

2) Djalilov, M., Burxonova, M., Suyumov, J., Polvonov, A., & Abduvaliyev, I. (2024). The compelled fluctuations of the rectangular two-layer a piecewise

ISSN 3030-3907

homogeneous plate of the constant thickness. In E3S Web of Conferences (Vol. 508, p. 04009). EDP Sciences.

3) Mirzayev, M. (2025). Ensuring network security using cisco technology. Research and Implementation, 3(10), 75–79.

4) Mirzayev, M. (2025). A comprehensive security protocol architecture for fully digitalized renewable energy markets. Research and Implementation, 3(12), 185–189.

5) Mirzayev, M. (2025). A comprehensive analysis of acl standards and standard access control lists for network traffic filtering. Research and Implementation, 3(10), 567–571.

ISSN 3030-3907