



Configure Performance-Measurement on All Routers

```
RP/0/RP0/CPU0:pe1#sh run performance-  
measurement  
Mon Sep  7 17:59:07.402 UTC  
performance-measurement  
  interface GigabitEthernet0/0/0/2  
    delay-measurement  
      advertise-delay 5000  
      !  
      !  
  interface GigabitEthernet0/0/0/3  
    delay-measurement  
      advertise-delay 20000  
      !  
      !  
      !
```

```
RP/0/RP0/CPU0:pe5#sh run performance-  
measurement  
Mon Sep  7 18:00:07.658 UTC  
performance-measurement  
  interface GigabitEthernet0/0/0/0  
    delay-measurement  
      advertise-delay 5000  
      !  
      !  
  interface GigabitEthernet0/0/0/1  
    delay-measurement  
      advertise-delay 20000  
      !  
      !  
      !
```

Configure Flex-Algo (OSPF) on All Routers

```
RP/0/RP0/CPU0:pe1#sh run router ospf 1
Mon Sep  7 18:02:05.131 UTC
router ospf 1
  distribute link-state
  log adjacency changes
  segment-routing mpls
  area 0
  interface Loopback0
    passive enable
    prefix-sid absolute 16001
    prefix-sid algorithm 128 absolute 16801
  !
  interface GigabitEthernet0/0/0/2
    cost 1
  !
  interface GigabitEthernet0/0/0/3
    cost 1
  !
  !
  flex-algo 128
  metric-type delay
  advertise-definition
  !
  !
```

Assign Flex-Algo 128 Prefix-SID to Loopback0

Create Flex-Algo 128 with delay as metric

Flex- Algo Validation

Flex- Algo 128

```
RP/0/RP0/CPU0:pe1#sh ospf routes flex-algo 128
Mon Sep  7 18:05:10.708 UTC
```

Route Table of ospf-1 with router ID 10.0.0.6 (VRF default)

Algorithm 128

```
1.1.1.2/32, Metric 5001, SID 802, Label 16802
  10.0.0.9, from 10.0.0.9, via GigabitEthernet0/0/0/2
1.1.1.3/32, Metric 10001, SID 803, Label 16803
  10.0.0.9, from 10.0.0.9, via GigabitEthernet0/0/0/2
1.1.1.4/32, Metric 20001, SID 804, Label 16804
  10.0.0.13, from 10.0.0.13, via GigabitEthernet0/0/0/3
1.1.1.5/32, Metric 15001, SID 805, Label 16805
  10.0.0.9, from 10.0.0.9, via GigabitEthernet0/0/0/2
```

Flex- Algo 0

```
RP/0/RP0/CPU0:pe1#sh ospf routes
Mon Sep  7 18:06:47.409 UTC
```

Topology Table for ospf 1 with ID 10.0.0.6

Codes: O - Intra area, O IA - Inter area

O E1 - External type 1, O E2 - External type 2

O N1 - NSSA external type 1, O N2 - NSSA external type 2

- O 1.1.1.1/32, metric 1
1.1.1.1, directly connected, via Loopback0, ifIndex 10
- O 1.1.1.2/32, metric 2
10.0.0.9, from 10.0.0.9, via GigabitEthernet0/0/0/2, ifIndex 8, path-id 1
- O 1.1.1.3/32, metric 3
10.0.0.9, from 10.0.0.18, via GigabitEthernet0/0/0/2, ifIndex 8, path-id 1
- O 1.1.1.4/32, metric 2
10.0.0.13, from 10.0.0.13, via GigabitEthernet0/0/0/3, ifIndex 9, path-id 1
- O 1.1.1.5/32, metric 3
10.0.0.13, from 10.0.0.26, via GigabitEthernet0/0/0/3, ifIndex 9, path-id 1

*** Notice that route to 1.1.1.5/32 takes different paths in each of the algorithms.

Create VPN red on PE towards CE

```
RP/0/RP0/CPU0:pe1#sh run vrf red
Mon Sep  7 18:12:20.117 UTC
vrf red
address-family ipv4 unicast
import route-target
100:1
!
export route-target
100:1
```

```
RP/0/RP0/CPU0:pe1#sh run int gi0/0/0/0
Mon Sep  7 18:12:28.284 UTC
interface GigabitEthernet0/0/0/0
description to ce1
vrf red
ipv4 address 10.0.0.6 255.255.255.252
!
```

```
RP/0/RP0/CPU0:pe1#sh run route-policy PASS
Mon Sep  7 18:14:55.812 UTC
route-policy PASS
pass
end-policy
```

```
RP/0/RP0/CPU0:pe1#sh run router bgp
Mon Sep  7 18:13:46.856 UTC
router bgp 100
bgp router-id 1.1.1.1
address-family vpnv4 unicast
!
vrf red
rd 100:1
address-family ipv4 unicast
as-path-loopcheck out disable
redistribute connected
!
neighbor 10.0.0.5
remote-as 65001
address-family ipv4 unicast
route-policy PASS in
route-policy PASS out
```

Color BGP Routes in VRF red on PE5

<pre>RP/0/RP0/CPU0:pe5#sh run begin extcommunity Mon Sep 7 18:16:54.976 UTC Building configuration... extcommunity-set opaque RED 5001 end-set !</pre>	<pre>RP/0/RP0/CPU0:pe5#sh run router bgp Mon Sep 7 18:18:26.854 UTC router bgp 100 bgp router-id 1.1.1.5 address-family vpnv4 unicast ! neighbor-group RR remote-as 100 update-source Loopback0 address-family vpnv4 unicast route-policy vpnv4 out ! ! neighbor 1.1.1.2 use neighbor-group RR !</pre>
<pre>RP/0/RP0/CPU0:pe5#sh run route-policy vpnv4 Mon Sep 7 18:17:36.950 UTC route-policy vpnv4 if destination in (3.3.3.2/32) then set extcommunity color RED else pass endif end-policy !</pre>	

****Route 3.3.3.2/32 received on PE5 sent from CE2 will be colored with community 5001 when advertised to BGP peer 1.1.1.2.**

Route Color Validation on PE1

```
RP/0/RP0/CPU0:pe1#sh bgp vrf red
Mon Sep  7 18:25:55.527 UTC
BGP VRF red, state: Active
BGP Route Distinguisher: 100:1

Status codes: s suppressed, d damped, h history, * valid, > best
                i - internal, r RIB-failure, S stale, N Nexthop-discard
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network        Next Hop        Metric LocPrf Weight Path
Route Distinguisher: 100:1 (default for vrf red)
*> 2.2.2.2/32     10.0.0.5             0           0 65001 i
*> 2.2.2.3/32     10.0.0.5             0           0 65001 i
*>i3.3.3.2/32     1.1.1.5 C:5001         0 100       0 65001 i
*>i3.3.3.3/32     1.1.1.5             0 100       0 65001 i
*> 10.0.0.4/30    0.0.0.0             0          32768 ?
*>i10.0.0.20/30   1.1.1.5             0 100        0 ?
*> 192.168.0.1/32 10.0.0.5             0           0 65001 i
*>i192.168.0.2/32 1.1.1.5             0 100        0 65001 i

Processed 8 prefixes, 8 paths
```

Assign BGP routes with Color 5001 to Flex- Algo 128 (SR ODN)

```
RP/0/RP0/CPU0:pe1#sh run segment-routing
Mon Sep 7 18:27:15.038 UTC
segment-routing
traffic-eng
  on-demand color 5001
  dynamic
    sid-algorithm 128
  !
```


Validate SR-TE policy for prefix 3.3.3.2/32 on PE1

```
RP/0/RP0/CPU0:pe1#sh segment-routing traffic-eng policy
```

```
Mon Sep 7 18:29:52.742 UTC
```

```
SR-TE policy database
```

```
-----
```

```
Color: 5001, End-point: 1.1.1.5
```

```
Name: srte_c_5001_ep_1.1.1.5
```

```
Status:
```

```
Admin: up Operational: up for 01:25:22 (since Sep 7 17:04:30.792)
```

```
Candidate-paths:
```

```
Preference: 200 (BGP ODN) (active)
```

```
Requested BSID: dynamic
```

```
Constraints:
```

```
Prefix-SID Algorithm: 128
```

```
Maximum SID Depth: 10
```

```
Dynamic (valid)
```

```
Metric Type: TE, Path Accumulated Metric: 0
```

```
16805 [Prefix-SID: 1.1.1.5, Algorithm: 128]
```

Validate Paths on CE1

```
ce1#sh ip route bgp
```

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP
a - application route
+ - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is 10.85.171.1 to network 0.0.0.0

3.0.0.0/32 is subnetted, 2 subnets

B 3.3.3.2 [20/0] via 10.0.0.6, 2d20h

B 3.3.3.3 [20/0] via 10.0.0.6, 01:38:16

10.0.0.0/8 is variably subnetted, 5 subnets, 3 masks

B 10.0.0.20/30 [20/0] via 10.0.0.6, 2d20h

192.168.0.0/32 is subnetted, 2 subnets

B 192.168.0.2 [20/0] via 10.0.0.6, 2d20h

Path to 3.3.3.2 from CE1 using shortest delay path (Flex-Algo 128)

```
ce1#tracert 3.3.3.2
```

Type escape sequence to abort.

Tracing the route to 3.3.3.2

VRF info: (vrf in name/id, vrf out name/id)

1 10.0.0.6 [AS 100] 14 msec 5 msec 3 msec

2 10.0.0.9 [MPLS: Labels 16805/24003 Exp 0] 208 msec 186 msec 190 msec

3 10.0.0.18 [MPLS: Labels 16805/24003 Exp 0] 154 msec 5 msec 7 msec

4 10.0.0.26 [MPLS: Label 24003 Exp 0] 10 msec 4 msec 7 msec

5 10.0.0.21 [AS 100] 7 msec * 7 msec

Path to 3.3.3.3 from CE1 using shortest delay path (Flex-Algo 0)

```
ce1#tracert 3.3.3.3
```

Type escape sequence to abort.

Tracing the route to 3.3.3.3

VRF info: (vrf in name/id, vrf out name/id)

1 10.0.0.6 [AS 100] 8 msec 6 msec 4 msec

2 10.0.0.13 [MPLS: Labels 16005/24005 Exp 0] 192 msec 189 msec 194 msec

3 10.0.0.30 [MPLS: Label 24005 Exp 0] 194 msec 193 msec 197 msec

4 10.0.0.21 [AS 100] 195 msec * 204 msec