<p style="text-align:right">C H A P T E R **11**</p>

Configuring Fibre Channel Routing Services and Protocols

Fabric Shortest Path First (FSPF) is the standard path selection protocol used by Fibre Channel fabrics. The FSPF feature is enabled by default on all Fibre Channel switches. Except in configurations that require special consideration, you do not need to configure any FSPF services. FSPF automatically calculates the best path between any two switches in a fabric. Specifically, FSPF is used to do the following:

- Dynamically compute routes throughout a fabric by establishing the shortest and quickest path between any two switches.

- Select an alternative path in the event of the failure of a given path. FSPF supports multiple paths and automatically computes an alternative path around a failed link. It provides a preferred route when two equal paths are available.

This chapter provides details on Fibre Channel routing services and protocols. It includes the following sections:

FSPF Features

FSPF is the protocol currently standardized by the T11 committee for routing in Fibre Channel networks. The FSPF protocol has the following characteristics and features:

- Supports multipath routing.

- Bases path status on a link state protocol.

- Routes hop by hop, based only on the domain ID.

- Runs only on E ports and provides a loop free topology.

- Uses a topology database to keep track of the state of the links on all switches in the fabric and associates a cost with each link.

- Guarantees a fast reconvergence time in case of a topology change. It uses the standard Dijkstra's algorithm, but there is a static dynamic option for a more robust, efficient, and incremental Dijkstra's algorithm.

FSPF Examples

This section provides examples of topologies and applications that demonstrate the benefits of FSPF.

> **Note**   The FSPF feature can be used on any topology.

Fault Tolerant Fabric

Figure 11-1 depicts a fault tolerant fabric using a partial mesh topology. If a link goes down anywhere in the fabric, any switch can still communicate with all others in the fabric. In the same way, if any switch goes down, the connectivity of the rest of the fabric is preserved.

Figure 11-1   Fault Tolerant Fabric
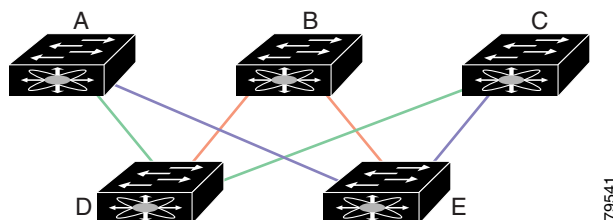
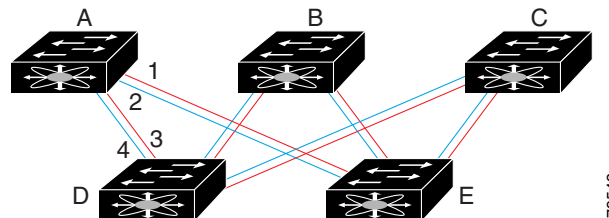
For example, if all links are of equal speed, the FSPF calculates two equal paths from A to C: A-D-C (green) and A-E-C (blue).

Redundant Links

To further improve on the topology in Figure 11-1, each connection between any pair of switches can be replicated; two or more links can be present between a pair of switches. Figure 11-2 shows this arrangement.

Figure 11-2   Fault Tolerant Fabric with Redundant Links

For example, if all links are of equal speed, the FSPF calculates four equal paths from A to C: A1-E-C, A2-E-C, A3-D-C, and A4-D-C.

Link State Record Defaults

Each time a new switch enters the fabric, a link state record (LSR) is sent to the neighboring switches and then flooded throughout the fabric. Table 11-1 displays the default settings for switch responses.

Table 11-1   LSR Default Settings

LSR Option	Default	Description
Acknowledgment interval (RxmtInterval)	5 seconds	The time a switch waits for an acknowledgment from the LSR before retransmission.
Refresh time (LSRefreshTime)	30 minutes	The time a switch waits before sending an LSR refresh transmission.
Maximum age (MaxAge)	60 minutes	The time a switch waits before dropping the LSR from the database.

Clearing FSPF Counters

To clear the FSPF statistics counters for one interface, perform this task:

	Command	Purpose
Step 1	`switch# clear fspf counters` `switch#`	Clears the FSPF statistics counters. If an interface reference is not specified, all counters are cleared.
	`switch# clear fspf counters interface fc1/1` `switch#`	Clears the FSPF statistics counters for the specified interface.

Displaying Global FSPF Information

Example 11-1 displays global FSPF information:

- Domain number of the switch.

- Autonomous region for the switch.

- Min_LS_arrival: minimum time that must elapse before the switch accepts LSR updates.

- Min_LS_interval: minimum time that must elapse before the switch can transmit an LSR.

Tip If the Min_LS_interval is higher than 10 seconds, the graceful shutdown feature is not implemented.

- LS_refresh_time: interval time lapse between refresh LSR transmissions.

- Max_age: maximum time aa LSR can stay before being deleted.

Example 11-1   Displays FSPF Information

```
switch# show fspf
FSPF routing administration status is enabled
FSPF routing operational status is UP
MinLsArrival = 1000 msec , MinLsInterval = 5000 msec
Local Domain is 0x61(97)
Number of LSRs = 0
Protocol constants :
    LS_REFRESH_TIME = 30 minutes (1800 sec)
    MAX_AGE         = 60 minutes (3600 sec)
Statistics counters :
    Number of LSR that reached MaxAge = 0
    Number of SPF computations = 0
    Number of Checksum Errors = 0
    Number of Transmitted packets : LSU 0 LSA 0 Hello 0 Retranmsitted LSU 0
    Number of Received packets : LSU 0 LSA 0 Hello 0 Error Packets 0
```

Displaying FSPF Interfaces

Example 11-2 displays the following information for each selected interface.

- Link cost

- Timer values

- Neighbor's domain ID (if known)

- Local interface number

- Remote interface number (if known)

- FSPF state of the interface

- Interface counters

Example 11-2   Displays FSPF Interface Information

```
switch# show fspf interface
FSPF interface fc1/1
FSPF routing administrative state is active
Interface cost is 0
Timer intervals configured, Hello 20 s, Dead 80 s, Retransmit 5 s
FSPF State is DOWN
Neighbor Domain Id is 0x0(0), Neighbor Interface index is 0x00000000

Statistics counters :
      Number of packets received : LSU 0 LSA 0 Hello 0 Error packets 0
      Number of packets transmitted : LSU 0 LSA 0 Hello 0 Retransmitted LSU 0

FSPF interface fc1/2
FSPF routing administrative state is active
Interface cost is 0
Timer intervals configured, Hello 20 s, Dead 80 s, Retransmit 5 s
FSPF State is DOWN
Neighbor Domain Id is 0x0(0), Neighbor Interface index is 0x00000000

Statistics counters :
      Number of packets received : LSU 0 LSA 0 Hello 0 Error packets 0
      Number of packets transmitted : LSU 0 LSA 0 Hello 0 Retransmitted LSU 0

FSPF interface fc1/3
FSPF routing administrative state is active
Interface cost is 0
Timer intervals configured, Hello 20 s, Dead 80 s, Retransmit 5 s
FSPF State is DOWN
Neighbor Domain Id is 0x0(0), Neighbor Interface index is 0x00000000

Statistics counters :
      Number of packets received : LSU 0 LSA 0 Hello 0 Error packets 0
      Number of packets transmitted : LSU 0 LSA 0 Hello 0 Retransmitted LSU 0
```

Default Settings

Table 11-2 lists the default settings for FSPF features.

Table 11-2   Default FSPF Settings

Parameters	Default
FSPF	Enabled on all E ports.
SPF computation	Dynamic.
SPF hold time	0.
Backbone region	0.
Acknowledgment interval (RxmtInterval)	5 seconds.
Refresh time (LSRefreshTime)	30 minutes.
Maximum age (MaxAge)	60 minutes.
Hello interval	20 seconds.
Dead interval	80 seconds.
Distribution tree information	Derived from the principal switch (root node).
Routing table	FSPF stores up to 4 equal cost paths to a given destination.
Load balancing	Based on destination ID, source ID, and oxID (switch by exchange) on different, equal cost paths.
Static route cost	If the cost (metric) of the route is not specified, the default is 10.
Remote destination switch	If the remote destination switch is not specified, the default is direct.
Multicast routing	Uses the principal switch to compute the multicast tree.