

# Research on IPv6 Network Protocol

## Computer Networking Course Project

In this project, you are required to complete a comprehensive research report about IPv6 Network Protocol. There are 3 parts in this project. In the first part, you need to get a basic understanding of the IPv6 protocol. And then you can choose an arbitrary advanced topic about IPv6 in part2. Finally, you are required to do some implementations in part3.

**Note:** This Project is **ONLY** for students whose majors are **not computer science and engineering**, **UP TO 2 students** are allowed to form the project team.

### Part 1. Basic information about IPv6 (20 scores in total)

Although the IPv4 network protocol is invasive in our daily life, its network structure's shortcomings have become more and more obvious with the development of information technology. To address this issue, IPv6 comes to the stage. It has been significantly strengthened in scalability and security. However, replacing IPv4 with IPv6 cannot be achieved overnight. For a long time, IPv6 and IPv4 will be used simultaneously. In this part, your research report should at least engage the following aspects:

1. Summary the **characteristics** of IPv6, including but not limited to the difference between IPv6 and IPv4, and its advantages in scalability and security.
2. Investigate the **status of development** of IPv6, and **status of migration** from IPv4 to IPv6. You should understand the disadvantages of IPv6 and the difficulties in the migration process.
3. You need to survey the **outside attitudes** towards IPv6, including the domestic and international policies, and what industries (Hardware manufacturers, Internet service providers, and so on) have done to support the application of IPv6.
4. Research the **application** of IPv6, especially in the field of IoT.

### Part 2. Advanced topics of IPv6(choose one among the following,20 scores in total)

#### Topic 1: IPv6+

IPv6+, which is represented by protocol innovations such as **SRv6**, **network slicing**, **IFIT**, **BIERv6**, etc., combined with AI such as network analysis, intelligent tuning, etc. is introduced to meet requirements for 5G transport and cloud-network synergy.

In this topic, you are required to do a comprehensive survey on at least 1 of the aforementioned protocol innovations. Your research should at least contain:

1. The motivation of the technology.
2. How it achieves its function based on the IPv6 protocol, you should analyze the extension header for the corresponding IPv6 packets as well as the implementation of the network structure.
3. What's the advantage of the technology regarding simplicity, scalability and security, delay, etc.?
4. Its application scenario.

#### Topic 2: Transition mechanisms

IPv6 is foreseen to coexist with IPv4 for a long time. Due to the difficulty in the deployment

of the network and upgrading infrastructure, many businesses and corporations are just reluctant to move to IPv6 when the IPv4 network works just fine, especially with the help of “NAT”. Therefore, IPv6 transition mechanisms are needed to enable IPv6 hosts to reach IPv4 services and to allow isolated IPv6 hosts and networks to reach each other over IPv4 infrastructure.

In this topic, you are required to choose at least 2 transition techniques among the following, give a detailed description of **how the connectivity is guaranteed** using that technology, and **compare the two technologies you choose**.

1. **Dual Stack** – Running both IPv4 and IPv6 on the same devices
2. **Tunneling** – Transporting IPv6 traffic through an IPv4 network transparently
3. **Translation** – Converting IPv6 traffic to IPv4 traffic for transport and vice versa

### Topic 3: IPsec Protocol

IPsec architecture is a suite of protocols providing a set of IP extensions for implementing security in the network layer for both IPv4 and IPv6.

In this topic, you should try to answer the following questions:

1. What are the **two modes** of operation of IPsec? Explain their characteristics.
2. IPsec has 3 key protocols to perform its functions: **AH, ESP, and IKE**. What do they stand for and what are they designed for? What layer of network protocol are they? Also, list some algorithms for each protocol.
3. IKE is composed of two phases, what are they and how do these two phases work together to guarantee security?
4. How do AH and ESP work in the two modes of IPsec in the IPv6 network? Analyze the corresponding packets and give a thorough answer.

### Part 3. Design and Implementation(50 scores in total)

In this part, you are supposed to verify IPv4 and IPv6 addressing. You can use Cisco packet tracer or Huawei's eNSP simulator as the platform. Specifically, you should design a network topology satisfying the following basic requirements:

1. Contains **at least 3** LANs (local area network), with each consisting of **at least**:
  - a) **2** types of end systems
  - b) **2** types of links
  - c) **3** routers

You'd better base your network topology on some real-life scenes, such as a Enterprise/ Campus Network.

2. There should be **at least 1** IPv4 LAN and **1** IPv6 LAN, and you are supposed to achieve connectivity between them using one of the transition techniques.
3. You should configure **HTTP, DHCP, DNS and EMAIL** servers in each of your LANs.
4. **Dynamic routing** should be configured in your network.
5. Realize network connectivity and necessary isolation.

We list some extra characteristics to boost your topology. You are encouraged but not required to implement some of them based on your conditions(**10~20 scores in total**):

1. Configure FTP service.
2. Include IoT equipment in your network.

3. You can add more advanced features to your networks like IPv6+ and IPsec.
4. Find some applications with those advanced characteristics mentioned in part2 and do verification on them.
5. If possible, use your own device to build a real network topology.

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TIPS: to make your topology clear and easy to understand, you should add labels to demonstrate the IP address of each interface and any information needed.

### **Submission:**

1. Technical report. This should include:
  - Your research result in part1&2
  - The platform and configuration of your experiment in part3
  - Necessary explanations to illustrate your design of network topology.
  - Test results of your experiment.
  - The problems you meet and how you learn from them.
  - Your personal views on this project.

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2. All necessary files to demonstrate your project.

### **NOTES:**

While encountering problems with eNSP, you are suggested to contact the following email: 11912039@sustech.edu.cn.