Cisco ME3600X/3800X/24CX and Cisco ASR 903 Interoperability with Cisco ASR 9000

Design Guide

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Cisco ME3600X-24TS/ME3600-24CX/ME3800X Design Guide

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Preface

Introduction

This document The Objective of this document is to go over the interoperability of CISCO ME3600X/3800X and CISCO ASR 903 with CISCO ASR 9000. Configuration of the following protocols/technologies will be covered.

1. Interface
2. Routing (OSPF and ISIS)
3. BGP and MPBGP
4. Fast Convergence (IGP and BFD)
5. G.8032
6. VPLS using BGP Auto Discovery
7. EOAM
8. Layer 2 Control Protocol forwarding
9. MPLS TE
10. Link Bundling - LACP

Audience

This document is intended for all technical person who are involved in the design/deployment of ME3600X/ME3800X, CISCO ASR 903 with CISCO ASR 9000 Carrier Ethernet products.

Chapter 1 Interface

Gigabit Ethernet Interfaces

No interoperability configurations required between the platforms

10GE ports on CISCO ME3600X/3800X operating at 1Gig rate

On CISCO ME3600X/3800X the TenGig Ethernet ports can operate at 1 Gig when 1 Gig SFPs are plugged in. In such scenarios additional interoperability commands are required.

Auto negotiation is disabled by default on Gigabit Ethernet Interfaces in CISCO ASR 9000.
Auto negotiation is enabled by default on Gigabit Ethernet Interfaces in CISCO ME3600X/3800X and CISCO ASR 903.

To establish the link between CISCO ASR 9000 and CISCO ME3600X/3800X, enable auto negotiation on CISCO ASR 9000.

CISCO ME3600X/3800X Configuration

```
interface TenGigabitEthernet0/1
end
```

CISCO ASR 9000 Configuration

```
interface GigabitEthernet0/0/0/1
 negotiation auto
```

Chapter 2 Routing

OSPF

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
router ospf 1
 network 122.1.1.2 0.0.0.0 area 0
 network 122.3.3.1 0.0.0.0 area 0
 network 122.123.1.1 0.0.0.0 area 0

interface GigabitEthernet0/11
 no switchport
  ip address 122.1.1.2 255.255.255.0
  ip ospf network point-to-point
!
```

CISCO ASR 9000 Configuration

```
router ospf 1
 router-id 11.1.1.1
 address-family ipv4 unicast
 area 0
  interface Loopback0
  !
  interface GigabitEthernet0/0/0/26
  !
  interface GigabitEthernet0/2/0/0
   network point-to-point
  !
  interface GigabitEthernet0/2/0/1
   network point-to-point
```

ISIS

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
router isis 1
 net 49.1234.1111.1111.1111.00

interface GigabitEthernet0/1
 no switchport
 ip address 123.1.1.2 255.255.255.0
 ip router isis 1
```

```
end
```

CISCO ASR 9000 Configuration

```
router isis 1
 net 49.1234.1111.1111.1112.00
 interface GigabitEthernet0/0/0/7
  address-family ipv4 unicast
  !
```

CISCO ASR 9000 Note : If the address-family under the interface is not configured then ISIS adjacency would not be established.

Chapter 3 BGP and MPBGP

BGP

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
router bgp 3
 bgp log-neighbor-changes
 neighbor 11.1.1.1 remote-as 3
 neighbor 11.1.1.1 update-source Loopback0
 neighbor 11.1.1.2 remote-as 3
 neighbor 11.1.1.2 update-source Loopback0
 neighbor 121.0.1.1 remote-as 3
 neighbor 121.0.1.1 update-source Loopback0
 !
 address-family vpnv4
  neighbor 11.1.1.1 activate
  neighbor 11.1.1.1 send-community extended
  neighbor 11.1.1.2 activate
  neighbor 11.1.1.2 send-community extended
  neighbor 121.0.1.1 activate
  neighbor 121.0.1.1 send-community extended
 exit-address-family
 !
```

CISCO ASR 9000 Configuration

```
router bgp 3
 address-family ipv4 unicast
 !
 address-family vpnv4 unicast
 !
 neighbor 11.1.1.1
  remote-as 3
  update-source Loopback0
  address-family ipv4 unicast
  !
  address-family vpnv4 unicast
  !
 !
 neighbor 121.0.1.1
  remote-as 3
  update-source Loopback0
  address-family ipv4 unicast
  !
  address-family vpnv4 unicast
  !
 !
```

```
 neighbor 121.0.1.2
  remote-as 3
  update-source Loopback0
  address-family ipv4 unicast
  !
  address-family vpnv4 unicast
  !
 !
!
```

CISCO ASR 9000 NOTE: If the address families must be defined globally under the BGP process and as well as under the neighbor statement.
For EBGP neighbor, an ingress and an egress route-policy must be defined for the neighbor relationship to be established.

MPBGP

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
ip vrf red
 rd 100:1
 route-target export 100:1
 route-target import 100:1
!
router bgp 3
 bgp log-neighbor-changes
 neighbor 11.1.1.1 remote-as 3
 neighbor 11.1.1.1 update-source Loopback0
 neighbor 11.1.1.2 remote-as 3
 neighbor 11.1.1.2 update-source Loopback0
 neighbor 121.0.1.1 remote-as 3
 neighbor 121.0.1.1 update-source Loopback0
 !
 address-family vpnv4
  neighbor 11.1.1.1 activate
  neighbor 11.1.1.1 send-community extended
  neighbor 11.1.1.2 activate
  neighbor 11.1.1.2 send-community extended
  neighbor 121.0.1.1 activate
  neighbor 121.0.1.1 send-community extended
 exit-address-family
 !
 address-family ipv4 vrf red
  redistribute connected
  neighbor 2.2.2.2 remote-as 65001
  neighbor 2.2.2.2 activate
 exit-address-family !
```

CISCO ASR 9000 Configuration

```
router bgp 3
 address-family ipv4 unicast
 !
 address-family vpnv4 unicast
 !
 neighbor 11.1.1.1
  remote-as 3
  update-source Loopback0
  address-family ipv4 unicast
  !
  address-family vpnv4 unicast
  !
 !
 neighbor 121.0.1.1
  remote-as 3
  update-source Loopback0
  address-family ipv4 unicast
  !
  address-family vpnv4 unicast
  !
 !
 neighbor 121.0.1.2
  remote-as 3
  update-source Loopback0
  address-family ipv4 unicast
  !
  address-family vpnv4 unicast
  !
 !
 vrf red
  rd 100:2
  address-family ipv4 unicast
  !
  neighbor 1.1.1.1
   remote-as 65001
   address-family ipv4 unicast
    route-policy pass_all in
    route-policy pass_all out
    !
```

Chapter 4 Fast Convergence

BFD on Physical Interface

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
router ospf 1
 network 122.123.1.1 0.0.0.0 area 0
 bfd all-interfaces'
!

interface GigabitEthernet0/11
 bfd interval 50 min_rx 50 multiplier 3
```

CISCO ASR 9000 Configuration

```
router ospf 1
 area 0
  interface GigabitEthernet0/2/0/0
   bfd minimum-interval 50
   bfd multiplier 3
  !
 !
!
```

BFD on Port Channel

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
interface GigabitEthernet0/11
 no switchport
 no ip address
 channel-group 11 mode on
!
interface Port-channel11
 no switchport
 ip address 115.1.1.2 255.255.255.0
 bfd interval 50 min_rx 50 multiplier 3
```

```
 no bfd echo!
!

router ospf 1
 network 115.1.1.2 0.0.0.0 area 0
 bfd all-interfaces
```

CISCO ASR 9000 Configuration

```
 bfd
 interface Bundle-Ether111
  echo disable
 !
 multipath include location 0/2/CPU0
!

router ospf 1
 area 0
  bfd minimum-interval 50
  bfd fast-detect
  bfd multiplier 3
  interface Bundle-Ether111
  !
 !
!
```

Chapter 5 VPWS

CISCO ASR 9000 EFP MTU behaviour

- CISCO ASR 9000 INTELLIGENTLY adjusts sub-interface/EFP MTU
- If “rewrite pop” is configured, MTU size is reduced by the 4 bytes for each VLAN popped.
- If “rewrite push” is configured, MTU size is increased by 4 bytes.

PROBLEM : The VPWS will not come up due to MTU mismatch !

SOLUTION : Configure MTU manually on the EFP on CISCO ASR 9000 to match with the MTU size on the remote side !

NOTE : Remember CISCO ASR 9000 takes L2 size on the MTU command.

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

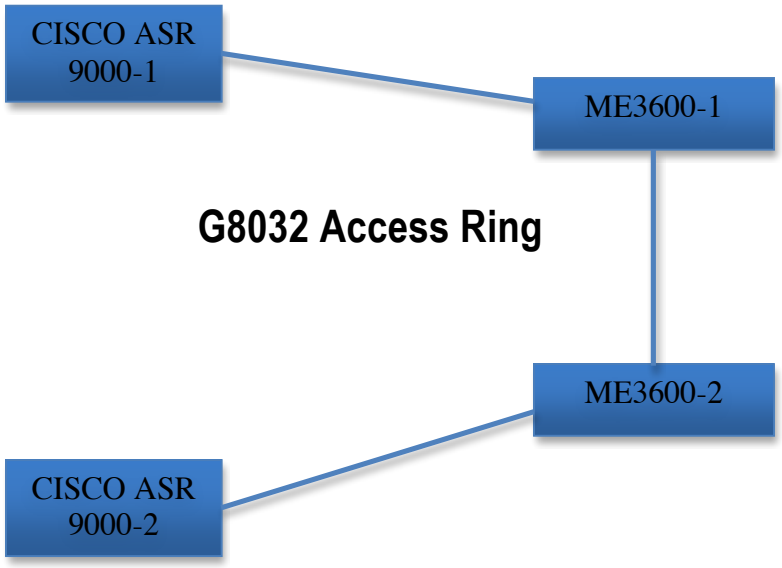
```
interface GigabitEthernet0/2/0
 no ip address
 negotiation auto
 service instance 555 ethernet
  encapsulation dot1q 100 second-dot1q 200
  rewrite ingress tag pop 1 symmetric
  xconnect 11.1.1.1 555 encapsulation mpls !
```

CISCO ASR 9000 Configuration

```
l2vpn
 xconnect group vpws
  p2p vpws
   interface GigabitEthernet0/2/0/0.555
   neighbor 121.0.1.1 pw-id 555
   !
  !
!
interface GigabitEthernet0/2/0/0.555 l2transport
 encapsulation dot1q 100 second-dot1q 200
 rewrite ingress tag pop 1 symmetric
 mtu 1518
```

Chapter 6 G8032

Topology



CISCO ME3600X/3800X and CISCO ASR 903 Configuration

ME3600-1

```
ethernet cfm ieee
ethernet cfm global
!
ethernet cfm domain MD-ERPS level 5
 service MA-link evc G8032EVC vlan 5 direction down
  continuity-check
  continuity-check interval 1s
  efd notify g8032
!
ethernet ring g8032 ring1
 open-ring
 port0 interface GigabitEthernet0/2
  monitor service instance 5
 port1 interface GigabitEthernet0/4
```

```
  monitor service instance 5
 instance 1
  profile profile1
  rpl port1 owner
  inclusion-list vlan-ids 5,100-200
  aps-channel
   level 2
   port0 service instance 5
   port1 service instance 5
  !
 !
!
!
ethernet evc G8032EVC
!
!
interface GigabitEthernet0/4
 switchport trunk allowed vlan none
 switchport mode trunk
 service instance 5 ethernet G8032EVC
  encapsulation dot1q 5
  bridge-domain 5
  cfm mep domain MD-ERPS mpid 3
 !
!
interface GigabitEthernet0/2
 switchport trunk allowed vlan none
 switchport mode trunk
 service instance 5 ethernet G8032EVC
  encapsulation dot1q 5
  bridge-domain 5
  cfm mep domain MD-ERPS mpid 1
 !
!
```

ME3600-2

```
ethernet cfm ieee
ethernet cfm global
!
ethernet cfm domain MD-ERPS level 5
 service MA-link evc G8032EVC vlan 5 direction down
  continuity-check
  continuity-check interval 1s
  efd notify g8032
!
ethernet ring g8032 ring1
 open-ring
 port0 interface GigabitEthernet0/2
  monitor service instance 5
 port1 interface GigabitEthernet0/4
  monitor service instance 5
 instance 1
  profile profile1
  inclusion-list vlan-ids 5,100-200
```

```
  aps-channel
   level 2
   port0 service instance 5
   port1 service instance 5
  !
 !
!
!
ethernet evc G8032EVC
!
!interface GigabitEthernet0/4
 switchport trunk allowed vlan none
 switchport mode trunk
 service instance 5 ethernet G8032EVC
  encapsulation dot1q 5
  bridge-domain 5
  cfm mep domain MD-ERPS mpid 3
 !
!
interface GigabitEthernet0/2
 switchport trunk allowed vlan none
 switchport mode trunk
 service instance 5 ethernet G8032EVC
  encapsulation dot1q 5
  bridge-domain 5
  cfm mep domain MD-ERPS mpid 1
 !
!
```

NOTE : The ME3600X supports G.8032 only on EVC and not on switchports for now.
It is recommended to use the CCM message interval as 1 second on ME3600X

CISCO ASR 9000 Configuration

ASR 9000-1 and CISCO ASR 9000-2

```
ethernet cfm
 domain MD-ERPS level 5
 service MA-link down-meps
 continuity-check interval 1s
 efd
 !
!
l2vpn
  ethernet ring g8032 G-RING
    port0 interface GigabitEthernet0/2/0/21
     monitor interface GigabitEthernet0/2/0/21.500
  !
  port1 none
  open-ring
  instance 1
```

```
    profile profile1
    inclusion-list vlan-ids 5,100-200
    aps-channel
level 2
port0 interface GigabitEthernet0/2/0/21.500
port1 none
   !
  !

bridge group RING
  bridge-domain RING1
    interface GigabitEthernet0/2/0/21.500
  !
 !
!
interface GigabitEthernet0/2/0/21.500 l2transport
  encapsulation dot1q 5
  ethernet cfm
   mep domain MD-ERPS service MA-link mep-id 2
```

Chapter 7 VPLS using BGP auto discovery

VPLS CLI and implementational differences

There is a distinct difference as how the split horizon groups are implemented in ME/CISCO ASR 903 platforms and CISCO ASR 9000. This is important to understand while configuring HVPLS or E-TREE based deployment scenario.

CISCO ME3600X/3800X and CISCO ASR 903	**CISCO ASR 9000**
1. To disable split-horizon on a psuedowire, the configuration is straight forward as mentioned below, where you use a "no-split-horizon" option with the neighbor command under VFI : l2 vfi VPLS manual vpn id 455 neighbor 1.1.1.1 encapsulation mpls **no-split-horizon**	1.On CISCO ASR 9000 to disable split-horizon for psuedowire/neighbor. The neighbor statement has to be configured under the bridge-domain and outside the vfi CLI. Below is the configuration : l2vpn bridge group VPLS bridge-domain VPLS **neighbor 1.1.1.1 pw-id 100** ! vfi vpls neighbor 2.2.2.2 pw-id 200 ! ! In a H-VPLS based deployment all the CORE psedowires are configured under VFI and the SPOKE psuedowires outside VFI under bridge-domain.
2. To enable split-horizon on an EFP or service instance. The command used to configure it is : inteface GigabitEthernet0/4 service instance 1 ethernet encapsulation default bridge-domain 100 split-horizon-group 0 In ME/CISCO ASR 903 platforms the EFPs that are in the same bridge domain and split-horizon group cannot forward data between each other. EFPs can be configured in 3 split-horizon groups	2. To enable split-horizon on an EFP. The commands are as below on CISCO ASR 9000. l2vpn bridge group VPLS bridge-domain VPLS **interface GigabitEthernet0/2/0/0.100** **split-horizon group** !

0 to 2. So in a E-Tree based deployment all the root EFPs are put in one split-horizon group and the Root is put in another split-horizon group. So all the leafs communicate with Root and not with each other.	The option “split-horizon group” enables split-horizon on EFPs. The concept of split-horizon groups are a different in CISCO ASR 9000. ▪ 3 Split Horizon groups are defined in CISCO ASR 9000 ▪ Group 0 is default. ▪ Group 1 – Any PW configured under the “vfi” ▪ Group 2 – Any AC configured with “split-horizon” keyword. By configuring Split-horizon option on an EFP, split-horizon is enabled by pushing the EFP to a Group 2 from default Group 0.

VPLS using BGP auto discovery

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
router bgp 3
 bgp router-id 121.0.1.1
 bgp log-neighbor-changes
 no bgp default ipv4-unicast
 neighbor 11.1.1.1 remote-as 3
!
 address-family ipv4
 neighbor 11.1.1.1 activate
!
 address-family l2vpn vpls
  neighbor 11.1.1.1 activate
  neighbor 11.1.1.1 send-community both
  neighbor 11.1.1.1 prefix-length-size 2
!

l2 vfi POD1 autodiscovery
 vpn id 100
 bridge-domain 100
```

NOTE : The command **neighbor 11.1.1.1 prefix-length-size 2** is required to interoperate with Cisco ASR 9000

CISCO ASR 9000 Configuration

```
router bgp 3
 bgp router-id 11.1.1.1
 address-family ipv4 unicast
 !
 address-family l2vpn vpls-vpws
 !
 neighbor 11.1.1.2
  remote-as 3
  update-source Loopback0
  address-family ipv4 unicast
  !
  address-family l2vpn vpls-vpws


l2vpn
 bridge group POD1
  bridge-domain POD1
   neighbor 122.3.3.1 pw-id 101
   !
   vfi POD1
    vpn-id 100
    autodiscovery bgp
     rd 3:100
     route-target 3:100
     signaling-protocol ldp
     !
    !
   !
  !
 !
```

Chapter 8 EOAM

Configuration of CFM over a Bridge domain

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
ethernet cfm ieee
ethernet cfm global
ethernet evc EVC
!

ethernet cfm domain MD-ERPS level 5
 service MA-link evc EVC vlan 5
  continuity-check
 !

interface GigabitEthernet0/4
 switchport trunk allowed vlan none
 switchport mode trunk
 service instance 5 ethernet EVC
  encapsulation dot1q 5
  bridge-domain 5
  cfm mep domain MD-ERPS mpid 3
 !
```

CISCO ASR 9000 Configuration

```
ethernet cfm
 domain MD-ERPS level 5
 service MA-link
 continuity-check interval 100ms
 !
l2vpn
 bridge group EOAM
  bridge-domain EOAM
    interface GigabitEthernet0/2/0/21.500
  !
 !
!
interface GigabitEthernet0/2/0/21.500 l2transport
  encapsulation dot1q 5
  ethernet cfm
   mep domain MD-ERPS service MA-link mep-id 2
!
```

Configuration of CFM over xconnect

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
ethernet cfm ieee
ethernet cfm global
ethernet evc EVC
!

ethernet cfm domain MD-2 level 5
service MA-3 evc EVC
 continuity-check
 !
!

interface GigabitEthernet0/4
 switchport trunk allowed vlan none
 switchport mode trunk
 service instance 3 ethernet EVC
 encapsulation dot1q 3
 rewrite ingress tag pop 1 symmetric
 xconnect 10.1.1.1 2 encapsulation mpls
 cfm mep domain MD-2 mpid 3
```

CISCO ASR 9000 Configuration

```
ethernet cfm
domain MD-2 level 5
 service MA-3 xconnect group apac p2p eoam-2
  continuity-check interval 100ms
  !
 !


interface GigabitEthernet0/0/1/3.2 l2transport
encapsulation dot1q 3
rewrite ingress tag pop 1 symmetric
ethernet cfm
 mep domain MD-2 service MA-3 mep-id 4
```

Chapter 9 Layer 2 Control Protocol Forwarding

The Layer 2 Control Protocol forwarding bahaviors are different between the set of CISCO ASR 9000 and ME and ASR platforms.

CISCO ME3600X/3800X and CISCO ASR 903 behaviour and configuration

- By default all layer 2 control frames are dropped on the EFP.
- The layer 2 control protocol forwarding is enabled using the command "l2protocol forward"
- By enabling just the command " l2protocol forwarding" All layer 2 control protocols will be forwarded.
- There is also a flexibility to forward a particular set of protocols as well by mentioning

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
ME3600-1(config-if-srv)#l2protocol forward ?
  R4     Reserved Protocol using DA Mac 0180.C200.0004
  R5     Reserved Protocol using DA Mac 0180.C200.0005
  R6     Reserved Protocol using DA Mac 0180.C200.0006
  R8     Reserved Protocol using DA Mac 0180.C200.0008
  R9     Reserved Protocol using DA Mac 0180.C200.0009
  RA     Reserved Protocol using DA Mac 0180.C200.000A
  RB     Reserved Protocol using DA Mac 0180.C200.000B
  RC     Reserved Protocol using DA Mac 0180.C200.000C
  RD     Reserved Protocol using DA Mac 0180.C200.000D
  RF     Reserved Protocol using DA Mac 0180.C200.000F
  cdp    Cisco Discovery Protocol
  dtp    Dynamic Trunking Protocol
  elmi   ELMI Protocol
  esmc   ESMC Protocol
  lacp   LACP Protocol
  lldp   Link Layer Discovery Protocol
  loam   Link OAM Protocol
  pagp   Port Aggregation Protocol
  ptppd  PTP Peer Delay Protocol
  stp    Spanning Tree Protocol
  udld   UDLD Protocol
  vtp    Vlan Trunking Protocol
  <cr>
```

CISCO ASR 9000 behaviour and configuration

- On the CISCO ASR 9000 all the L2 control frames are forwarded by default on the EFP.
- In order to block or permit a certain set of protocols. The L2 access lists need to be configured.

CISCO ASR 9000 Configuration

```
interface TenGigE0/0/0/0.11 l2transport
 encapsulation dot1q 11
 ethernet-services access-group L2CP_deny ingress
 !
!

ethernet-services access-list L2CP_deny
10 deny any 0180.c200.0000 0000.0000.000f
20 deny any 0180.c200.0020 0000.0000.000f
30 permit any any!
```

Chapter 10 MPLS TE

CISCO ME3600X/3800X and CISCO ASR 903 as Headend and CISCO ASR 9000 as Midpoint/Tailend

Headend - CISCO ME3600X/3800Xand CISCO ASR 903 Configuration

```
mpls traffic-eng tunnels
!

interface Loopback0
 ip address 10.1.1.1 255.255.255.255
!

interface Gig1/0
 ip address 10.0.0.1 255.255.255.0
 mpls traffic-eng tunnels
 ip rsvp bandwidth
 !
!

router ospf 1
network 10.0.0.0 0.255.255.255 area 0
mpls traffic-eng router-id Loopback0
mpls traffic-eng area 0
!

interface tunnel1
  ip unnumbered loopback 0
  tunnel destination 11.1.1.1
  tunnel mode mpls traffic-eng
  tunnel mpls traffic-eng path-option 1 dynamic
```

Midpoint - CISCO ASR 9000 Configuration

```
interface Loopback0
 ipv4 address 11.1.1.1 255.255.255.255
!

interface GigabitEthernet0/2/0/0
 ipv4 address 10.0.0.2 255.255.255.0
!

router ospf 1
```

```
 area 0
  mpls traffic-eng
  interface Loopback0
  !
  interface GigabitEthernet0/2/0/0
  !
 !
 mpls traffic-eng router-id Loopback0
!


rsvp
 interface GigabitEthernet0/2/0/0
 !

mpls traffic-eng
 interface GigabitEthernet0/2/0/0
 !
!
```

CISCO ME3600X/3800Xand CISCO ASR 903 as Midpoint/Tailend and CISCO ASR 9000 as Headend

Midpoint - CISCO ME3600X/3800Xand CISCO ASR 903 Configuration

```
mpls traffic-eng tunnels
!

interface Loopback0
 ip address 10.1.1.1 255.255.255.255
!

interface Gig1/0
 ip address 10.0.0.1 255.255.255.0
 mpls traffic-eng tunnels
 ip rsvp bandwidth
 !
!

router ospf 1
network 10.0.0.0 0.255.255.255 area 0
mpls traffic-eng router-id Loopback0
mpls traffic-eng area 0
!
```

Headend - CISCO ASR 9000 Configuration

```
router ospf 1
 area 0
  mpls traffic-eng
  interface GigabitEthernet0/2/0/0
  !
 !
 mpls traffic-eng router-id Loopback0
!


rsvp
 interface GigabitEthernet0/2/0/0
 !

mpls traffic-eng
 interface GigabitEthernet0/2/0/0
 !
!

interface GigabitEthernet0/2/0/0
 ipv4 address 10.0.0.2 255.255.255.0
!

interface tunnel-te1
 ipv4 unnumbered Loopback0
 destination 10.1.1.1
 path-option 1 dynamic
```

Chapter 11 Link Bundling - LACP

CISCO ME3600X/3800X and CISCO ASR 903 Configuration

```
interface GigabitEthernet0/11
 switchport trunk allowed vlan none
 switchport mode trunk
 channel-group 1 mode passive
!
interface Port-channel1
 switchport trunk allowed vlan none
 switchport mode trunk
 service instance 1 ethernet
  encapsulation untagged
  l2protocol peer lacp
  bridge-domain 1
 !
```

CISCO ASR 9000 Configuration

```
interface GigabitEthernet0/2/0/32
 bundle id 10 mode active
!

interface Bundle-Ether10
!
```

NOTE : The ME3600X should have an untagged EFP with L2protocol peering for LACP frames to accept and process LACP frames.