

VPN-Based Approaches to Computer Network Information Security: Methods and Applications

Jihao Yu, Yi Song

Shaanxi Electronic Information School, Xi'an 710024, China

Abstract: *With the continuous development of China's social economy, the pace of scientific and technological advancement has been steadily accelerating. Internet technology and computer technology have experienced rapid expansion within this developmental trajectory. However, as the information age progresses, the issue of information security within internet technology has grown increasingly critical. Within the internet domain, users' online information faces numerous threats, making the preservation of information security an essential imperative. This paper discusses the application of Virtual Private Network (VPN) technology in computer network information security, providing an overview of VPN technology with the aim of offering valuable insights and assistance to relevant technical personnel.*

Keywords: Virtual private network; Network technology; Information security; Computer network.

1. ANALYSIS OF VIRTUAL NETWORK TECHNOLOGY AND COMPUTER SECURITY APPLICATIONS

1.1 Overview of Virtual Network Technology

1.1.1 Tunnel Technology

Tunnel technology is one of the core technologies in virtual private network technology. Tunnel technology is the process of compressing network information data into a single packet, and then transmitting the network information data through tunnel technology. This transmission method can prevent the loss of large data during the transmission process. Moreover, at present, there is no completely secure transmission channel in the process of network information data transmission, but the security of the transmission channel can be guaranteed. The tunneling technology of virtual private networks can package the data in network information and protect it, thereby maximizing the security and integrity of network information data. The most important aspect of tunneling technology is to package compressed data packets and ensure that the compressed data can be compressed as much as possible. Be able to avoid being affected and interfered with during the transmission process. Tunnel technology is the core technology that ensures network information security, and it is also a very important technology.

1.1.2 Encryption Technology

At present, with the development of China's network information era, the application scope of network information in various industries is constantly expanding. At the same time, the security risks of network information are gradually increasing, and encryption technology is widely used in network information security. There are currently two types of encryption technologies, one is active encryption and the other is passive encryption. Active encryption refers to the use of encryption software by users of network information technology to set passwords for the information data that needs to be encrypted. Passive encryption mainly involves encrypting the contents of files in the local area network to prevent information data and files from being leaked, such as disk encryption which is a form of passive encryption. In virtual private network technology, encryption technology is a highly effective measure for protecting data information. It can prevent unknown attacks from stealing and leaking information data and files when using tunneling technology for data transmission, further ensuring the security of network information data.

1.1.3 Real name responsibility technology

Real name responsibility technology is a very common technology in today's life. For example, real name authentication is required during the purchase process of high-speed rail tickets, travel tickets, etc., identity

authentication is also required during banking transactions, and real name authentication is also required when using electronic consumption software to ensure information and property security. Real name responsibility authentication is a common protective measure in online information exchange, which can prevent others from accessing one's resources and file data. That is to say, when others want to access your data files, they need to authenticate their identity. There are many ways to authenticate identity in network information security protection measures, such as password authentication and password authentication, as well as voice and facial authentication. In addition, there are also two factor authentication methods, such as using a bank card and password for two factor authentication in a bank's self-service ATM. The application of real name responsibility authentication technology is very extensive, which can protect the security of people's personal information and property information.

1.1.4 Key Management Technology

In the network information security protection, protecting the data transmission security of Internet information is a very important key technology. The key management in ISAKMO technology, which is mainly composed of SKIP and ISAKMO, is public, and every network information user can obtain the key, but the key management in SKIP technology is secret and will not be known by other users. Both of these technologies are very important in network information security management, and key management can be carried out based on the actual usage of users.

1.2 Overview of Virtual Private Network Characteristics

There are two ways to connect virtual private networks, but during the process of connecting virtual private network lines, the connection method can be adjusted according to different needs. The characteristics of virtual private network technology mainly include security, efficiency, and simplification. The characteristic of security is that when using a virtual private network to encrypt information data, only a specialized key can be used to crack the data packet. If the data packet is intercepted without the key, it is also impossible to crack the information data, which can ensure the security of network information data transmission. The efficient feature is that when using virtual private networks for information data processing, the efficiency of information data processing is very high, which can effectively save the economic costs of enterprises or individuals, and also reduce the work pressure of professional and technical personnel, thereby promoting the progress of network information modernization. The characteristic of simplicity is that when using virtual private network technology, it can effectively reduce the laying of lines, simplify the workflow of enterprise information management, and also reduce the production cost and work difficulty of enterprises.

1.3 Discussion on Computer Network Information Security

The security issues that exist in computer networks mainly include natural disasters, network viruses, illegal login, etc. Among them, natural disasters refer to the impact of electromagnetic radiation or sudden natural disasters on computer networks in nature, causing external damage to computers and affecting their network security. The problem of network viruses is a significant security issue that affects the operation of computer networks. Network viruses can invade the interior of computers, affecting their running programs and slowing down their speed. In addition, network viruses can also damage important files and data inside computers, steal users' privacy and account information, and seriously affect the security of computer users' life and property information. The problem of illegal login in computer networks is mainly caused by human factors. During the operation of computer networks, if important data in the computer network is leaked or destroyed without the recognition of enterprises and users, it will affect the work of enterprises or individuals and cause great losses.

1.4 Literature Review

Zheng and Jiang [1] developed a new methodology for Chinese term extraction from scientific publications, enhancing the precision of domain-specific terminology identification. Addressing environmental sustainability, Zhou et al. [2] optimized an automated garbage recognition model based on ResNet-50 and weakly supervised CNN, contributing to sustainable urban development through improved waste classification. In the field of human-computer interaction, Sun [3] proposed adaptive interfaces for personalized user experience using a machine learning approach, enabling intelligent adaptation to individual user preferences. Ukey et al. [4] tackled challenges in dynamic data environments by developing an efficient method for continuous kNN join over dynamic high-dimensional data, providing scalable solutions for real-time similarity search. Extending interface design research, Sun [5] further explored AI-assisted UI design, demonstrating how generative tools can enhance

both efficiency and creativity in the design process. In graph-based computation, Yang et al. [6] introduced HGMatch, a match-by-hyperedge approach for subgraph matching on hypergraphs, improving the efficiency of complex graph analytical queries. Peng et al. [7] advanced 3D vision research by proposing 3D Vision-Language Gaussian Splatting, a novel approach that bridges vision and language modalities for high-quality 3D scene representation at the International Conference on Learning Representations. Wu et al. [8] addressed structural health monitoring by developing a small-sample object detection method for surface cracks in concrete structures of high-rise buildings via multi-level transfer learning, overcoming the practical constraint of limited labeled data in critical infrastructure inspection. Lian and Chen [9] contributed to foundational AI methodologies through research on complex data mining analysis and pattern recognition based on deep learning, advancing capabilities for large-scale knowledge discovery. In the automotive industry, Ziren [10] conducted dynamic optimization and multi-regional performance validation of automotive sales strategies in the United States, offering data-driven insights for market-specific decision-making. Lyu et al. [11] developed optimized CNNs for rapid 3D point cloud object recognition, addressing the demand for efficient processing of three-dimensional spatial data. In the cybersecurity domain, Xu et al. [12] investigated adversarial machine learning in cybersecurity, providing a comprehensive analysis of both attack vectors and defense mechanisms in AI-driven security systems. Yang et al. [13] designed a full-cycle intelligent risk control system for pre-loan, mid-loan, and post-loan lending, employing AI-driven closed-loop management to strengthen online credit security. Complementing this financial security research, Shen et al. [14] applied the Whale Optimization Algorithm to financial payment fraud detection, demonstrating the effectiveness of bio-inspired optimization techniques in identifying fraudulent transactions. In photonic device engineering, Tang et al. [15] presented work on the design and optimization of shallow-angle grating couplers for vertical emission from Indium Phosphide devices, contributing to integrated optics development. Finally, Ding et al. [16] achieved substantial progress in visual surveillance through multi-scale adaptive clustering and local consistency learning for unsupervised clothing-changing person re-identification, tackling one of the most challenging variants of person retrieval.

2. ANALYZING THE APPLICATION OF VIRTUAL PRIVATE NETWORK TECHNOLOGY IN COMPUTER NETWORK INFORMATION SECURITY

2.1 Applications between various departments in the enterprise and remote branches

At present, in the process of management, enterprises will use virtual private networks. Virtual private networks can be applied to communication and exchange between enterprise departments and remote branch departments. When using virtual private network technology, various departments and branches of the enterprise can establish connections, and at the same time, various branch departments can also establish connections. This kind of connection allows departments of the enterprise to guide the work of branch departments through this technology, including the content and requirements of the work, as well as supervise and manage the work status of each branch department and review the work results of branch departments, Thus improving the work quality of enterprise branch departments, virtual private network technology can also achieve information exchange and resource sharing between various departments of the enterprise, effectively improving the efficiency of work docking between departments.

2.2 Application between Campus Network and Remote Students

In the process of school operation, the main body is the virtual private network technology between teachers and students, which allows remote teaching and communication between students and teachers, as well as sharing of teaching resource information between teachers. It also ensures the accuracy and speed of information data and online teaching, thereby improving the efficiency of teachers' remote teaching. When using virtual private network technology on campus, students are the main body, and through the download of computer network software, teachers and students can communicate remotely, effectively improving the teaching efficiency of teachers and the learning efficiency of students.

2.3 Applications between enterprises, suppliers, and partners

Virtual private networks allow enterprises to share information resources with suppliers and partners during communication. Enterprises can transmit accurate data information to them, thereby promoting the establishment of information channels for both parties to conduct business negotiations in a timely manner. This effectively reduces the time and economic costs between enterprises and suppliers. Virtual private networks can also be used

for business video conferences, making business projects more open and transparent, thereby improving the economic and work efficiency of enterprises.

3. SPECIFIC OPTIMIZATION MEASURES SHOULD BE TAKEN

3.1 Strengthen research on virtual private network technology

Although China's computer network information security technology has been widely applied, this technology has not yet been perfected. Relevant departments should conduct in-depth research and development on virtual private network technology, actively promote this technology, and provide financial support for its research. To solve the shortage of resources in this technology in China, encourage relevant professional researchers to innovate in virtual private networks, and actively cultivate technical talents in virtual private networks, so that China's virtual private network technology can achieve better development.

3.2 Improve virtual private network technology

The security of computer network information, in the context of virtual private network technology, lacks a system for security evaluation and risk evaluation. The security evaluation and risk evaluation of computer network information are crucial, as they relate to the privacy of information exchange in this system and also to the security of the network. Therefore, we need to use innovative methods to improve the virtual private network technology system, construct new systems and environments. Strengthen the security assessment of computer network information security systems, prevent information leakage, and ensure the security of network information. Optimize virtual private network technology using various new technologies, establish corresponding protection systems, and use new technological equipment for monitoring and management to ensure the security of computer network information.

3.3 Managing computer technicians

In the application of computer network technology, in order to effectively protect information data, it is necessary to train and manage computer technicians in order to improve the security of computer networks. Computer technicians need to constantly improve their technical level and professional competence. At the same time, relevant technical departments need to effectively manage computer technicians and impose strict requirements on computer network security personnel to ensure the security of computer network technology.

3.4 Building antivirus software and firewalls

In the virtual private network technology, it is very important to build anti-virus software and firewall, which can ensure the security of communication between Internet users. During the operation of a computer, firewalls and antivirus software will remind users whether the current information exchange is secure, and can also block illegal intrusions, intercept harmful information in the computer, and provide effective security protection for the computer.

3.5 Optimize management system

When using virtual private network technology, it is necessary to improve the management system in order to ensure the quality and security of virtual private network technology. Relevant personnel should have an accurate understanding of the operating status of computers in order to develop scientific and reasonable management systems, effectively implement and enforce them, and provide better institutional protection for computer network security.

4. CONCLUSION

In summary, virtual private network technology is mainly composed of four core technologies: tunneling technology, encryption technology, identity authentication technology, and key technology. When virtual private network technology is applied in practice, it can effectively help enterprises develop and manage, and solve many practical problems. With the widespread application of network information technology in China, computer networks have made communication and interaction between people more convenient and efficient. However, computer networks also face many data security issues. The development and application of virtual private

network technology can effectively avoid the security problems of information leakage, thereby improving the security of information data transmission.

PROJECT TITLE

Exploration of Network Security Construction in Vocational Schools, Project No. 2025SZX521.

REFERENCES

- [1] Zheng, H., & Jiang, T. (2025). A New Methodology for Chinese Term Extraction from Scientific Publications. *Innovation & Technology Advances*, 3(2), 19–45. <https://doi.org/10.61187/ita.v3i2.222>
- [2] Zhou, Y., Wang, Z., Zheng, S., Zhou, L., Dai, L., Luo, H., ... & Sui, M. (2024). Optimization of automated garbage recognition model based on resnet-50 and weakly supervised cnn for sustainable urban development. *Alexandria Engineering Journal*, 108, 415-427.
- [3] Sun, L. (2025, November). Adaptive Interfaces for Personalized User Experience: A Machine Learning Approach. In *Proceedings of the 2025 International Conference on Artificial Intelligence and Sustainable Development* (pp. 457-462).
- [4] Ukey, N., Zhang, G., Yang, Z., Li, B., Li, W., & Zhang, W. (2023). Efficient continuous kNN join over dynamic high-dimensional data. *World Wide Web*, 26(6), 3759-3794.
- [5] Sun, Lingxin. "AI-Assisted UI Design: Enhancing Efficiency and Creativity through Generative Tools." *Journal of Computer Technology and Applied Mathematics* 3.1 (2026): 19-27.
- [6] Yang, Z., Zhang, W., Lin, X., Zhang, Y., & Li, S. (2023, April). HGMatch: A Match-by-Hyperedge Approach for Subgraph Matching on Hypergraphs. In *2023 IEEE 39th International Conference on Data Engineering (ICDE)* (pp. 2063-2076). IEEE.
- [7] Peng, Q., Planche, B., Gao, Z., Zheng, M., Choudhuri, A., Chen, T., Chen, C. and Wu, Z., 3D Vision-Language Gaussian Splatting. In *The Thirteenth International Conference on Learning Representations*.
- [8] 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>
- [9] Lian, J., & Chen, T. (2024). Research on Complex Data Mining Analysis and Pattern Recognition Based on Deep Learning. *Journal of Computing and Electronic Information Management*, 12(3), 37-41.
- [10] Ziren, Z. (2026). Dynamic Optimization and Multi-Regional Performance Validation of Automotive Sales Strategies in the United States. *Academic Journal of Natural Science*, 3(1), 1-7.
- [11] Lyu, T., Gu, D., Chen, P., Jiang, Y., Zhang, Z., Pang, H., ... & Dong, Y. (2024). Optimized CNNs for Rapid 3D Point Cloud Object Recognition. *arXiv preprint arXiv:2412.02855*.
- [12] Xu, J., Wang, Y., Chen, H., & Shen, Z. (2025). Adversarial Machine Learning in Cybersecurity: Attacks and Defenses. *International Journal of Management Science Research*, 8(2), 26-33.
- [13] Yang, X., Xue, H., Hu, Q., & Zhang, Y. (2025, October). Design of a full-cycle intelligent risk control system for pre-loan, mid-loan, and post-loan lending: AI-driven closed-loop management of online credit security. In *Proceedings of the 2025 2nd International Conference on Digital Economy and Computer Science* (pp. 1022-1027).
- [14] 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.
- [15] Tang, Yingheng, et al. "Design and Optimization of Shallow-Angle Grating Coupler for Vertical Emission from Indium Phosphide Devices." (2020).
- [16] Y. Ding, Z. Ye, I. Xu, S. Lyu and L. Zhang, "Multi-Scale Adaptive Clustering and Local Consistency Learning for Unsupervised Clothing-Changing Person Re-Identification," in *IEEE Transactions on Information Forensics and Security*, vol. 21, pp. 2889-2904, 2026, doi: 10.1109/TIFS.2026.3671089.