Chapter 43: OSPF

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Chapter 43 OSPF

43.1 OSPF Overview

Open Shortest Path First (OSPF) is an interior routing protocol, which is developed by IETF based on the link state detection and shortest path first technologies. In an IP network, OSPF dynamically discovers and advertise routes by collecting and transmitting the link states of autonomous systems (ASs). It supports interface-based packet authentication for purposes of route calculation security and employs IP multicast to send and receive packets.

Each OSPF router maintains a database that describes the topological structure of an AS. The database is a collection of link-state advertisements (LSAs) of all the routers. Every router always broadcasts the local state information across the entire AS. If two or more routers exist in a multi-access network, a designated router (DR) and a backup designated router (BDR) must be elected. The DR is responsible for broadcasting the LSAs of the network. With a DR, a multi-address access network may require less neighbor relationships to be established between routers. OSPF allows an AS to be divided into areas, between which routing information is further abstracted. As a result, smaller network bandwidth will be occupied.

OSPF uses four types of routes, which are listed in order of priority as follows:

Intra-area routes

Inter-area routes

Type 1 external routes

Type 2 external routes

Intra-area and inter-area routes describe the network structure of an AS, while external routes depict how routes are distributed to destinations outside an AS. Generally, type 1 external routes are based on the information imported by OSPF from other interior routing protocols and comparable to OSPF routes in routing cost; type 2 external routes are based on the information imported by OSPF from exterior routing protocols and the costs of such routes are far greater than those of OSPF routes. Therefore, route calculation only takes the external costs into consideration.

Based on the link state database (LSDB), each router builds a shortest path tree with itself as the root, which presents the routes to every node in an AS. An external route emerges as a leaf node and can also be marked by the router that broadcasts the external route so that additional information about an AS is recorded.

All the OSPF areas are connected to the backbone area, which is identified by 0.0.0.0. OSPF areas must be logically continuous. To achieve this end, virtual connection is introduced to the backbone area to ensure the logical connectivity of areas even if they are physically separated.

All the routers in an area must accept the parameter settings of the area. Therefore, the configuration of routers in the same area must be performed in consideration of the parameter settings of the area. A configuration error may lead to the failure of information transfer between adjacent routers and even routing failures or routing loops.

43.2 Configure OSPF

43.2.1 OSPF Configuration List

Configuration Task	Description	Detailed Configuration
EnableOSPF	Required	43.2.2
ConfigureOSPF Parameter	Required	43.2.3
Configure OSPF Interface	Required	43.2.4

Configure OSPF Area	Required	43.2.5

43.2.2 Enable OSPF

Operation	Command	Remarks
Enter the global configuration mode	**system-view**	
Enters global configuration mode.	**router ospf**	
Enters global configuration mode.	**undo router ospf**	

43.2.3 Configure OSPF Parameter

OSPF divides an AS into different areas, based on which routers are logically classified into different groups. Area border routers (ABRs) may belong to different areas. A network segment belongs to only one area, that is, the homing area of an OSPF interface must be specified. An area is identified by an area ID. Routes between areas are transmitted by ABRs.

In addition, all the routers in an area must unanimously accept the parameter settings of the area. Therefore, the configuration of routers in the same area must be performed in consideration of the parameter settings of the area. A configuration error may lead to the failure of information transfer between adjacent routers and even routing failures or routing loops.

Operation	Command	Remarks
Enter the global configuration mode	**system-view**	
Enters global configuration mode.	**router ospf**	
Enters global configuration mode.	**router id** *router-id*	
Enters global configuration mode.	**undo router id**	
Runs the command in OSPF configuration mode.	**network** *ipaddress wildcard-mask* **area** *area-id*	
Runs the command in OSPF configuration mode.	**undo network** *ipaddress wildcard-mask* **area** *area-id*	
Configures the authentication type for an area.	**area** *area-id* **authentication** [**message-digest**]	
Restores the authentication type of an interface to no authentication.	**undo area** *area-id* **authentication**	

43.2.4 Configure OSPF Interface

OSPF calculates routes based on the topological structure of the network adjacent to the local router. Each router describes the topology of its adjacent network and transmits it to the other routers. According to the link layer protocol, OSPF classifies networks into the following four types:
Broadcast networks: When Ethernet or FDDI is used as the link layer protocol, OSPF considers that the network type is broadcast by default.
Non broadcast Multiaccess (NBMA) networks: When ATM is used as the link layer protocol, OSPF considers that the network type is NBMA by default.
Point-to-Multipoint networks: This network type will be considered as default in no case. It is always a substitute of other network types through forcible change. An NBMA network that is not fully meshed is often changed to a point-to-multipoint network.
Point-to-Point networks: When PPP, LAPB, or POS is used as the link layer protocol, OSPF considers that the network type is Point-to-Point by default.
The ATM network is a typical NBMA network. A polling interval can be configured to specify the interval of sending Hello packets before a router establishes a neighbor relationship with its neighboring router.
On a broadcast network incapable of multi-address access, you can configure the interface type to nonbroadcast.
If some routers are not directly reachable on an NBMA network, you can configure the interface type to point-to-multipoint.
If a router has only one peer router on an NBMA network, you can set the interface type to point-to-point.
The differences between an NBMA network and a point-to-multipoint network are as follows:
In OSPF, an NBMA network refers to a non-broadcast multi-access network that is fully meshed. A point-to-multipoint network may not be fully meshed.
A DR and a BDR must be elected on an NBMA network but are not involved on a point-to-multipoint network.
NBMA is a default network type. For example, if the link layer protocol is ATM, OSPF considers that the network type is NBMA by default no matter whether the network is fully meshed. Point-to-multipoint is not a default network type. No link layer protocol is viewed as a point-to-multipoint protocol. You can use this network type through a forcible change. An
NBMA network that is not fully meshed is often changed to a point-to-multipoint network.
On an NBMA network, packets are transmitted in unicast mode, which requires you to configure neighbor relationship manually. On a point-to-multipoint network, packets are transmitted in multicast mode.

An Ethernet GPON uses Ethernet as the link layer protocol, so OSPF regards that the network type is broadcast. Do not change the network type of an Ethernet GPON at discretion.

Operation	Command	Remarks
Enter the global configuration mode	**system-view**	
Enter the VLAN-interface or Supervlan-interface configuration mode	**interface** { **vlan-interface** | **supervlan-interface** } *vlan-id*	
Sets the network type of an	**ip ospf network** { **broadcast** |	

interface.	**non-broadcast** | **point-to-multipoint** | **point-to-point** }	
Restores the network type of an interface to the default value.	**undo ip ospf network**	
Sets the cost of sending packets through a VLAN interface.	**ip ospf cost** *cost*	
Restores the packet sending cost of a VLAN interface to the default value.	**undo ip ospf cost**	
Sets the priority of an interface in DR election.	**ip ospf priority** *value*	
Restores the default priority of an interface.	**undo ip ospf priority**	
Sets the interval of sending Hello packets for an interface.	**ip ospf hello-interval** *seconds*	
Restores the interval of sending Hello packets for an interface to the default value.	**undo ip ospf hello-interval**	
Sets the timeout time of the neighboring router.	**ip ospf dead-interval** *seconds*	
Restores the timeout time of the neighboring router to the default value.	**undo ip ospf dead-interval**	
Sets the interval of LSA retransmission between two adjacent routers.	**ip ospf retransmit-interval** *seconds*	

Restores the interval of LSA retransmission between two adjacent routers to the default value.	**undo ip ospf retransmit-interval**	
Sets the time for sending a link state update packet.	**ip ospf transmit-delay** *seconds*	
Restores the time for sending a link state update packet to the default value.	**undo ip ospf transmit-delay**	
Sets the authentication type	**ip ospf authentication** [**null** | *ipaddress* | **message-digest** [*ipaddress*]]	
Restores the authentication type	**undo ip ospf authentication** [*ipaddress*]	
Sets a password for plaintext authentication.	**ip ospf authentication-key** *password* [*ipaddress*]	
Disables plaintext authentication.	**undo ip ospf authentication-key** [*ipaddress*]	
Sets a password for MD5 authentication.	**ip ospf message-digest-key** *key-id* **md5** *key* [*ipaddress*]	
Disables MD5 authentication.	**undo ip ospf message-digest-key** *key-id* [*ipaddress*]	

43.2.5 Configure OSPF Area

A stub area is a special LSA area in which ABRs do not distribute the external routes they have received. In stub areas, both the size of routing tables and the amount of the routing information are drastically reduced.

Any area that meets certain conditions can be configured into a stub area. Generally, a stub area is located at the border of an AS. It may be a non-backbone area with only one ABR or a non-backbone area with multiple ABRs between which no virtual connection is configured.

To make a stub area reachable for other ASs, the ABR in the stub area generates a default route (0.0.0.0) and advertises it to non-ABR routers in this area.

When Configure a stub area, note the following points:

-A backbone area cannot be a stub area and a virtual connection is not allowed in a stub area.

-All the routers in a stub area must be configured to indicate that they are located in a stub area.

-No ASBR is allowed in a stub area, that is, routes from outside the AS where the stub area resides cannot be advertised within the stub area.

Operation	Command	Remarks
Enter the global configuration mode	**system-view**	
Enters global configuration mode.	**router ospf**	
Configures a stub area.	**area** *area-id* **stub** [**no-summary**]	
Cancels the stub area configuration.	**undo area** *area-id* **stub** [**no-summary**]	
Configures the cost of the default route to a stub area.	**area** *area-id* **default-cost** *cost*	
Cancels the cost configuration for the default route to a stub area.	**undo area** *area-id* **default-cost**	
Configures an NSSA area.	**area** *area-id* **nssa** [**no-summary**]	
Cancels the NSSA area configuration.	**undo area** *area-id* **nssa** [**no-summary**]	
Configures the cost of the default route to an NSSA area.	**area** *area-id* **default-cost** *cost*	
Cancels the cost configuration for the default route to an NSSA area.	**undo area** *area-id* **default-cost**	
Configures route aggregation in an OSPF area.	**area** *area-id* **range** *ip-address/mask-length* [**advertise** | **notadvertise**] [**substitute** *p-address/mask-length*]	
Removes route aggregation in an OSPF area.	**undo area** *area-id* **range** *ip-address/mask-length* [**substitute** *p-address/mask-length*]	
Creates and configures a virtual connection.	**area** *area-id* **virtual-link** *router-id* [{ **hello-interval** *seconds* | **retransmit- interval** *seconds* | **transmit-delay** *seconds* | **dead-interval** *seconds* | { **authentication-key** *password* | **message-digest-key** *keyid* **md5** *key* } } *]	

Cancels a virtual connection.	**undo area** *area-id* **virtual-link** *router-id*	
Imports routes of other protocols into OSPF.	**redistribute** { **babel** | **bgp** | **connected** | **isis** | **kernel** | **rip** | **static** } [**metric** *metric-value*] [**metric-type** { **1** | **2** }] [**route-map** *map-name*]	
Disables the import of routes of other protocols into OSPF.	**undo redistribute** { **babel** | **bgp** | **connected** | **isis** | **kernel** | **rip** | **static** } [**metric** *metric*] [**metric-type** { **1** | **2** }] [**route-map** *map-name*]	
Imports the default route to OSPF.	**default-information originate** [**always**] [**metric** *metric-value*] [**metric-type** { **1** | **2** }] [**route-map** *map-name*]	
Disables the import of the default route.	**undo default-information originate** [**always**] [**metric** *metric-value*] [**metric-type** { **1** | **2** }] [**route-map** *map-name*]	
Configures a default metric value for reception of external routes.	**default-metric** *metric-value*	
Cancels the default metric value configuration for reception of	**undo default-metric**	
external routes.		
Configures distribute-list	**distribute-list** { *ip-acl-name* | *ip-acl-number* } **out** { **babel** | **bgp** | **connected** | **isis** | **kernel** | **rip** | **static** }	
Delete distribute-list	**undo distribute-list** { *ip-acl-name* | *ip-acl-number* } **out** { **babel** | **bgp** | **connected** | **isis** | **kernel** | **rip** | **static** }	
Enter the VLAN-interface or Supervlan-interface configuration mode	**interface** { **vlan-interface** | **supervlan-interface** } *vlan-id*	
Enables BFD for link state monitoring.	**ip ospf bfd**	

Disables BFD.	**undo ip ospf bfd**	