

# Research on the Application of Modern Communication Technology in the Field of the Internet of Things

**Jie Chen**

*Tarim University, Alar, Xinjiang, 843300, China*

**Abstract:** *With the rapid development of Internet of Things (IoT) technology, the application of modern communication technology in the field of IoT is becoming increasingly widespread, serving as an important force driving the construction of an intelligent society. This paper, starting from the background of the New Engineering disciplines, explores the application of modern communication technology in the IoT field and conducts an in-depth analysis of its development trends. Firstly, it introduces the basic concepts and key roles of modern communication technology in IoT, emphasizing its importance in promoting the intelligence and interconnection of IoT. Secondly, through investigation and analysis of the current status of IoT communication technology, it reveals the challenges and problems faced by IoT communication technology in the context of the New Engineering disciplines. Subsequently, innovative research methods based on the concept of New Engineering are proposed, including project-driven and interdisciplinary integration, aiming to promote in-depth exploration and practical application of IoT communication technology issues. Finally, the future development direction of IoT communication technology is prospected, emphasizing the importance of cross-disciplinary cooperation and technological innovation, and calling for strengthening research and application of communication technology in the field of IoT to contribute to the construction of an intelligent society. This paper aims to provide theoretical support and practical guidance for the application research of modern communication technology in the IoT field, offering ideas and experiences for the development and innovation of related fields.*

**Keywords:** *Internet of Things (IoT); modern communication technology; application research; communication protocols and standards; smart cities*

## 1. Introduction

The emergence of the Internet of Things connects various objects together, realizing data exchange and sharing through the Internet, communication technology, and smart terminals, bringing unprecedented convenience to human life and social development. In this process, information and communication technology plays a crucial role as the foundation of IoT development, continuously evolving and improving to provide strong support for the wide application of IoT. This paper aims to explore the development and application of information and communication technology in the era of IoT, focusing particularly on the challenges and future trends faced by information and communication technology in the IoT era. Specifically, it considers issues such as security and privacy in IoT communication, the scalability and reliability of IoT communication systems, and the prospects for 6G communication technology and its applications. The research in this paper aims to provide practitioners, researchers, and policymakers with a comprehensive understanding of the development of information and communication technology in the era of IoT, thereby promoting the development and innovation of related fields.

## 2. Overview of Modern Communication Technology

Modern communication technology is increasingly being applied in the field of the Internet of Things (IoT), playing a crucial role in building an intelligent and interconnected society. This section will provide an overview of 5G communication technology and its characteristics, as well as IoT communication protocols and standards, aiming to explore their key roles in the IoT domain.

## **2.1 5G Communication Technology and Its Characteristics**

As a representative of the fifth-generation mobile communication technology, 5G technology features high speed, low latency, and massive connectivity, bringing enormous opportunities for the development of IoT. The following will introduce the basic principles and architecture of 5G technology and its key roles in IoT.

### **2.1.1 Basic Principles and Architecture of 5G Technology**

5G technology is based on novel wireless communication technology and network architecture, including principles such as massive Multiple-Input Multiple-Output (MIMO), millimeter-wave communication, and beamforming. In terms of architecture, 5G adopts technologies such as virtualized networks and network slicing, achieving flexible configuration and efficient utilization of network resources. Additionally, 5G introduces new core network architectures such as cloud-based core networks and Network Function Virtualization (NFV) technology, further enhancing network flexibility and scalability.<sup>[1]</sup>

### **2.1.2 Key Roles of 5G Technology in IoT**

5G technology plays a key role in IoT, mainly in providing high-speed and high-capacity communication support for connecting a large number of IoT devices, reducing communication latency to support real-time applications, and ensuring higher network security for the secure transmission of IoT data. Moreover, 5G provides a more stable and reliable communication infrastructure for IoT applications, thereby supporting the development of smart cities, intelligent transportation, industrial IoT, and other fields.

## **2.2 IoT Communication Protocols and Standards**

IoT communication protocols and standards are essential foundations for device-to-device communication and data exchange, with different protocols and standards suitable for different scenarios and requirements. The following will introduce the characteristics and applicable scenarios of common IoT communication protocols such as MQTT, CoAP, and the development and application of IoT-related standards.

### **2.2.1 Characteristics and Applicable Scenarios of Common IoT Communication Protocols like MQTT, CoAP**

MQTT is a lightweight publish/subscribe messaging transport protocol suitable for low-bandwidth, high-latency networks, commonly used for real-time transmission of sensor data due to its simplicity, low overhead, and ease of implementation and deployment. CoAP, on the other hand, is a lightweight application layer protocol based on the REST architecture, suitable for communication between resource-constrained IoT devices. CoAP features low overhead, support for multicast and group communication, making it suitable for IoT environments with limited bandwidth and power.<sup>[2]</sup>

### **2.2.2 Development and Application of IoT-related Standards**

With the rapid development of IoT, related standards are continuously being improved and developed. For example, the IEEE 802.15.4 standard is used for communication in Low-Power Wireless Personal Area Networks (WPANs), while the IEEE 802.11 standard is applicable to Wireless Local Area Networks (WLANs), providing the foundation for interconnection between IoT devices. Additionally, industry organizations and standardization bodies have developed IoT standards tailored to specific domains such as smart homes, industrial IoT, etc. In the future, as IoT technology evolves and application scenarios diversify, related standards will continue to be improved and expanded, providing more stable and reliable technical support for the development of IoT.

By elaborating on the overview of modern communication technology, we can gain a deeper understanding of the important roles of 5G communication technology and IoT communication protocols and standards in the IoT domain, providing a strong theoretical foundation and technical support for subsequent research and practices.

## **3. Communication Network Architecture in the Internet of Things**

In today's communication network architecture of the Internet of Things (IoT), edge computing, edge communication networks, and Wireless Sensor Networks (WSNs) play crucial roles. They

establish a flexible and efficient communication infrastructure, providing strong support for the operation of IoT systems. This section will delve into the roles, advantages, and future development directions of these key technologies in the IoT domain.

### ***3.1 Edge Computing and Edge Communication Networks***

#### ***3.1.1 Roles and Advantages of Edge Computing in IoT***

Edge computing, as a computing paradigm that deploys data processing and analysis functions on edge devices close to the data source, brings many advantages to IoT systems. Firstly, edge computing can reduce data transmission latency, achieve rapid response, and support real-time decision-making, especially suitable for time-sensitive IoT application scenarios. Secondly, edge computing can reduce dependence on centralized cloud servers, improving system stability and reliability. Additionally, edge computing can mitigate security risks during data transmission, protecting user privacy and data security. In summary, edge computing plays a crucial role in IoT, providing more efficient and secure computing and storage capabilities for IoT applications.

#### ***3.1.2 Architecture and Key Technologies of Edge Communication Networks***

Edge communication networks are an essential foundation for supporting edge computing, consisting of edge nodes, edge servers, and cloud servers. In this architecture, edge nodes are responsible for data collection and transmission, edge servers handle data processing and analysis, while cloud servers are used for data storage and management.<sup>[3]</sup> Key technologies include deployment and management of edge nodes, load balancing and scheduling of edge servers, and data transmission and synchronization between edge and cloud. Among them, energy management of edge nodes, optimization of communication protocols, and data security are current research hotspots and challenges.

### ***3.2 Wireless Sensor Network (WSN) Technology***

#### ***3.2.1 Application Scenarios and Challenges of WSN in IoT***

Wireless Sensor Networks (WSNs) are common communication technologies in IoT, with application scenarios including environmental monitoring, smart agriculture, smart health, and more. However, WSN technology also faces various challenges in practical applications. Firstly, due to sensor nodes being typically battery-powered, energy consumption becomes a critical factor limiting WSN applications. Secondly, the instability of network topologies and communication contention among nodes also restrict the coverage and reliability of WSNs. Additionally, the high deployment and maintenance costs of sensor nodes are significant factors hindering the widespread adoption of WSN applications.

#### ***3.2.2 Development Directions and Improvement Strategies for WSN Technology***

To overcome the challenges faced by WSN technology, future development directions mainly include optimization of energy management, network topology, and communication protocols. Optimization of energy management can be achieved by introducing new low-power chips, energy harvesting techniques, and intelligent sleep scheduling algorithms. Network topology optimization can utilize hierarchical network structures and self-organizing network topologies to improve network stability and coverage. Improvements in communication protocols require the design of more efficient routing protocols and data transmission protocols to enhance network transmission efficiency and reliability. Through these improvement strategies, the further development of WSN technology can be promoted, driving the application and popularization of IoT technology.

## **4. Key Applications of Communication Technology in the Internet of Things**

Communication technology plays a crucial role in the Internet of Things (IoT), facilitating the intelligent and interconnected development across various industries. This section will focus on discussing the key applications of communication technology in smart cities and intelligent logistics, as well as smart healthcare and medical fields.<sup>[4]</sup>

#### **4.1 Smart Cities and Intelligent Logistics**

Smart cities and intelligent logistics are vital areas of IoT technology application, relying on advanced communication technology to achieve efficient data transmission and intelligent decision-making. Below are specific case analyses:

##### **4.1.1 Application Cases of 5G Technology in Smart City Management and Logistics**

5G technology, as the next-generation mobile communication technology, has brought revolutionary changes to smart city management and logistics. In smart city management, the high speed and low latency enabled by 5G technology facilitate rapid collection, transmission, and processing of various urban data, thus realizing functions such as smart transportation, intelligent lighting, and environmental monitoring. For example, some cities utilize 5G technology to implement smart streetlight systems, automatically adjusting lighting brightness based on traffic flow and weather conditions, thereby enhancing energy efficiency. In the field of logistics, 5G technology enables applications such as cargo tracking, vehicle dispatching, and smart warehousing, improving logistics efficiency and service quality. For instance, the 5G smart port project in Nanjing, China, utilizes 5G technology to achieve intelligent management of containers and automated navigation for vessels, significantly enhancing port operation efficiency and safety.

##### **4.1.2 Application Practices of IoT Technology in Urban Infrastructure Monitoring and Intelligent Transportation**

IoT technology plays a significant role in urban infrastructure monitoring and intelligent transportation. Through the deployment of sensors, cameras, and other devices, real-time monitoring of urban road traffic, air quality, water quality, etc., is achieved, providing data support for urban management departments. IoT-based intelligent transportation systems can realize intelligent control of traffic signals, prediction, and mitigation of traffic congestion, effectively alleviating urban traffic pressure. For example, the smart traffic project in London, UK, utilizes IoT technology to achieve adaptive adjustment of traffic signals and intelligent navigation for vehicles, significantly improving urban traffic efficiency and safety.

#### **4.2 Smart Healthcare and Medical Fields**

Smart healthcare and medical fields represent another important application area of IoT, utilizing communication technology to achieve remote monitoring and personalized management of medical services. Below are specific case analyses:

##### **4.2.1 Current Status and Prospects of Communication Technology in Remote Medical Monitoring and Medical Device Networking**

Communication technology is increasingly being applied in smart healthcare and medical fields, providing more convenient and efficient means for medical services. Remote medical monitoring technology utilizes communication networks to achieve remote transmission of medical data and remote communication between doctors and patients, realizing seamless medical service connections. Networking of medical devices enables information sharing and collaboration among medical devices, improving the accuracy and efficiency of medical diagnosis. In the future, with the gradual commercialization of 5G technology and the continuous development of intelligent medical devices, applications such as remote medical monitoring and medical device networking will have broader development prospects.<sup>[5]</sup>

##### **4.2.2 Innovative Applications of IoT Technology in Health Management and Medical Diagnosis**

IoT technology has also achieved some innovative applications in health management and medical diagnosis. Wearable devices equipped with biosensors can monitor users' health data, such as heart rate, blood pressure, blood sugar, etc., in real-time, providing data support for personalized health management. Additionally, smart medical imaging diagnosis systems built using IoT technology can automatically identify and analyze medical image data, assisting doctors in disease diagnosis and treatment planning. For example, some hospitals in the United States have begun using IoT technology to build smart medical imaging diagnosis systems, achieving good application effects and improving the accuracy and efficiency of medical imaging diagnosis.

Through the above key application cases, we can see the important role of communication technology in the IoT field, not only promoting the intelligent development of cities and efficient

operation of logistics but also bringing new service models and medical practices to the healthcare field. In the future, with continuous innovation in communication technology and deepening application of IoT technology, these key application areas will have broader development prospects.

## **5. Challenges and Prospects**

The Internet of Things (IoT), as one of the forefront technologies in the field of information and communication, brings about numerous conveniences and opportunities, yet it also faces a series of challenges and future development prospects. This section will primarily discuss security and privacy issues, as well as technological innovation and future development trends.

### **5.1 Security and Privacy Issues**

#### **5.1.1 Security Risks and Threat Analysis in IoT Communication**

There are various security risks and threats in IoT communication, including data breaches, network attacks, device tampering, etc. Firstly, due to the large-scale collection, transmission, and processing of sensitive data in IoT systems, any data leakage or malicious tampering poses a severe threat to personal privacy and enterprise security. Secondly, IoT devices typically use wireless communication for data transmission, which carries risks of being targeted by hackers, such as DDoS attacks, man-in-the-middle attacks, etc., potentially resulting in system paralysis or data manipulation. Additionally, due to the large-scale deployment and low manufacturing costs of IoT devices, there are concerns about poor device security, making them susceptible to physical attacks and device tampering.

To address these security challenges, comprehensive security strategies need to be formulated, including techniques such as data encryption, network firewalls, security authentication, etc., as well as establishing sound security management mechanisms and emergency response systems. Strengthening security monitoring and vulnerability remediation for IoT devices and communication networks, enhancing the system's resilience to attacks, and improving security levels are crucial for ensuring the security of IoT communication<sup>[6]</sup>

#### **5.1.2 Targeted Security Solutions and Future Development Trends**

Targeted security solutions are required to address the security risks and threats in IoT communication. Firstly, strengthening encryption and authentication of IoT communication networks to ensure the confidentiality and integrity of data during transmission. Secondly, establishing comprehensive security monitoring and defense systems to promptly detect and respond to network attack incidents, ensuring the secure operation of the system. Additionally, enhancing the security design and production of IoT devices to improve their resistance to attacks. In the future, with the development and application of emerging security technologies such as blockchain and quantum encryption, the security of IoT communication will be further enhanced, providing more reliable guarantees for the development of IoT applications.

### **5.2 Technological Innovation and Future Development Trends**

#### **5.2.1 Impact and Application Prospects of New Technologies such as Artificial Intelligence and Edge Computing on IoT Communication**

The impact of new technologies such as Artificial Intelligence (AI) and edge computing on IoT communication is becoming increasingly evident, bringing about new development opportunities for IoT applications. Firstly, the application of AI technology can achieve intelligent analysis and processing of IoT data, improving data utilization efficiency and intelligence level. Secondly, edge computing technology deploys computing and storage functions at the network edge, reducing data transmission and processing latency, and improving system response speed and real-time performance. In the future, with the continuous maturity and popularization of AI and edge computing technologies, IoT communication will become more intelligent and efficient, bringing more innovative applications across various industries.

#### **5.2.2 Development Trends of Future Communication Technologies and Innovative Directions for IoT Applications**

Future developments in communication technology will continue to focus on improving network speed, reducing latency, and enhancing device connectivity. With the commercialization of 5G

technology and research progress in 6G technology, IoT communication will achieve faster data transmission, lower latency, and larger-scale device connectivity. Additionally, emerging applications such as ultra-high-definition video, virtual reality, augmented reality, etc., will also become key development directions for IoT communication. In the future, IoT applications will not only be limited to traditional fields such as smart homes and smart cities but will also extend to emerging fields such as smart factories, smart agriculture, smart healthcare, etc., bringing more convenience and opportunities to human society.

Through the analysis of challenges and prospects above, we can see that although facing various challenges, IoT communication technology is still full of tremendous development potential and endless innovation possibilities. Only by continuously strengthening research and innovation, actively addressing various challenges, can we better promote the development of IoT communication technology and make greater contributions to building a more intelligent, convenient, and secure IoT world.

## 6. Conclusion

With the exploration and practice of high-frequency electronic circuit course design under the background of the new engineering disciplines, we have seen numerous opportunities and challenges. As technology continues to advance and society develops, there will be new opportunities for the development of high-frequency electronic circuit course design. Through project-driven and interdisciplinary design methods, we can better cultivate students' practical abilities and innovative consciousness, laying a solid foundation for their future work and research. However, we also need to address various issues such as updating and adjusting course content, innovating and improving teaching methods, etc. In the future, we need to further deepen teaching reforms, strengthen interdisciplinary cooperation, continuously explore high-frequency electronic circuit course design models adapted to the background of the new engineering disciplines, to better meet students' learning needs, and promote the development and innovation of electronic engineering education.

## References

- [1] Zhou, Y., & Sun, H. (2022). *Application of Artificial Intelligence in Contemporary Computer Information Technology*. *Wireless Interconnection Technology*, 19(15), 19-21.
- [2] Zhang, J. (2022). *Discussion on the Application of 5G Communication Technology in the Era of Internet of Things*. *Internet of Things Technology*, 12(7), 116-118.
- [3] Zhang, H. (2021). *Exploration of the Application of Artificial Intelligence in Computer Network Technology in the Era of Big Data*. *Technology Information*, 19(30), 17-19.
- [4] Li, X. (2021). *Analysis of the Application of Artificial Intelligence in Contemporary Computer Information Technology*. *Digital Communication World*, (10), 167-168, 207.
- [5] Cai, D. (2020). *Application of Artificial Intelligence in Computer Network Technology Based on Big Data Background*. *Computer Programming Skills and Maintenance*, (11), 75-77.
- [6] Shi, J., Li, R., & Song, T. (2020). *Blockchain-Based Access Control Framework for the Internet of Things*. *Computer Applications*, 40(4), 931-941.