

1. INTRODUCTION

The TCP/IP protocol supports reliable communication across devices and global connectivity in modern networks, while the network layer routing is responsible for packet forwarding and optimal path selection. The Internet is composed of multiple autonomous systems, and routers rely on routing protocols to exchange topology data. Different protocols vary significantly in terms of convergence speed, scalability, and other aspects, directly affecting network performance. Enterprises need to choose dynamic routing protocols such as RIP, OSPF, and EIGRP according to their needs, to accommodate network expansion and structural changes, reduce transmission delays, and minimise packet loss. This project will use simulation tests to comparatively analyse the actual operational performance of various routing protocols.

2. AIMS

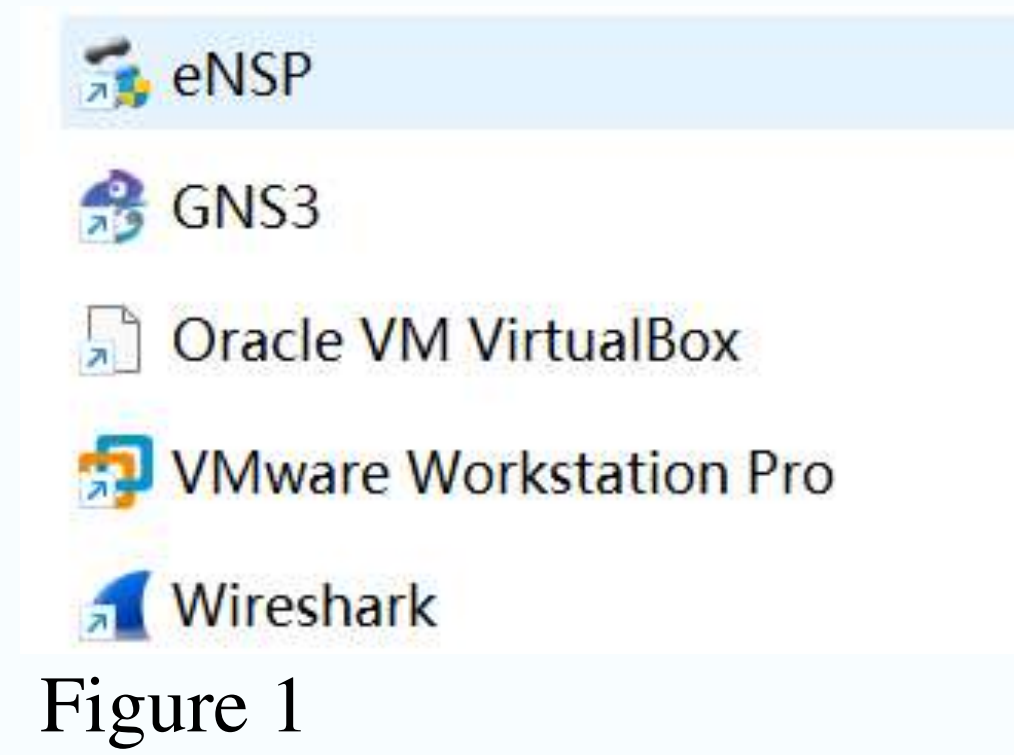
- Test the performance of the routing protocol on different platforms and obtain relevant data.
- It provides references and suggestions for companies that need to select network routing equipment.

3. OBJECTIVES

- Conduct a structured literature review, identify the key performance indicators of the experiments, and compare the standards and existing research gaps.
- Determine and prove the appropriate research methods for the project.
- Design and implement representative enterprise network simulations.
- Use tools to capture and analyse network performance data, and evaluate measurable indicators.
- Compare protocol performance with the expected deployment, and propose reasonable suggestions for enterprise network architecture and routing strategy selection.

4. MATERIALS & METHODS

During the preparation stage, it is necessary to install and configure the network simulator GNS3 and Huawei eNSP separately, as well as the corresponding virtual workstations VMware and Oracle VM. At the same time, install Wireshark and Npcap.



According to the initial experimental design, the equipment setup will be completed in GNS3(Figure 2) and Huawei eNSP(Figure 3). After completing the device configuration for the dual-platform, the test was conducted to send ICMP communication from Router 1 to PC4. The main test indicators are to observe the convergence speed of EIGRP, OSPF and RIP routing protocols as well as their internal protocol behaviours. In order to obtain the target data more accurately and precisely, the experimental testing method is as follows: after the communication is initiated, the main link interface is turned off. Then, the data is observed through the client software in the network simulator and by using Wireshark for packet capture.

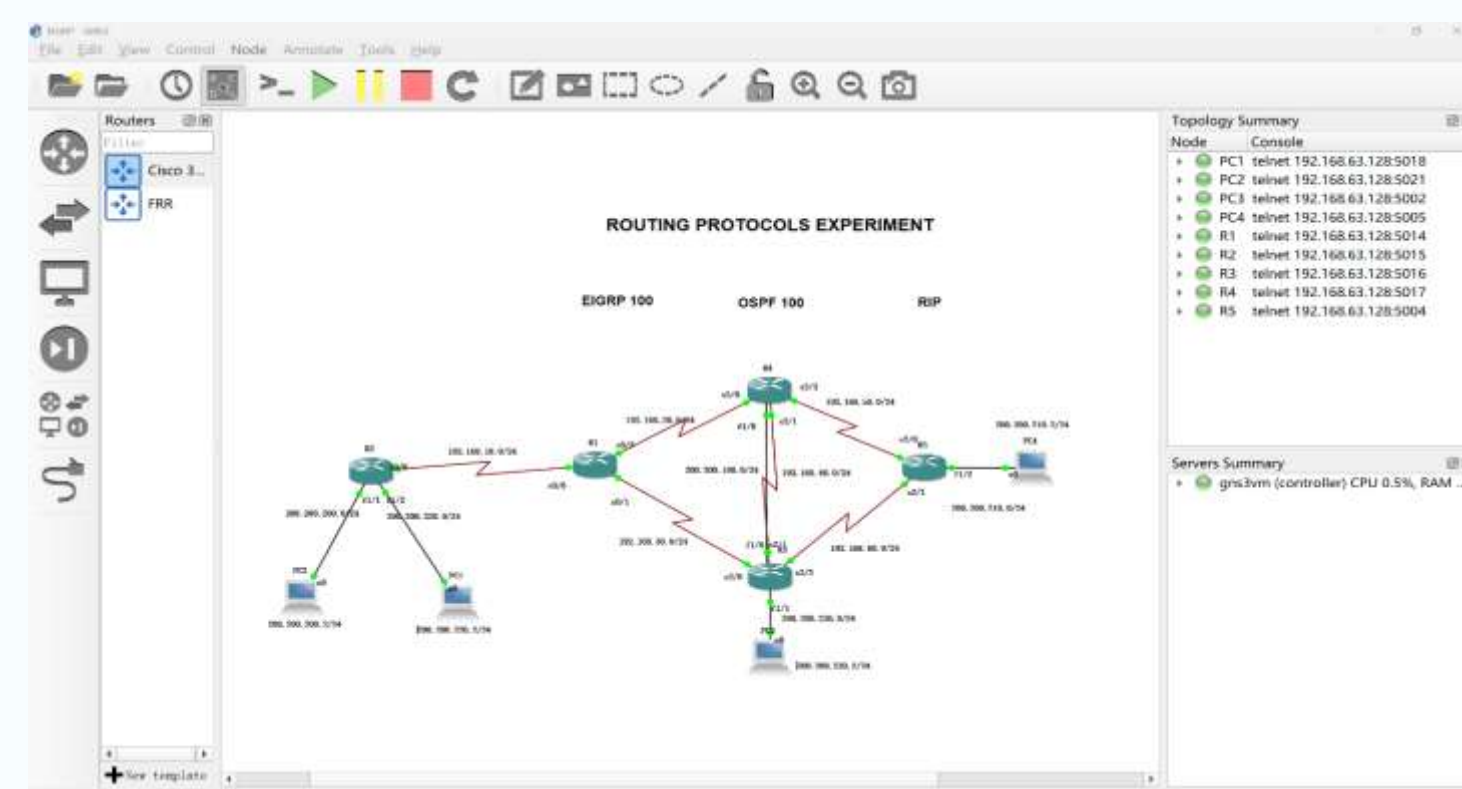


Figure 2

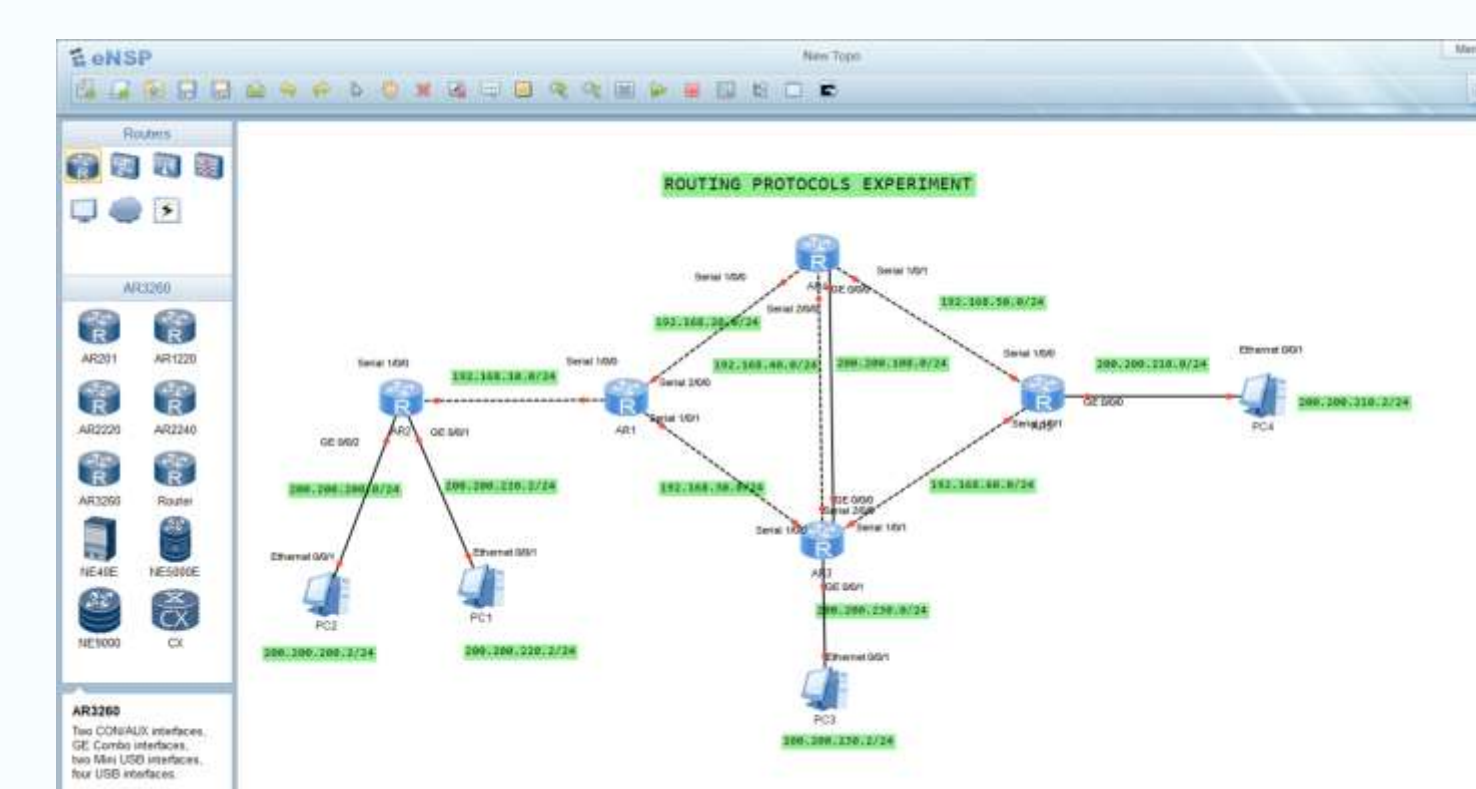


Figure 3

5. TESTING

RIP test demonstration between eNSP (Figure 4) and GNS3 (Figure 5). After successfully capturing the packet, by checking the routing information protocol's metric, we observed until we found 16 metric.

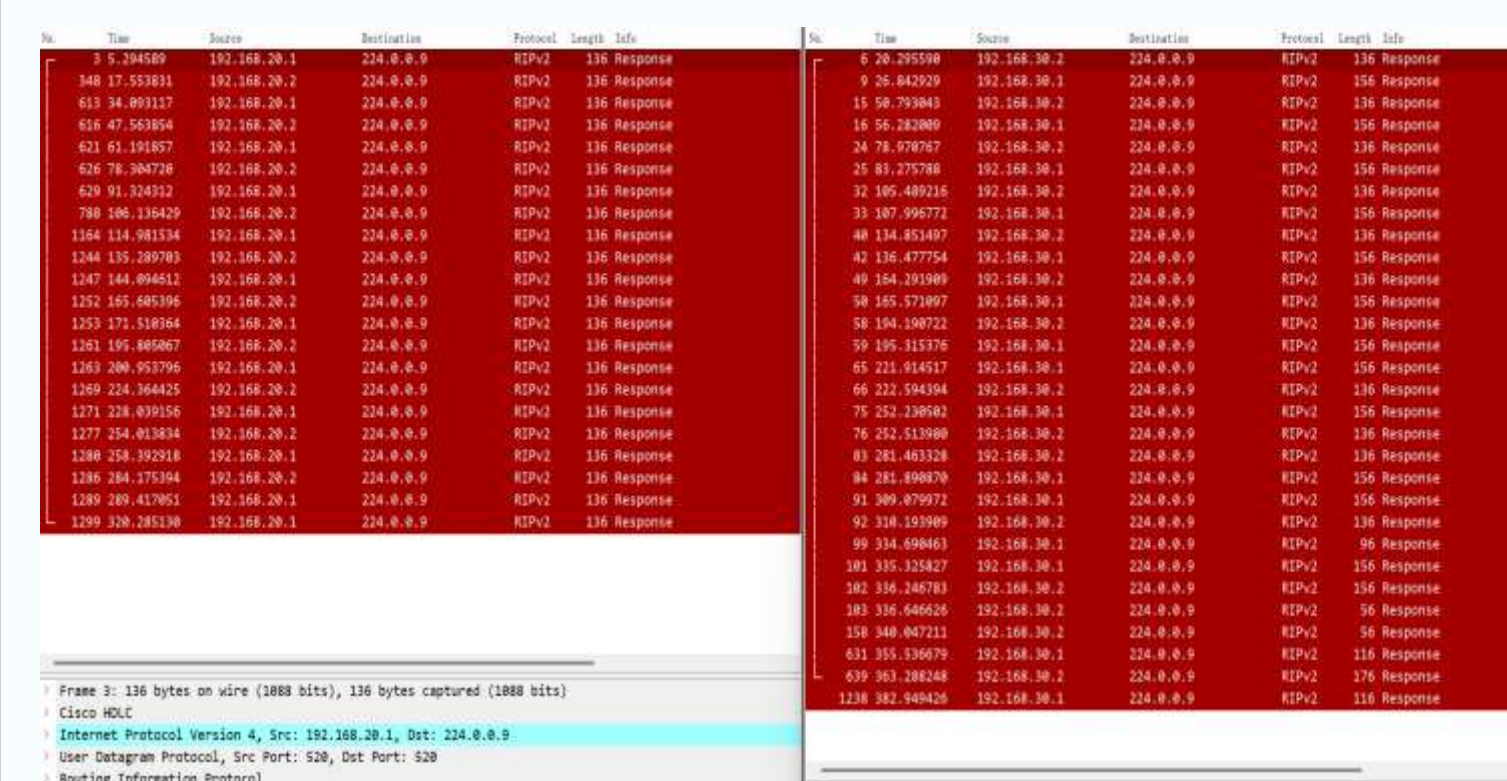


Figure 4

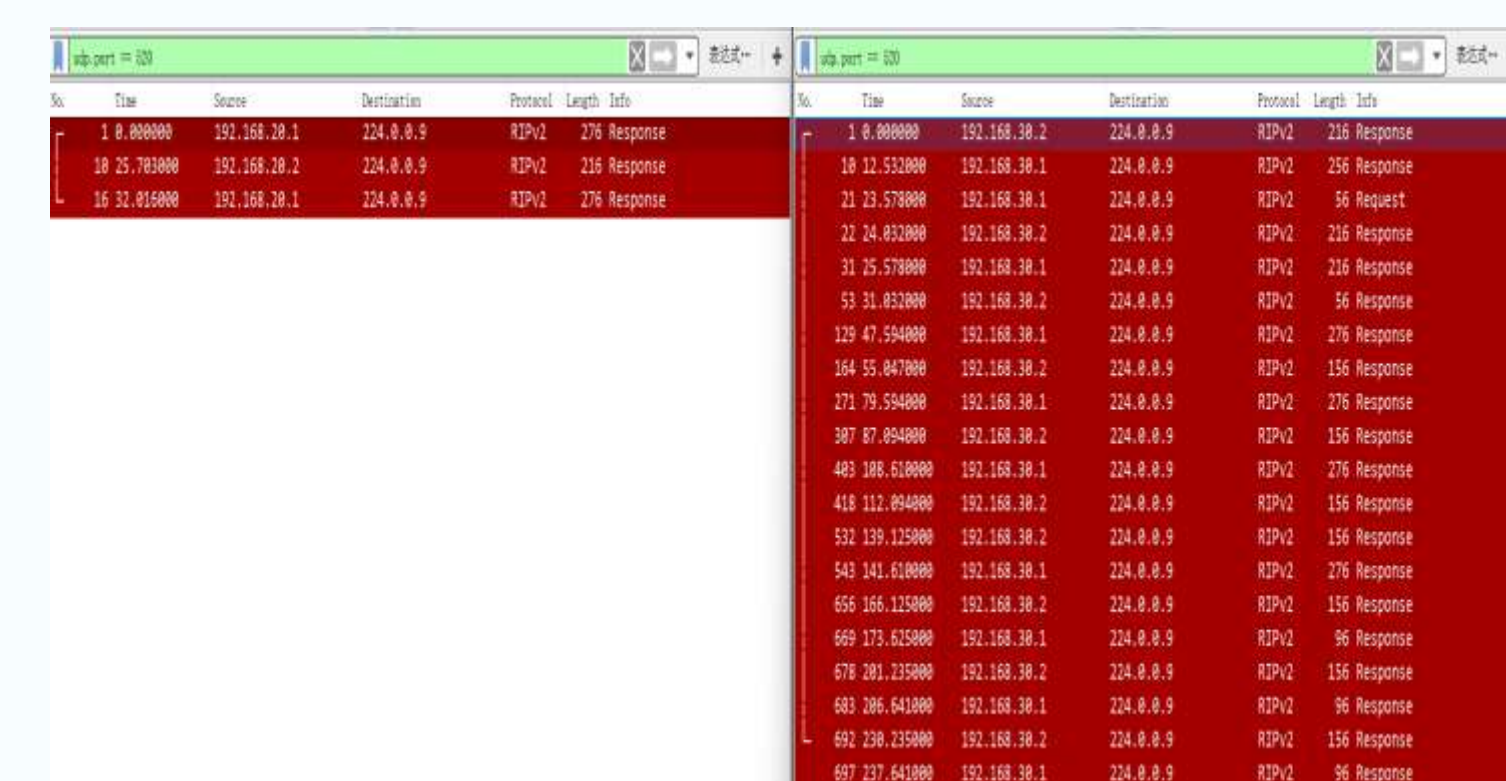


Figure 5

6. RESUTLS

Figure 6 and 7 illustrate significant differences among different routing protocols. Under normal circumstances, OSPF achieves lower latency on both platforms compared to RIP. In eNSP, the latency of OSPF is 27 milliseconds, while that of RIP is 30 milliseconds. In GNS3, the latency of OSPF is 43 milliseconds, while that of RIP reaches 74 milliseconds, indicating higher latency. In the case of link failure, the convergence speed of OSPF is also faster. In eNSP, OSPF completes convergence in 3 seconds, while RIP requires 6 seconds. In GNS3, OSPF completes convergence in 5 seconds, while RIP requires 43 seconds. This indicates that OSPF responds more quickly to topological changes. The situation of data packet loss also confirms this trend. In the GNS3 failure test, the data packet loss rate of RIP is 5%, while OSPF is only 1%. In eNSP, the data packet loss rate of RIP is 2%, while OSPF is still 1%.EIGRP in GNS3 also performs well. Under normal circumstances, the latency is 47 milliseconds, and the convergence time in the case of failure is 6 seconds, which is better than RIP but slightly worse than OSPF.

Comparing with OSPF protocol and RIP protocol between the GNS and eNSP				
In normal situation.				
Platform	Protocol	Avg Latency (ms)	Packet Loss	Convergence Time (s)
eNSP	RIP	30	0%	
eNSP	OSPF	27	0%	
GNS3	RIP	74	0%	
GNS3	OSPF	43	0%	

In Link-state is failure				
Platform	Protocol	Avg Latency (ms)	Packet Loss	Convergence Time (s)
eNSP	RIP	28	2%	6
eNSP	OSPF	26	1%	3
GNS3	RIP	40	5%	43
GNS3	OSPF	34	1%	5

Figure 6

Comparing three different routing protocols in GNS3			
In normal situation.			
Protocol	Avg Latency (ms)	Packet Loss	Convergence Time (s)
RIP	74	0%	
OSPF	43	0%	
EIGRP	47	0%	

In Link-state is failure			
Protocol	Avg Latency (ms)	Packet Loss	Convergence Time (s)
RIP	46	5%	19
OSPF	34	1%	5
EIGRP	40	2%	6

Figure 7

7. CONCLUSIONS

Based on the research results, different routing solutions are suitable for different equipment environments.

- For a mixed multi-vendor network, OSPF is the preferred solution as it achieves low latency, rapid convergence, and low packet loss rate in both Huawei and Cisco's simulation platforms. As an open standard protocol, OSPF also avoids the problem of vendor lock-in, allowing organizations to choose equipment more flexibly while balancing performance and cost.
- For a Cisco network, OSPF should still be regarded as the main choice as it supports future expansion and can be more easily integrated with products from other vendors. EIGRP is used only in a closed environment limited to Cisco because it has excellent convergence performance.
- For a Huawei network, OSPF is the most reliable and efficient routing solution. When used in combination with Huawei AR series routers, it can reduce deployment costs while maintaining stable network performance.
- For smaller and less demanding environments, RIP may still be acceptable, but its slow convergence speed and high packet loss rate during faults may cause service interruptions. Therefore, RIP is only suitable for very small-scale office networks with extremely low stability requirements and should not be used in medium-sized or large enterprise networks..