Chapter 16
OSPF-Based Network Engineering Design and Implementation

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Abstract This essay Designs an enterprise network engineering, which solves the problem of poor device performance bottlenecks, and then improves the scalability of enterprise network engineering. Combining with the project, it discusses the enterprise network requirements, including a division of IP address and a description of network topology design. In addition, this essay focuses on the design and implementation of OSPF protocol-based network, and discusses the use and implementation of the agreement, providing the solution to enterprise network performance for different applications, providing protection for later maintenance and scalability and basic network model for all types of enterprises.

Keywords Network engineering · OSPF protocol · Performance · Safety · Model

16.1 Introduction

According to the enterprise scale and complexity degree of the network system, user demand for networks vary a lot, from simple file sharing, Office Automation to complex e-commerce, ERP and so on [1]. So requirements vary from each other according to Enterprise network performance based on application, network selection should be based on actual requirements [2]. Less network technicians work in non-professional network enterprise, while stronger dependency on the network, therefore network needed should be as simple as possible, reliable, easy to use, and reducing network usage and maintenance costs is very important [3, 4].

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Open Shortest Path First (OSPF) is an Interior Gateway Protocol (IGP) to a single autonomous system (autonomous system, AS) decision-making routes [5]. Comparing with RIP, OSPF is a link-state routing protocol, RIP is a distance vector routing protocol [6]. The protocol management distance (AD) of OSPF was 110.

16.2 OSPF Dynamic Routing Protocol

16.2.1 Advantages of OSPF Protocol

OSPF is a true LOOP-FREE (no routing loop) routing protocol. The advantages are derived from the algorithm itself (Shortest path tree and link state algorithm).

OSPF convergence speed: it can pass routing changes throughout the autonomous system in the shortest amount of time [7].

The concept of area Division is put forward. The amount of routing information needed to be passed is greatly reduced through the summary of routing information between the areas. After the autonomous system is divided into different region, further avoiding the rapid expansion of routing information following with the network scale.

Control the cost of the agreement itself to the minimum:

Hello packet that does not contain routing information, which is used to discover and maintain neighbor relationships, is very short. Messages that contain routing information is the new mechanism triggered. (Sent only when a route changes). But in order to enhance Protocol robustness, every 1,800 s it will be sent again.

In broadcasting network, using a multicast address (non-broadcast) newspaper delivery can reduce interference to other devices that are not running OSPF network.

In multiple access networks (broadcast, NBMA), through the election of DR, routing and switching between the routers and network segments (synchronization) from o (N*N) time is reduced to o (n) time.

Put forward the concept of STUB areas, making the STUB no longer spread introduction of ASE route in the region. ABR (area border router) support on route aggregation, further reducing the routing information between the area.

In a point-to-point interface types, properties, by configuring the on-demand broadcast (OSPF over On Demand Circuits), OSPF is no longer scheduled sending Hello packets and routing information updates on a regular basis. Only sending updates when real changes occur in network topology information.

Routes are divided through a strict separation of levels (four), providing more reliable routing.

Good security, OSPF supports clear text and MD5 authentication based on the interface.

OSPF adapt to all sizes of networks, up to thousands of units.

16.2.2 OSPF Communication Between the Different Regions and Certification

F0/0 interfaces of R1 and R2 belong to area0, F0/1 interface of R1 and R2 belong to Area1.

F0/0 and F0/1 interface of R3 and R4 belong to arae1.

R1 configuration: the configuration of R1 and R2 is the same.

```
Router(config)#int f 0/0
Router(config-if)#ip add 192.168.10.2 255.255.255.0
Router(config-if)#int f 0/1
Router(config-if)#ip add 192.168.20.2 255.255.255.0
Router(config-if)#router ospf 100
Router(config-router)#net 192.168.10.2 0.0.0.255 area 0
Router(config-router)#net 192.168.20.3 0.0.0.255 area 1
Router(config-router)#no au
Router(config-router)#exit
```

R3 configuration: Configuration is the same for R3 and R4

```
Router(config)#int f 0/0
Router(config-if)#ip add 192.168.20.3 255.255.255.0
Router(config-if)#int f 0/1
Router(config-if)#ip add 192.168.40.2 255.255.255.0
Router(config-if)#no sh
Router(config-if)#int f 0/
*Mar  1 00:16:46.823: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar  1 00:16:47.823: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
Router(config-if)#int f 0/0
Router(config-if)#no sh
Router(config-if)#int f 1/0
Router(config-if)#
*Mar  1 00:16:52.591: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar  1 00:16:53.591: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
Router(config-if)#ip add 192.168.50.2 255.255.255.0
Router(config-if)#no sh
Router(config-if)#router ospf 100
Router(config-router)#net 192.168.20
*Mar  1 00:17:16.775: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on FastEthernet0/0 (not full duplex)
net0/1 (full duplex).
Router(config-router)#net 192.168.20.3 0.0.0.255 area 1
Router(config-router)#net 192.17
*Mar  1 00:17:26.319: %OSPF-5-ADJCHG: Process 100, Nbr 192.168.20.2 on FastEthernet0/0 from LOADING to FULL,
Router(config-router)#net 192.168.40.2 0.0.0.255 area 1
Router(config-router)#net 192.168
*Mar  1 00:18:16.771: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on FastEthernet0/0 (not full duplex)
net0/1 (full duplex).
Router(config-router)#no au
Router(config-router)#exit
```

Change the duplex status of the interface R3f0/0 to modified duplex

```
Router(config)#int f 0/0
Router(config-if)#
*Mar  1 00:14:30.999: %CDP-4-DUPLEX_MISMATCH: duplex mismatch discovered on FastEthern
net0/1 (full duplex).sp
Router(config-if)#speed 100
Router(config-if)#du
Router(config-if)#duplex f
*Mar  1 00:14:38.199: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to upu
Router(config-if)#duplex full
Router(config-if)#
Router(config-if)#exit
```

Enable OSPF interface redaction MD5 authentication work in Area0

```
Router(config)#int f0/0
Router(config-if)#ip ospf me
Router(config-if)#ip ospf message-digest-key 1 md5 cisco
Router(config-if)#ip ospf au
Router(config-if)#ip ospf authenticationme
Router(config-if)#ip ospf authentication me
Router(config-if)#ip ospf authentication message-digest
Router(config-if)#exit
Router(config)#
*Mar  1 00:19:14.375: %OSPF-5-ADJCHG: Process 100, Nbr 192.168.30.2 on FastEthernet0/0 from FULL to DOWN
```

16.3 Design

16.3.1 Design Principles and Objectives of Engineering

16.3.1.1 Design Follows the Following Principles

Practical and economical: network applications should be implemented in the processes, focus on the practical, building viable network of enterprises by using the principles of economy.

Advance and maturity: when organizing the network, the concept of the nature should be taken into account as well as its maturity, its technology, its equipment, structures, tools, not only shows the advanced properties, but also has the potential to guarantee after several years in a leading position.

Reliability and stability: in the case of advancement and maturity of technologies and products, pay attention to that system, structure, maintenance management, reliability, and stability. Ensure that the network is running properly.

Security and privacy: the purpose of the network is to share resources, a reliable and stable network must possess security and privacy, take different measures in different environments, network security and correct operation can be guaranteed.

Scalability and maintainability: because the network is not the same.

Considering the changes in network, you should design the simplest and most economical network, achieving scalability and maintainability requirements and increasing your network's performance.

16.3.1.2 Purpose of Engineering Design

With the rapid development of enterprise business, current network architecture can no longer meet the needs of enterprises, Enterprise network aimed primarily at the construction of figures in enterprise-wide information management, build a high performance, high security, ease of management and maintenance of enterprise networks to ensure the smooth of the network, easy to apply, will eventually be brought information management to enterprise, improving the quality and productivity of enterprises.

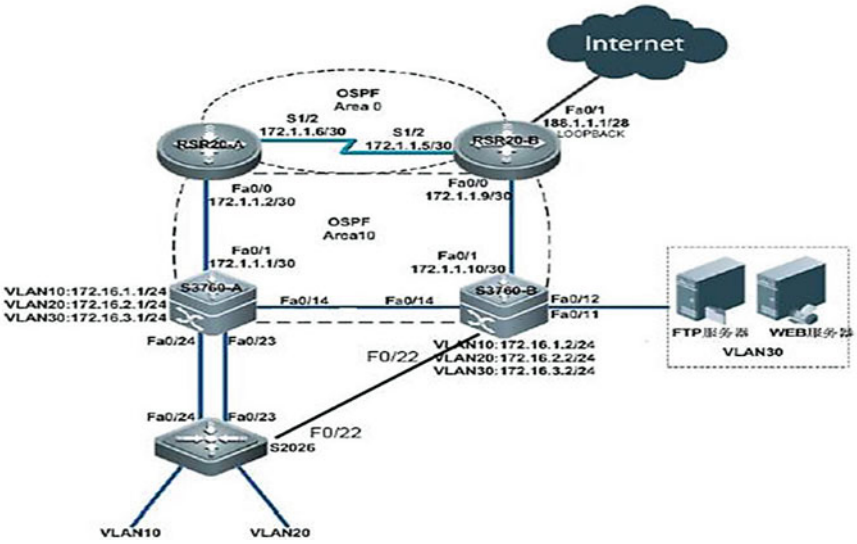

Fig. 16.1 Overall topology

16.3.2 General Topology

Figure 16.1.

16.4 Realization of the Project

16.4.1 Simulators: Stimulate the Entire Topology

Figure 16.2 and Table 16.1.

16.4.2 Connectivity and Technical Support of Full Network

16.4.2.1 In the Core Layer

OSPF routing protocol on the R3 and R4 is necessary by using OSPF in dynamic routing of the enterprise, which not only solved the problem that RIP is only allowed for smaller networks, while also solved that RIP consume too much network bandwidth, processor and memory resources.

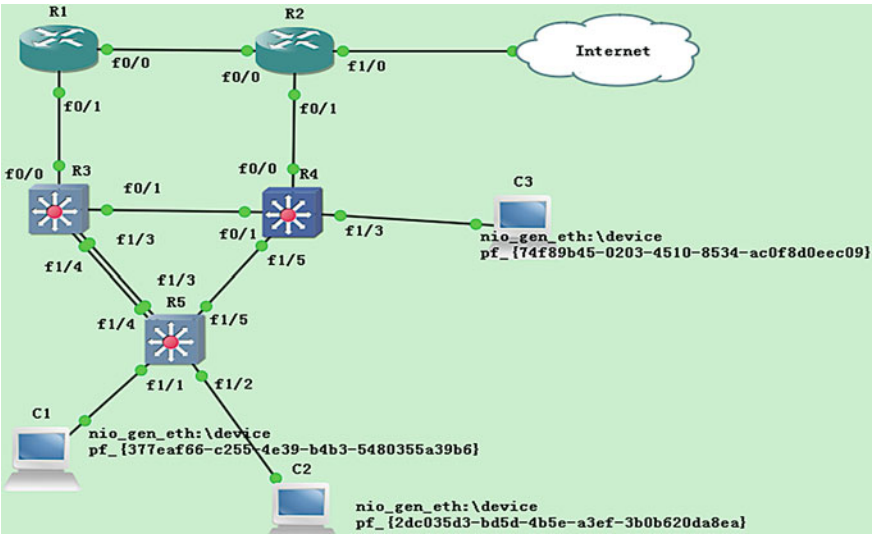

Fig. 16.2 Design with simulator

Table 16.1 IP address distribution

Equipment	Interface	IP	Corresponding equipment	Corresponding interface	Corresponding IP
R1	F0/0	192.168.10.2	R2	F0/0	192.168.10.3
R1	F1/0	192.168.20.2	R3	F0/0	192.168.20.3
R2	F1/0	192.168.30.2	R4	F0/0	192.168.30.3
R3	F0/1	192.168.40.2	R4	F0/1	192.168.40.3
R3	F1/3	192.168.60.2	R5	F1/3	192.168.60.3
	F1/4			F1/4	
R4	F1/5	192.168.50.2	R5	F1/5	192.168.50.3
R4	F1/3	192.168.70.2	C3		192.168.3.2
R5	F1/1		C1		192.168.528.2
R5	F1/2		C2		192.168.2.2

Put F0/0 of the R1 and R2 interfaces into area 0. F0/1 of R1 and R2 belongs to the area of 1. The goal is to realize the communication between different OSPF areas.

Return for testing on R2.

The most important thing is to open the OSPF MD5 authentication in this area on 0. If both interfaces of the router does not have the correct certificate password, an error must occur, the router does not work properly, this router has played very well for privacy and security.

16.4.2.2 In the Aggregation Layer

F0/0, F0/1, F1/0, F2/0 in R3 and F0/0, F0/1, F1/0, F2/0 in R4, F0/1 in R2 also obey OSPF routing protocol, at the same time they belong to the area 1, while using regional certification in area 1.

Because half-duplex is used in interface of Cisco layer three switch. Router interface uses full-duplex, duplex mismatch, so let the duplex mode applied in interface of the switch and router ports connected to the modified three-layer.

Divide two VLAN on the R5, and configure the gateway for C1 and C2 to normal communications.

R3, R4, and R5 can easily cause loops, because the switch does not recognize broadcast, so he will forever be broadcast, causing network congestion. STP spanning tree Protocol must be used to solve this problem. Why? Loop caused much trouble? Because in actual engineering process, something can't be avoided, if we only use a line and someday there is something wrong with this line, it cannot work, entire network will stop, this is immeasurable loss for the enterprise, so the benefits of links are in that if R1 road breaks down, R2 can work instead, during this time we can have adequate time to find the solution to R1 problem, making entire network run security.

Make VTP Protocol in effect on the three sets of three-layer switches, let R5 be client, R3 and R4 do server-side. Achieve unified management for VLAN. At the same time enable STP spanning tree Protocol work, let R3 follow VLAN 10, while V R4 follow LAN 20.

Do link aggregation and load balancing on the R3 and R5. The purpose of connecting the two root line is to accelerate transmission of network, in actual engineering process transmission information of network is large, so it brings much burden on to the device transmission, making its transmission slow and putting effect on efficiency, if connecting so, data package that only transmits in a line can be divided into two separate lines, improving its transmission efficiency greatly, but not for each group of lines because of possibilities of raising loop, so it only can be connected in the main road.

16.4.2.3 In the Access Layer

WEB server and FTP services on the C3, where associated with VM, simulation server. Select the network adapter on the virtual machine, do the FTP and WEB services in the Windows Server 2003 virtual machine.

On the C2 simulation for PC engine, select local loopback port on this computer, the interface is not existed, you need to find the information yourself and add it up, Windows 7 and Windows XP are not the same.

Select the second network adapter on the C1 of the virtual machine, analog PC, test connectivity.

The service can come true in virtual machine, while we can build experimental environment in simulation device, in addition, we can test network of Unicom

sexual with this machine, so on to virtual machine and simulation device also be associated together, making it play their roles, it is very practical in actual work, because in actual work it is impossible to be dependent on each other, so it needs to associate with different environments, which is most effective approach feasible.

16.5 Conclusion

Enterprise networks require sub netting, while communication between subnets requires routes. There are two ways of Routes, static routing and dynamic routing. In general there are three dynamic routing in the enterprise network, EIGRP, RIP and OSPF. RIP is just a smaller network, and because of its principle, the larger the network is, the more network bandwidth processor and memory resources Rip consumes. OSPF and EIGRP are considering the need for large networks for larger business network. While EIGRP is Cisco proprietary, some users want to use open protocols. So finally only OSPF can be selected. This engineering can be applied for all types of business, mainly following several features, including the internal division of the business segment, IP allocation, achieving ease of management.

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