# Use OSPFv3 Configuration Example

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## Introduction

This document describes how to enable Open Shortest Path First (OSPF) version 3 for IPv6 on an interface.

## Prerequisites

### Requirements

Before you enable OSPF for IPv6 on an interface, you must:

- Complete the OSPF network strategy and planning for your IPv6 network. For example, decide whether multiple areas are required.
- Enable IPv6 unicast routing.
- Enable IPv6 on the interface.
- Configure the IP Security (IPsec) secure socket application program interface (API) on OSPF for IPv6 in order to enable authentication and encryption.

### Components Used

This document is not restricted to specific software and hardware versions.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

### Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

# Background Information

Open Shortest Path First (OSPF) is a routing protocol for IP. It is a link-state protocol, as opposed to a distance-vector protocol.

A link-state protocol makes routing decisions based on the states of the links that connect source and destination machines.

The state of a link is a description of that interface and the relationship to its neighbor networking devices.

The interface information includes the IPv6 prefix of the interface, the network mask, the type of network it is connected to, the routers connected to that network, and so forth.

This information is propagated in various type of link-state advertisements (LSAs). OSPF version 3, which is described in RFC 2740, supports IPv6.

# Configure

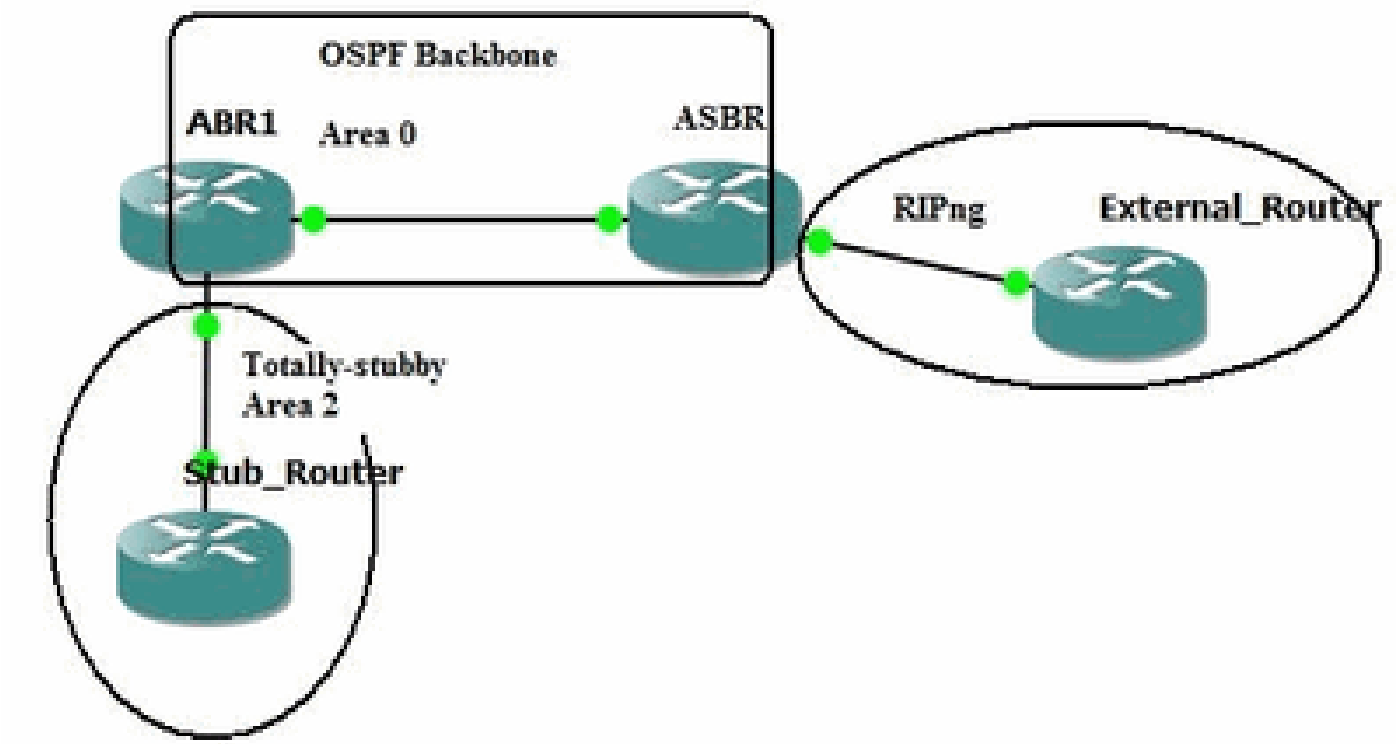
In this section, you are presented with the information to configure the features described in this document.

**Note**: Use the Command Lookup Tool /a> to find more information on the commands used in this document.

**Note**: Only registered Cisco users have access to internal Cisco tools and information.

## Network Diagram

This document uses this network setup:




*Network Diagram*

## Configuration

This is the configuration of OSPFv3 for the routers shown in the diagram:

| Stub Router |
| --- |
| <#root><br><br>ipv6 unicast-routing<br>ipv6 cef<br>!<br>interface GigabitEthernet0/0<br> no ip address<br> ipv6 address FD01:ABAB::/64 eui-64<br> ipv6 enable<br><br>**ipv6 ospf 1 area 2**<br>**ipv6 ospf network point-to-point**<br>**!**<br>**ipv6 router ospf 1**<br>**router-id 10.3.3.3**<br>**area 2 stub**<br>**!** |
| **ABR1 Router** |
| <#root><br><br>ipv6 unicast-routing<br>ipv6 cef<br>!<br>interface GigabitEthernet1 |

```
 no ip address
 speed auto
 ipv6 address FD03::1/124
 ipv6 enable


ipv6 ospf 1 area 0
!

interface GigabitEthernet2
 no ip address
 ipv6 address FD02:ABAB::/64 eui-64
 ipv6 enable


ipv6 ospf 1 area 2
 ipv6 ospf network point-to-point
!
ipv6 router ospf 1
 router-id 10.1.1.1
 area 2 stub no-summary
!
```

**ASBR Router**

```
<#root>

ipv6 unicast-routing
ipv6 cef
!
interface GigabitEthernet1
 no ip address
 ipv6 address FD03::2/124
 ipv6 enable


ipv6 ospf 1 area 0
!

interface GigabitEthernet2
 no ip address
 ipv6 address FD03::1:1/124
 ipv6 enable


ipv6 rip EXT enable
!

ipv6 router ospf 1
 router-id 10.2.2.2
 default-metric 25
 redistribute rip EXT metric-type 1 include-connected
!
ipv6 router rip EXT
 redistribute ospf 1 match internal external 1 external 2 include-connected
!
```

**External Router**

```
<#root>
```

```
ipv6 unicast-routing
ipv6 cef
!
interface Loopback0
 no ip address
 ipv6 address FD04:ABAB::/64 eui-64
 ipv6 enable


ipv6 rip EXT enable
!

interface GigabitEthernet0/0
 no ip address
 ipv6 address FD03::1:2/124
 ipv6 enable


ipv6 rip EXT enable
!
ipv6 router rip EXT
```

# Verify

Use this section to confirm that your configuration works properly.

TheOutput Interpreter Tool supports certain **show** commands. Use the OIT to view an analysis of **show** command output.

The **show ipv6 ospf database** command shows the Link State Database (LSDB) of the router.

**Note**:Only registered Cisco users can access internal Cisco tools and information.

<#root>

Stub_Router#

**show ipv6 ospf database**

```
            OSPFv3 Router with ID (10.3.3.3) (Process ID 1)


Router Link States (Area 2)

ADV Router       Age         Seq#       Fragment ID  Link count  Bits
 10.1.1.1        5           0x8000000F  0            1           B
 10.3.3.3        38          0x8000000E  0            1           None


Inter Area Prefix Link States (Area 2)

ADV Router       Age         Seq#       Prefix
```

```
 10.1.1.1        5           0x80000002  ::/0


Link (Type-8) Link States (Area 2)

ADV Router      Age         Seq#        Link ID    Interface
 10.1.1.1       5           0x8000000A  8          Gi0/0
 10.3.3.3       292         0x80000005  2          Gi0/0


 Intra Area Prefix Link States (Area 2)

ADV Router      Age         Seq#        Link ID    Ref-lstype  Ref-LSID
 10.1.1.1       5           0x8000000B  0          0x2001      0
 10.3.3.3       548         0x80000002  0          0x2001      0
```

The **show ipv6 ospf database router** command shows the Router LSAs where the router originates and receives. The Router LSAs carry no address or prefix information.

```
<#root>

Stub_Router#

show ipv6 ospf database router


            OSPFv3 Router with ID (10.3.3.3) (Process ID 1)

                Router Link States (Area 2)

  Routing Bit Set on this LSA
  LS age: 141


Options: (V6-Bit, R-Bit, DC-Bit)

  LS Type: Router Links
  Link State ID: 0


Advertising Router: 10.1.1.1

  LS Seq Number: 8000000F
  Checksum: 0x9C2C
  Length: 40
  Area Border Router
  Number of Links: 1

    Link connected to: another Router (point-to-point)
      Link Metric: 1
      Local Interface ID: 8
      Neighbor Interface ID: 2
      Neighbor Router ID: 10.3.3.3


  LS age: 174
  Options: (V6-Bit, R-Bit, DC-Bit)
```

```
  LS Type: Router Links
  Link State ID: 0
  Advertising Router: 10.3.3.3
  LS Seq Number: 8000000E
  Checksum: 0xBBF
  Length: 40
  Number of Links: 1

    Link connected to: another Router (point-to-point)
      Link Metric: 1
      Local Interface ID: 2
      Neighbor Interface ID: 8
      Neighbor Router ID: 10.1.1.1
```

The LSAs carry an Options field which has these bits:

- **V6 bit** — Indicates whether the router/link must be used in routing calculation.
- **R bit** — This is the "Router bit". It indicates if the originator is an active router.
- **DC bit** — Indicates the router handling of Demand Circuit.

The **show ipv6 ospf database link self-originate** command shows that Link LSAs carry link-specific addresses.

<#root>

Stub_Router#

**show ipv6 ospf database link self-originate**

```
            OSPFv3 Router with ID (10.3.3.3) (Process ID 1)

                Link (Type-8) Link States (Area 2)

  LS age: 650
  Options: (V6-Bit, R-Bit, DC-Bit)
  LS Type: Link-LSA (Interface: GigabitEthernet0/0)
  Link State ID: 2 (Interface ID)
```

**Advertising Router: 10.3.3.3**

```
  LS Seq Number: 80000005
  Checksum: 0x8578
  Length: 56
  Router Priority: 1
```

**Link Local Address: FE80::5054:FF:FE00:3A**

```
  Number of Prefixes: 1
```

**Prefix Address: FD01:ABAB::**

```
  Prefix Length: 64, Options: None
```

Because the Stub Router belongs to a Totally-Stub Area, the ABR1 Router sends only the default route to the Stub Router.

<#root>

Stub_Router#

**show ipv6 route**

```
IPv6 Routing Table - default - 5 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP
       H - NHRP, I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea
       IS - ISIS summary, D - EIGRP, EX - EIGRP external, NM - NEMO
       ND - ND Default, NDp - ND Prefix, DCE - Destination, NDr - Redirect
       RL - RPL, O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1
       OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       la - LISP alt, lr - LISP site-registrations, ld - LISP dyn-eid
       lA - LISP away, a - Application

OI  ::/0 [110/2]
     via FE80::5054:FF:FE00:15, GigabitEthernet0/0

C   FD01:ABAB::/64 [0/0]
     via GigabitEthernet0/0, directly connected
L   FD01:ABAB::5054:FF:FE00:3A/128 [0/0]
     via GigabitEthernet0/0, receive
O   FD02:ABAB::/64 [110/2]
     via FE80::5054:FF:FE00:15, GigabitEthernet0/0
L   FF00::/8 [0/0]
     via Null0, receive
```

The ABR1 Router is the Area Border Router.

<#root>

ABR1#

**show ipv6 ospf**

```
 Routing Process "ospfv3 1" with ID 10.1.1.1
 Supports NSSA (compatible with RFC 3101)
 Supports Database Exchange Summary List Optimization (RFC 5243)
 Event-log enabled, Maximum number of events: 1000, Mode: cyclic
```

**It is an area border router**

```
 Router is not originating router-LSAs with maximum metric
 Initial SPF schedule delay 50 msecs
 Minimum hold time between two consecutive SPFs 200 msecs
 Maximum wait time between two consecutive SPFs 5000 msecs
 Initial LSA throttle delay 50 msecs
 Minimum hold time for LSA throttle 200 msecs
 Maximum wait time for LSA throttle 5000 msecs
 Minimum LSA arrival 100 msecs
```

```
 LSA group pacing timer 240 secs
 Interface flood pacing timer 33 msecs
 Retransmission pacing timer 66 msecs
 Retransmission limit dc 24 non-dc 24
 EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300
 Number of external LSA 2. Checksum Sum 0x011699
 Number of areas in this router is 2. 1 normal 1 stub 0 nssa
 Graceful restart helper support enabled
 Reference bandwidth unit is 100 mbps
 RFC1583 compatibility enabled
```

**Area BACKBONE(0)**

```
        Number of interfaces in this area is 1
        SPF algorithm executed 17 times
        Number of LSA 8. Checksum Sum 0x05579B
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

**Area 2**

```
        Number of interfaces in this area is 1
        It is a stub area, no summary LSA in this area
        Generates stub default route with cost 1
        SPF algorithm executed 20 times
        Number of LSA 7. Checksum Sum 0x0380EA
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

The ABR1 Router receives external routes (RIP routes) from the ASBR Router.

<#root>

ABR1#

**show ipv6 route**

```
IPv6 Routing Table - default - 8 entries
Codes: C - Connected, L - Local, S - Static, U - Per-user Static route
       B - BGP, R - RIP, H - NHRP, I1 - ISIS L1
       I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external, ND - ND Default, NDp - ND Prefix, DCE - Destination
       NDr - Redirect, RL - RPL, O - OSPF Intra, OI - OSPF Inter
       OE1 - OSPF ext 1, OE2 - OSPF ext 2, ON1 - OSPF NSSA ext 1
       ON2 - OSPF NSSA ext 2, la - LISP alt, lr - LISP site-registrations
       ld - LISP dyn-eid, lA - LISP away, le - LISP extranet-policy
       lp - LISP publications, a - Application, m - OMP
O   FD01:ABAB::/64 [110/2]
     via FE80::5054:FF:FE00:3A, GigabitEthernet2
C   FD02:ABAB::/64 [0/0]
     via GigabitEthernet2, directly connected
L   FD02:ABAB::5054:FF:FE00:15/128 [0/0]
     via GigabitEthernet2, receive
C   FD03::/124 [0/0]
```

```
     via GigabitEthernet1, directly connected
L    FD03::1/128 [0/0]
     via GigabitEthernet1, receive

OE1 FD03::1:0/124 [110/26]
     via FE80::5054:FF:FE00:3E, GigabitEthernet1
OE1 FD04:ABAB::/64 [110/26]
     via FE80::5054:FF:FE00:3E, GigabitEthernet1

L    FF00::/8 [0/0]
     via Null0, receive
```

The ASBR Router is the Autonomous System Boundary Router for the network. It is connected to the RIP network through Serial 0/0 interface.

<#root>

ASBR#

**show ipv6 ospf**

```
 Routing Process "ospfv3 1" with ID 10.2.2.2
 Supports NSSA (compatible with RFC 3101)
 Supports Database Exchange Summary List Optimization (RFC 5243)
 Event-log enabled, Maximum number of events: 1000, Mode: cyclic
```

**It is an autonomous system boundary router**

```
 Redistributing External Routes (with default metric 25) from,
    rip EXT with metric-type 1 include-connected
 Router is not originating router-LSAs with maximum metric
 Initial SPF schedule delay 50 msecs
 Minimum hold time between two consecutive SPFs 200 msecs
 Maximum wait time between two consecutive SPFs 5000 msecs
 Initial LSA throttle delay 50 msecs
 Minimum hold time for LSA throttle 200 msecs
 Maximum wait time for LSA throttle 5000 msecs
 Minimum LSA arrival 100 msecs
 LSA group pacing timer 240 secs
 Interface flood pacing timer 33 msecs
 Retransmission pacing timer 66 msecs
 Retransmission limit dc 24 non-dc 24
 EXCHANGE/LOADING adjacency limit: initial 300, process maximum 300
 Number of external LSA 2. Checksum Sum 0x011699
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 Graceful restart helper support enabled
 Reference bandwidth unit is 100 mbps
 RFC1583 compatibility enabled
```

**Area BACKBONE(0)**

```
        Number of interfaces in this area is 1
        SPF algorithm executed 10 times
        Number of LSA 8. Checksum Sum 0x05579B
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

```
ASBR#
show ipv6 rip

RIP process "EXT", port 521, multicast-group FF02::9, pid 678
     Administrative distance is 120. Maximum paths is 16
     Updates every 30 seconds, expire after 180
     Holddown lasts 0 seconds, garbage collect after 120
     Split horizon is on; poison reverse is off
     Default routes are not generated
     Periodic updates 267, trigger updates 11
     Full Advertisement 1, Delayed Events 0
  Interfaces:


GigabitEthernet2

  Redistribution:


Redistributing protocol ospf 1 with transparent metric (internal, external 1 & 2, ) include-connec
```

# Troubleshoot

Use this section to troubleshoot your configuration.



**Note**: Refer to Important Information on Debug Commands before you use debug commands.

### debug ipv6

As soon as OSPFv3 is enabled on the Stub Router, it sends out OSPFv3 Type 1 Hello messages to the FF02::5 multicast address. Once it receives Hello packets from the ABR1 Router, they negotiate the Primary/Secondary relationship and then start to send DBD packets.

```
<#root>

Stub_Router#
debug ipv6 ospf events

Stub_Router#
debug ipv6 ospf packet

Stub_Router#
debug ipv6 ospf adj

*Mar  8 17:47:01.324: OSPFv3-1-IPv6 PAK  : Gi0/0: OUT: FE80::5054:FF:FE00:3A->FF02::5: ver:3 type:1 len:36 rid:10.3.3.3 area:0.0.0.2 chksu
*Mar  8 17:47:03.307: OSPFv3-1-IPv6 PAK  : Gi0/0:  IN: FE80::5054:FF:FE00:15->FF02::5: ver:3 type:1 len:36 rid:10.1.1.1 area:0.0.0.2 chksum
*Mar  8 17:47:03.308: OSPFv3-1-IPv6 ADJ   Gi0/0: Added 10.1.1.1 to nbr list
*Mar  8 17:47:03.308: OSPFv3-1-IPv6 PAK  : Gi0/0: OUT: FE80::5054:FF:FE00:3A->FE80::5054:FF:FE00:15: ver:3 type:1 len:40 rid:10.3.3.3 a
*Mar  8 17:47:03.320: OSPFv3-1-IPv6 PAK  : Gi0/0:  IN: FE80::5054:FF:FE00:15->FE80::5054:FF:FE00:3A: ver:3 type:1 len:40 rid:10.1.1.1 are
*Mar  8 17:47:03.321: OSPFv3-1-IPv6 ADJ   Gi0/0: 2 Way Communication to 10.1.1.1, state 2WAY
*Mar  8 17:47:03.321: OSPFv3-1-IPv6 ADJ   Gi0/0: Nbr 10.1.1.1: Prepare dbase exchange
*Mar  8 17:47:03.322: OSPFv3-1-IPv6 ADJ
```

```
Gi0/0: Send DBD to 10.1.1.1 seq 0x983C9C0 opt 0x11 flag 0x7 len 28

*Mar  8 17:47:03.322: OSPFv3-1-IPv6 PAK  : Gi0/0: OUT: FE80::5054:FF:FE00:3A->FE80::5054:FF:FE00:1
*Mar  8 17:47:03.328: OSPFv3-1-IPv6 PAK  : Gi0/0:  IN: FE80::5054:FF:FE00:15->FE80::5054:FF:FE00:3
*Mar  8 17:47:03.329: OSPFv3-1-IPv6 ADJ

Gi0/0: Rcv DBD from 10.1.1.1 seq 0x983C9C0 opt 0x11 flag 0x2 len 148 mtu 1500 state EXSTART

*Mar  8 17:47:03.330: OSPFv3-1-IPv6 ADJ

Gi0/0: NBR Negotiation Done. We are the MASTER

*Mar  8 17:47:03.330: OSPFv3-1-IPv6 ADJ   Gi0/0: Nbr 10.1.1.1: Summary list built, size 7
*Mar  8 17:47:03.331: OSPFv3-1-IPv6 ADJ   Gi0/0: Send DBD to 10.1.1.1 seq 0x983C9C1 opt 0x11 flag
*Mar  8 17:47:03.331: OSPFv3-1-IPv6 PAK  : Gi0/0: OUT: FE80::5054:FF:FE00:3A->FE80::5054:FF:FE00:1
*Mar  8 17:47:03.334: OSPFv3-1-IPv6 PAK  : Gi0/0:  IN: FE80::5054:FF:FE00:15->FE80::5054:FF:FE00:3
*Mar  8 17:47:03.335: OSPFv3-1-IPv6 PAK  : Gi0/0:  IN: FE80::5054:FF:FE00:15->FE80::5054:FF:FE00:3
```

Once the DBD packets are exchanged, the routers send Link-State Request (LS REQ) and Link-State Update (LS UPD) messages to build their LSDB. After successive LS REQ and LS UPD messages, and when the state reaches FULL, the routers continue to exchange Hello packets.

```
<#root>

Stub_Router#

*Mar  8 17:47:03.337: OSPFv3-1-IPv6 ADJ

Gi0/0: Rcv LS REQ from 10.1.1.1 length 64 LSA count 4

*Mar  8 17:47:03.337: OSPFv3-1-IPv6 ADJ

Gi0/0: Send LS UPD to FE80::5054:FF:FE00:15 length 172 LSA count 4

*Mar  8 17:47:03.338: OSPFv3-1-IPv6 PAK  : Gi0/0: OUT: FE80::5054:FF:FE00:3A->FE80::5054:FF:FE00:1
*Mar  8 17:47:03.339: OSPFv3-1-IPv6 ADJ   Gi0/0: Rcv DBD from 10.1.1.1 seq 0x983C9C1 opt 0x11 flag
*Mar  8 17:47:03.339: OSPFv3-1-IPv6 ADJ   Gi0/0: Exchange Done with 10.1.1.1 *Mar  8 17:47:03.340: OSPFv3

Gi0/0: Send LS REQ to 10.1.1.1 length 40

*Mar  8 17:47:03.340: OSPFv3-1-IPv6 PAK  : Gi0/0: OUT: FE80::5054:FF:FE00:3A->FE80::5054:FF:FE00:1
*Mar  8 17:47:03.343: OSPFv3-1-IPv6 PAK  : Gi0/0:  IN: FE80::5054:FF:FE00:15->FE80::5054:FF:FE00:3
*Mar  8 17:47:03.345: OSPFv3-1-IPv6 ADJ

Gi0/0: Rcv LS UPD from Nbr ID 10.1.1.1 length 72 LSA count 2

*Mar  8 17:47:03.345: OSPFv3-1-IPv6 ADJ

Gi0/0: Synchronized with 10.1.1.1, state FULL

*Mar  8 17:47:03.346: %OSPFv3-5-ADJCHG:

Process 1, Nbr 10.1.1.1 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
```

# Related Information

- **IP Version 6 (IPv6) Technology Support**
- **Open Shortest Path First (OSPF) Technology Support**
- **Cisco Technical Support & Downloads**