

# Virtual Network Technologies in Cybersecurity: An Exploratory Study of Applications and Mechanisms

Weiwei Zhou

Xi'an Vocational College of Urban Construction, Xi 'an 710114, China

**Abstract:** *To safeguard the security of computer network information systems and effectively mitigate network information risks—including Trojan viruses and hacker intrusions—it is essential to proactively deploy advanced technological solutions. This article takes virtual network technology as its research focus and provides a concise overview of both virtual network technology and the fundamental importance of computer network security. It further examines the applications of virtual network technology in computer network security across four analytical dimensions: technology types, application scope, practical impact, and effective implementation measures. The objective is to reinforce the stability of computer networks and protect user information security, thereby offering valuable insights for relevant practitioners and stakeholders in the field.*

**Keywords:** Computer; Network Security; Virtual Network Technology; Application Exploration.

## 1. INTRODUCTION

In the era of big data, the problem of computer network security is worrying, how to improve the level of network information security is an important direction of the development of the industry. Through the introduction of virtual network technology, by virtue of its security, reliability, flexibility and other technical advantages, it can build a virtual private network to achieve end-to-end data information transmission, improve the quality of network information security, and greatly enhance the computer network security protection capability. Zhou [1] introduced a hierarchical needs framework for analyzing US automotive customer feedback, linking sentiment to functional requirements. Similarly, Wensi [2] explored AI-enabled data visualization marketing for automated production lines, demonstrating its role in building customer trust and improving lead-to-order conversion. Li [3] further optimized AI-driven bid pricing models for non-standard automation projects by leveraging historical financial data and machine learning algorithms. In the field of natural language processing, Ren [4] proposed a Semantic Transformation Network for dialogue summarization using contrastive learning and attention mechanisms, while Ren [5] developed an enhanced graph convolutional network model (VGCN) for text classification. For fraud detection, Ximeng and Yiming [6] applied offline conservative reinforcement learning to balance fraud risk and customer friction in transaction authorization, and Yang and Zhang [7] designed an edge-enabled real-time fraud detection system for network lending terminals under low-latency constraints. Zhao et al. [8] optimized deep learning models for dynamic market behavior prediction, and Yang, Zheng, and Lu [9] constructed multi-dimensional credit-related transaction risk maps using graph neural networks. Shen et al. [10] researched the application of the whale optimization algorithm in financial payment fraud detection. Yang [11] applied LightGBM in the Chinese stock market, demonstrating its effectiveness in financial forecasting. In medical imaging, Tian, Wang, and Cui [12] proposed an improved U-Net for brain tumor image segmentation using GSConv and ECA attention mechanisms. Wu, Luo, and Liao [13] addressed small-sample object detection of surface cracks in concrete structures of high-rise buildings via multi-level transfer learning. Finally, Yang [14] further confirmed the utility of LightGBM in the Chinese stock market, highlighting its robustness in financial applications.

## 2. BASIC SITUATION OF VIRTUAL NETWORK TECHNOLOGY

Virtual network technology mainly relies on public network resources, builds a dedicated information transmission channel, and remotely connects network users around the world through network protocols and service providers to form a virtual subnet, enabling end-to-end information transmission between users and effectively improving the level of network information security. At the same time, the virtuality of this technology is reflected in that it is a virtual subnet attached to the public network, and all users can use public network resources and share information with other users. The professionalism is reflected in that only VPN users can

access, and non-VPN users can not connect to use. Give full play to its application advantages such as low construction cost, easy technology management, high security performance, high data and information transmission efficiency, high scalability and flexibility.

According to the application direction, virtual network technology can be classified into three forms: Remote access VPN remote access to the virtual network, which can connect the user's client to the network of the server gateway; The Intranet VPN is an internal virtual private network, which connects the VPN internal gateway through the tunnel technology. Extranet VPN is an extended virtual network, which mainly connects the VPN networks of two users to realize network resource link and communication, and achieve the synergistic promotion effect under data sharing.

### **3. THE IMPORTANCE OF COMPUTER NETWORK SECURITY**

In the era of big data, the increase in the amount of information involved in computer networks, coupled with the continuous expansion of network platform atmosphere, makes computers often face more complex problems, such as various viruses and trojans infiltrating into the network environment, causing the risk of stealing and leaking user personal information. In view of the unique characteristics of computer network security, such as strong concealment, low threshold for users to enter the Internet, and strong concealment of their own identity information, when stealing others' information, they can break through the barriers of time and space, connect to the network at will to obtain information, the process of illegal crime is very hidden, and it is not easy to be found by the parties, so it is necessary to continue to maintain computer network security. Do a good job of related protective work, regularly upgrade the network information system, in order to ensure the security of computer network.

At present, China attaches great importance to the problem of computer network security, in addition to vigorously introducing and developing virtual networks, but also hire professional and technical personnel to adjust and optimize virtual network technology, fundamentally reduce the negative factors in the virtual network environment, help promote the healthy and stable Internet access of the masses, to prevent user information from being stolen and tampered with. Provide protection for the property security and personal privacy security of the majority of users.

### **4. THE PRACTICAL APPLICATION OF VIRTUAL NETWORK TECHNOLOGY IN COMPUTER NETWORK SECURITY**

#### **4.1 Type of technology**

##### **4.1.1 Tunnel technology**

Tunnel technology is the core of virtual network technology, which can improve the quality and efficiency of data transmission. It mainly relies on the user end of the router network to complete the communication protocol encryption and address link, and build a dedicated data transmission tunnel, which can enable the encapsulated data information to be transmitted through the public network without expression. After reaching the target address, the tunnel protocol header is discarded, the encrypted information will be unsealed, and the original expression of the data will be restored. It fully embodies the characteristics of security and stability of this technology. At present, the mainstream tunnel technology can be divided into two categories; Layer 2 tunnel protocol, such as PPTP, establishes a virtual network for remote access and connects the client to the server. Layer 3 tunnel protocols, such as IPSec, are used to build internal and expand virtual private networks with higher security and are mainly used for the transmission of enterprise confidential files.

##### **4.1.2 Encryption and decryption Technologies**

In essence, encryption and decryption technology is a further upgrade and optimization of tunnel technology, which continues the point-to-point data transmission mode in tunnel technology, and scientifically processes data encapsulation on this basis, and transmits relevant information in the protocol. If the application of computer network information has not paid attention to the application of this technology, it will not only complicate the network information, but also reduce the security of data information, such as hackers into the computer network to steal personal information and corporate secrets. Therefore, it is necessary to reasonably apply encryption and decryption technology, rely on the carrier of computer network system, and adopt scientific programming and

setting methods to add security locks for data information, so as to provide a safe and stable transmission environment for data information, maintain personal and enterprise information security, protect their legitimate rights and interests from infringement, and fundamentally improve the level of computer network security [2].

#### 4.1.3 Key management technology

As the name suggests, the application object of this technology is the key in data encryption and decryption. Through the management of the whole life cycle process of the key in accordance with the relevant basic requirements, the risk of key disclosure is effectively prevented, so as to ensure the data security in the computer network. The specific management contents are as follows: key generation, according to the pseudo-random number generator, generate related key data; Key storage, the key is kept in a special memory device to realize the safe storage of the key; Key distribution, the distribution and sharing of public keys for different data; Key backup and recovery is mainly to ensure the security and availability of the key, so as to prevent the key from being damaged and the encrypted data cannot be decrypted. Key destruction, the destruction of the used key; Key archiving: The key data that has been used is archived and stored, and will not be used in future encryption. This process is used to ensure data security on virtual networks.

#### 4.1.4 Identity authentication technology

The identity authentication technology verifies the user's identity and permission, and confirms the user by logging in to the account and entering the password, effectively preventing illegal login or access to resources. As a mature virtual network technology, it is widely used in daily life. For example, when users use online banking, wechat payment, Alipay payment, mainly by entering the password, fingerprint, or SMS verification code to confirm their identity, to prevent others from stealing property; Another example is the juvenile game anti-addiction system in recent years, which is verified by entering identity information or facial recognition to effectively control the duration of minors' games and recharge.

### 4.2 Application level

#### 4.2.1 Network

In the application of virtual network technology to the network level, we must first focus on the network data center and exchange channels, take a full range of supervision access and application of the network line, not only can do intelligent identification supervision, but also can improve the security of data information storage and management, to prevent criminals from releasing viruses or direct attacks, effectively improve the computer network security management ability. At the same time, it is also necessary to regularly update and upgrade computer network security data, continuously promote the modernization and intelligent development of computer network technology, and properly cope with computer network threats in subsequent applications by enhancing the intelligent recognition ability of the system, so as to provide users with high security information storage conditions and give full play to the application efficiency of virtual network technology [3].

#### 4.2.2 Software

The application of virtual network technology to software can gradually improve the security and stability of computer network by maintaining the adaptability and adjusting the protocol. Based on the coordination Angle, virtual network technology can rationally deploy servers, efficiently manage all kinds of computer resources, and comprehensively strengthen the data processing ability of the system. For the open network environment, in order to eliminate the unstable factors in the virtual network, it is also necessary to implement personalized virtual network design. Through scientific application of this technology, many personalized networks can be adjusted to further improve the level of computer network security, and multiple authentication of user identity information, such as password, fingerprint verification and facial recognition, can also be carried out. Maximize the security and stability of data transmission.

#### 4.2.3 Devices

The application of virtual network technology to computer equipment can greatly improve the current computer network security environment through network cards, network cables, hard disks and other devices. First, network card, mainly connects the computer to the server, completes the packet verification and builds a dedicated link on

the basis of ensuring the security of the computer network. Second, network cable, by using the physical function of virtual technology, timely find the abnormal situation in the network line, and take targeted measures to solve the problem, completely eliminate the hidden trouble. Third, the application of hard disk and virtual network technology can upgrade hard disk devices in time, and cooperate with daily management and maintenance to effectively improve data storage and transmission efficiency.

#### 4.2.4 User Interconnection

Through the application of virtual network technology, the security of computer network can be effectively enhanced, which can enable users to connect with each other, achieve the goal of data information sharing, and better expand the available information resources. In general, there are the following four main points:

The first is the firewall, which can connect the computer hardware and software to provide security for the data files in the computer system, especially when dealing with common threats in the network, such as hacker attacks, Trojan viruses, can play a good defense effect;

The second is to choose the sending way, for the communication between users, in order to reduce the risk of leakage in the transmission of data information, you can choose the specific transmission route of a computer;

The third is to obtain confirmation information, in real life authentication, it is the use of software to streamline the process, in order to facilitate the user to obtain identity authentication, so to take comprehensive verification information, enhance its security; The fourth is to select security customers. By selecting a client with high security factor and scientific management system, the security and stability of all information resources storage and transmission can be ensured, and work efficiency can be improved [4].

### 4.3 Application effect

#### 4.3.1 Enhance data and information security

In the operation of computer network, security and stability is the primary concern of technical personnel to avoid the risk of hacker intrusion, Trojan virus and malicious program, so it is necessary to use virtual network technology scientifically and reasonably to ensure the security of computer network information. During this period, technical personnel can use virtual network technology to build a safe, reliable, efficient and stable network operating environment, which can improve the data transmission speed between the client and the server, and provide better information security services for the majority of users.

#### 4.3.2 Quickly sharing data and information

As a kind of raw material, data can be divided into structured and unstructured data types, such as office OA system, financial system, etc. are structured, and office documents, images, etc. are unstructured. By applying virtual technology to data transmission, it can achieve secondary packaging, effectively protect the security of data information, prevent it from being stolen and used by others, and also solve problems such as frame loss, so that data transmission is more complete. For example, the application of virtual network technology in the management of college education and teaching resources can not only prevent the loss of educational resources, incomplete and other problems, but also connect the education system of different colleges and universities to realize the sharing of educational resources.

#### 4.3.3 Strengthen cooperation and exchanges between different entities

##### (1) Between remote branches and corporate headquarters

Under the background of economic globalization, the scale of enterprises is gradually expanding, and there are branches in different regions. The communication between them and the headquarters is mainly conducted by special line, which is costly and inflexible. The application of virtual network technology can establish data and information transmission channels between the two, ensure the security of information transmission between the remote branch and the corporate headquarters, and facilitate the supervision and management of the remote branch by the corporate headquarters, and further enhance the communication between the two.

##### (2) Between remote employees and other employees

In the context of the novel coronavirus epidemic, some employees work at home. In order to ensure the normal operation of the enterprise, these employees can use virtual network technology to connect their personal computers to the enterprise network, so that they can access the enterprise information system remotely, promote the communication and interaction between remote employees and other employees, and ensure the security and stability of data and information transmission.

### (3) between enterprises

Under normal circumstances, enterprise partners, including suppliers, transporters and sellers, often involve a lot of confidential information in their information exchange. In order to ensure the security of information exchange, virtual network technology can be applied in it, which can not only realize online face-to-face communication, save the meeting time of both parties, but also improve work efficiency [5].

## 4.3.4 Apply policies

### (1) Enhance network security awareness

Only to ensure that computer technicians have a good sense of prevention, in order to fundamentally prevent the occurrence of computer network security hidden problems. To this end, it is necessary to strengthen the popularization of network security knowledge education for users, and actively learn network security knowledge, so that they can fully understand and understand the importance of network security, and gradually develop good computer application habits. At the same time, the government and relevant departments should also strengthen education and guidance, conduct network security education for the majority of computer users, and unconsciously help the masses to form a good awareness of network security through the use of new media platforms such as Weibo and Tiktok.

### (2) Strengthen protection against hackers

Compared with ordinary computer users, hackers generally have strong computer technology, can use the network to invade the user client, steal valuable and private information, causing huge property losses, personal information leakage and other problems. In the era of big data, this problem is becoming more and more prominent, so it is necessary to take preventive measures against network hackers, strengthen their understanding of hackers by enhancing the awareness of users to prevent hackers, and actively learn some advanced network security technologies to ensure their own information security. At the same time, enterprises and organizations should actively attract computer professionals, regularly update and upgrade the corporate firewall, and improve their own network security level, so as to better prevent hacker attacks and ensure the security of the computer network environment.

### (3) Improve the network security mechanism

On the one hand, it is necessary to improve the network use management mechanism, the relevant departments should vigorously strengthen the supervision of bad websites, crack down on illegal websites, thoroughly clear the network environment of risky websites, websites, and formulate detailed laws and regulations to let hackers know their illegal behavior; On the other hand, it is necessary to implement a security protection mechanism, set up network security officers in enterprises, introduce relevant technical personnel to ensure network security, and effectively improve the effect of network security protection.

## 5. CONCLUSION

To sum up, virtual network technology plays an important role in computer network security, which can improve interaction efficiency, strengthen work quality, and provide convenient conditions for important data and information management on the basis of ensuring the security of data and information transmission. To this end, it is necessary to continuously and deeply explore virtual network technology, correctly understand the application value of this technology, carry out in-depth analysis from the type of technology and application level, and enhance network security awareness, increase hacker protection, improve network security mechanism, and constantly ensure computer network security, ensure the security of data information resources, and effectively improve work efficiency.

## REFERENCES

- [1] Zhou, Z. (2026). Hierarchical Needs in US Automotive Customer Feedback and the Sentiment–Function Nexus. *Journal of Industrial Engineering and Applied Science*, 4(1), 27-33.
- [2] Wensi, L. (2026). AI-Enabled Data Visualization Marketing for Automated Production Lines: Building Customer Trust and Improving Lead-to-Order Conversion. *Academic Journal of Natural Science*, 3(1), 8-13.
- [3] Li, W. (2026). Optimizing AI-Driven Bid Pricing Models for Non-Standard Automation Projects: Leveraging Historical Financial Data and Machine Learning Algorithms.
- [4] Ren, Z. (2024). Semantic Transformation Network: Improving Dialogue Summarization Through Contrastive Learning and Attention. *Journal of Theory and Practice in Engineering and Technology*, 1(3), 1–8. Retrieved from <https://woodyinternational.com/index.php/jtpet/article/view/59>
- [5] Ren, Z. (2024). VGCN: An Enhanced Graph Convolutional Network Model for Text Classification. *Journal of Industrial Engineering and Applied Science*, 2(4), 110–115. <https://doi.org/10.5281/zenodo.13118430>
- [6] Ximeng, Y., & Yiming, Z. (2026). Offline Conservative RL for Transaction Authorization: Smartly Balancing Fraud Risk and Customer Friction. *Journal of Economic Theory and Business Management*, 3(1), 1-9.
- [7] Yang, X., & Zhang, Y. (2026). Edge-Enabled Real-Time Fraud Detection for Network Lending Terminals under Low-Latency Constraints. *Journal of Computer Technology and Applied Mathematics*, 3(1), 55-62.
- [8] Zhao, S., Lin, Y., Yang, X., Lu, Q., Xue, H., & Jiang, G. (2025). Optimization of Deep Learning Models for Dynamic Market Behavior Prediction. arXiv preprint arXiv:2511.19090.
- [9] Yang, X., Zheng, X., & Lu, Q. (2025, October). Construction and early warning of multi-dimensional network credit-related transaction risk maps by integrating graph neural network (GNN). In *Proceedings of the 2025 2nd International Conference on Digital Economy and Computer Science* (pp. 919-923).
- [10] Shen, Zepeng, et al. "Research on Application of Whale Optimization Algorithm in Financial Payment Fraud Detection." 2025 4th International Conference on Artificial Intelligence, Internet and Digital Economy (ICAID). IEEE, 2025.
- [11] Yang, J. (2025, January). Application of lightgbm in the chinese stock market. In *Proceedings of the 2025 4th International Conference on Big Data, Information and Computer Network* (pp. 853-858).
- [12] Tian, Q., Wang, Z., & Cui, X. (2024). Improved Unet brain tumor image segmentation based on GSConv module and ECA attention mechanism. arXiv preprint arXiv:2409.13626.
- [13] Wu, J., Luo, L., & Liao, N. (2025). Small-Sample Object Detection of Surface Cracks in Concrete Structures of High-Rise Buildings via Multi-Level Transfer Learning. *Innovation & Technology Advances*, 3(2), 57–72. <https://doi.org/10.61187/ita.v3i2.262>
- [14] Yang, J. (2025). Application of LightGBM in the Chinese Stock Market.

## Author Profile

**Weiwei Zhou** (1983.7), female, Han, Shaanxi Province, lecturer, undergraduate, research direction: Network technology.