AT&T IP Flexible Reach and AT&T IP Toll-Free on AT&T VPN Service as the Underlying Transport Service

Border Gateway Protocol Resiliency (BGP-R) & Call Preservation Customer Configuration Guide

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Version 1.3

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1. Introduction

This Customer Configuration Guide ("CCG") provides recommended guidelines for configuring the Border Gateway Protocol Resiliency (BGP-R) and the Call Preservation feature for use with AT&T IP Flexible Reach service (including Enhanced Features Service) and/or AT&T IP Toll-Free, on AT&T VPN Service ("AT&T VPN") as the underlying transport service. Customer Edge Routers (CERs) can be utilized for either one of those services or for both services simultaneously. Please ensure your system setup is consistent with the recommended specifications provided in this document. AT&T reserves the right to modify or update its guidelines at any time without notice, so please check the following link to be sure you have the latest version of this document. (*http://www.corp.att.com/bvoip/avpn/implementation/ (login: att, password: attvoip)*). You may also wish to consult with your AT&T technical sales representative.

1.1 *Overview*

AT&T IP Flexible Reach and/or AT&T IP Toll-Free over AT&T VPN as the underlying transport service are AT&T Business Voice over IP (BVoIP) services. BGP-R is a BVoIP feature that provides backup paths for advertising BVoIP routes into AT&T VPN. The backup paths will add resiliency for inbound and outbound VoIP calls. Failover to backup paths will be employed in situations where a single AT&T VPN circuit and/or router are down and the device with the AT&T IP Flexible Reach IP address is still active. BGP-R works in conjunction with the following:
1) AT&T certified IP-PBX solutions with customer managed cascaded SBCs
2) AT&T certified IP-PBX solutions with an integrated Cisco Unified Border Element (CUBE)
3) Integrated TDM Gateway
4) AT&T certified IP-PBX solutions with customer managed cascaded SBCs and Media Flow Around (MFA) on AT&T IP Flexible Reach only

BGP-R is based on the Internet Engineering Task Force (IETF) Request for Comments (RFC) 1998 (http://www.ietf.org/rfc/rfc1998.txt) which allows customers to set their local preference to differentiate equal cost routes. To make use of this feature, the routes advertised from the CER must be "tagged" with a specific BGP community value (CV). This value corresponds to pre-determined BGP local-preferences on the BGP neighbor configuration on the AT&T Provider Edge Router (PER). Customers can choose the "best" route for a particular CER by manipulating the BGP local-preference value using CV "tagging" as advertised from that CER.

Call Preservation is an additional BVoIP feature that works in conjunction with BGP-R on IPV4 only. Call Preservation has the stated goal of restoring end-to-end call connectivity between the primary and secondary CERs. Call Preservation provides call failover within seconds between the primary and secondary CERs if they are connected with a common Layer 2 Local Area Network (LAN) or are separated by a single hop. Note that CERs with Call Preservation can be located on the same site or different sites as long as they:
1) share Layer 2 LAN; or
2) are separated by a single hop

If CERs do not share a Layer 2 LAN or are not separated by a single hop, calls may not failover within seconds when a failure occurs.

Call Preservation between primary and secondary CERs is accomplished by the configuration of /32 and /29 advertised prefix size in the CER for the IP Flexible Reach Signaling IP address (/32 has preference over the /29). The CER with the primary route for an IP Flexible Reach Signaling IP address will be configured with /32. The CER with the secondary route for an IP Flexible Reach signaling IP network will be configured with /29. Both the /32 and /29 routes will be maintained in the AT&T Provider Edge Router (PER). The lower route (/29) will be suppressed until the time when the higher route (/32) is removed from the table (due to link primary link failure). Media Flow Around operation requires similar routing arrangements for all networks that contain IP telephony devices that send or receive media.

Customers must meet the following criteria in order for Call Preservation to work. Customers that do not meet these requirements will have standard BGP-Resiliency **without** Call Preservation.

- The primary and secondary CERs must be connected via a layer 2 LAN or a single hop.
- WAN access speed of T3 or higher (excluding legacy Frame Relay access).
- For customers with Ethernet WAN access, Bidirectional Forwarding Detection (BFD) must be enabled.

BGP-R and Call Preservation is handled at the transport level; therefore, the BVoIP service itself is not aware of the failover. In other words, if the BVoIP service initiated a call to an IP Flexible Reach signaling IP address on circuit 1, it is unaware that BGP-R/Call Preservation has rerouted the call over to circuit 2. The BGP failover is triggered based on circuit, CER or PER outages. It may be accompanied by other resiliency features, such as Inbound Alternate Routing (IAR), to provide failover in the event of a complete site or SBC/IP-PBX or TDM Gateway failure.

Below is a table that summarizes the BGP community values (used for BGP-R) and the advertised prefix size (used for Call Preservation):

Route Priority	**BGP Local-Preference**	**BGP Community Value**	**IPV4 IP Flexible Signaling Address Advertised Prefix Size**	**IPV6 IP Flexible Reach Signaling Address Advertised Prefix Size**
Primary	120	13979:120	/32	/64
Secondary	110	13979:110	/29	/64
Tertiary	100	13979:100	/29	/64
Quaternary	90	13979:90	/29	/64
Quinary	80	13979:80	/29	/64

Note: The remainder of this document will refer to BGP-R with Call Preservation as "BGP-R".

1.2 *Media Flow Around (MFA)*

The Border Gateway Protocol Resiliency (BGP-R) and the Call Preservation feature for use with AT&T IP Flexible Reach service (including Enhanced Features Service) are supported with MFA operation. MFA causes media to flow directly between customer end devices such as phones and the AT&T IP Border Element (IPBE) rather than being processed through the customer managed SBC. There are several advantages to MFA including media flow directly to remote IP Phone sites (avoiding hub sites) and potentially increased concurrent call capacity on the customer managed SBC. Several prerequisites must be met to enable MFA. Your account team can help determine if this feature is available in your environment. See the following document for the configuration of MFA. Media Flow Around Addendum for Cisco Unified Border Element (CUBE) Customer Configuration Guide with AT&T Certified IP-PBX Solutions *(login: att, password: attvoip)*.

The following router configurations for cascaded CUBE using IPv4 are currently supported for MFA in this guide:

Router Configurations with OSPF

Router Configurations with EBGP

Router Configurations with HSRP

The term *voice media endpoint network* (vmen) refers to any network that contains elements that receive or transmit voice media and require BGP Resiliency and call preservation. Included in *voice media endpoint networks* are the networks for any elements such as phones, ip pbx, voice mail servers, music on hold servers, annunciators, interactive voice response systems, etc. *Voice media endpoint network* is abbreviated as (**vmen)** throughout this document.

CAUTION! The advertisement of a shorter prefix (shorter network mask) for the secondary path to voice media endpoint networks can cause issues. If the shorter prefix overlaps existing network(s) use only cv value {use the actual network prefix, not prefix -1} in these cases. For example if a voice endpoint network is 10.0.0.0/24 the secondary path would advertise 10.0.0.0/23. However, if the network 10.0.1.0/24 (or any addresses in that network range) is in use any place else on the customer's vrf do not use the prefix -1 advertisements (10.0.0.0/23 in this example). In this type of case use only the CV value advertisements with the actual network prefix.

1.3 *Scope*

- BGP-R can be enabled on existing and new AT&T IP Flexible Reach Service (basic or enhanced features) and/or AT&T IP Toll-Free on AT&T VPN service for US sites only.

- BGP-R is supported in the event of a physical failure of the CER (only applies to AT&T certified IP-PBX solutions with cascaded SBC's), Wide Area Network (WAN) link or PER failure. That is to say a "hard down" scenario will result in the immediate route removal from the primary path.
- BGP-R for AT&T IP Flexible Reach will also work with sites configured for IAR and AT&T IP Flexible Reach with enhanced features trunk re-routing capabilities.
- Circuits must be BVoIP enabled (each site must go thru the BVoIP provisioning process for signaling and media IP address assignments and other BVoIP network configurations). Each circuit must be configured as a primary for one IP Flexible Reach signaling IP address (/32 prefix) and as a backup for any additional IP Flexible Reach signaling networks (/29 prefix). For MFA operation the backup CER(s) do not need to be a primary for an SBC.
- Symmetrical routing must occur through the primary CER for the provisioned IP Flexible Reach signaling IP address (this is required for the Voice Quality Monitor (VQM) to gather information on call quality statistics).
- Reporting through the VQM and call quality Service Level Agreements (SLAs) will not be supported in a rainy day (failure) scenario
- A VQM can still be used for troubleshooting in a rainy day situation but may not provide call quality statistics needed for reporting and SLAs.
- Network Address Translation (NAT) of the SBC Signaling IP address is not supported with BGP-R.
- Each CER must only have one WAN access.
- Cisco ISR G2 platforms can support the following with BGP-R :
  - Cascaded SBC
  - Integrated CUBE
  - Integrated TDM Gateway
- Cisco ISR G1, 7200, 7300 and ASR platforms can support the cascaded SBC scenario with BGP-R

  .

1.4 *Network Topology*

This section describes the generic AT&T supported topologies for BGP-R.

- Please refer to the following document for details on configuring a customer managed CER for specific AT&T supported topologies and related configuration information: "*CER CCG for AT&T IP Flexible Reach Service and AT&T IP Toll-Free on AT&T VPN Service".* (*http://www.corp.att.com/bvoip/avpn/implementation/ (login: att, password: attvoip))*. Use the appropriate guide for your router platform.

- Please refer to the following document for details on configuring the vendor specific AT&T supported topologies and related configuration information for IP-PBX's: "*Customer Edge Router Customer Configuration Guide for AT&T Certified IP-PBX Solutions".* (*http://www.corp.att.com/bvoip/avpn/implementation/ (login: att, password: attvoip))*.

- Please refer to the following document for details on configuring a customer-managed TDM Gateway for supported topologies and related configuration information: "*TDM Gateway Customer Configuration Guide for AT&T IP Flexible Reach Service and AT&T IP Toll-Free on AT&T VPN Service as the Underlying Transport Service for ISR G2 Platform*". (*http://www.corp.att.com/bvoip/avpn/implementation/ (login: att, password: attvoip)*).

- Please refer to the following document for details on configuring a customer-managed integrated CER/CUBE for supported topologies and related configuration information: "*Customer Edge Router Customer Configuration Guide for Integrated CER/CUBE with AT&T Certified IP-PBX Solutions*". (*http://www.corp.att.com/bvoip/avpn/implementation/ (login: att, password: attvoip)*).

Three topologies will be supported on the customer LAN;

1) Open Shortest Path First (OSPF)
2) External Border Gateway Protocol (EBGP)
3) Hot Standby Routing Protocol (HSRP).

For OSPF and EBGP topologies, each IP Flexible Reach signaling IP address will have a route to one primary CER and can have routes on up to four backup CERs. CERs may be located at the same physical location or at separate locations connected by a backdoor link. Each CER must be a primary for an IP Flexible Reach signaling IP address. For MFA operation the secondary CER does not need to be a primary for an SBC.

HSRP topologies will only support a primary and a single backup CER. CERs must be located at the same site connected via an IBGP link. For the cascaded SBC topology, each CER must be a primary for an SBC. For the integrated CUBE topology, both CERs will function as a primary for the local CUBE and as backup for the other CUBE. For MFA operation the secondary CER does not need to be a primary for an SBC.

1.4.1 OSPF/EBGP

OSPF or EBGP can be configured on the LAN between the CERs in order to determine the path for the outbound VoIP packets to the active CER. This can be accomplished with **either**:

- A cascaded router or layer 3 switch, titled the "cascaded OSPF or EBGP device".
- OSPF/EBGP configured directly on the CUBE router for cascaded SBC scenarios. **Only an option if the SBC is a CUBE.**

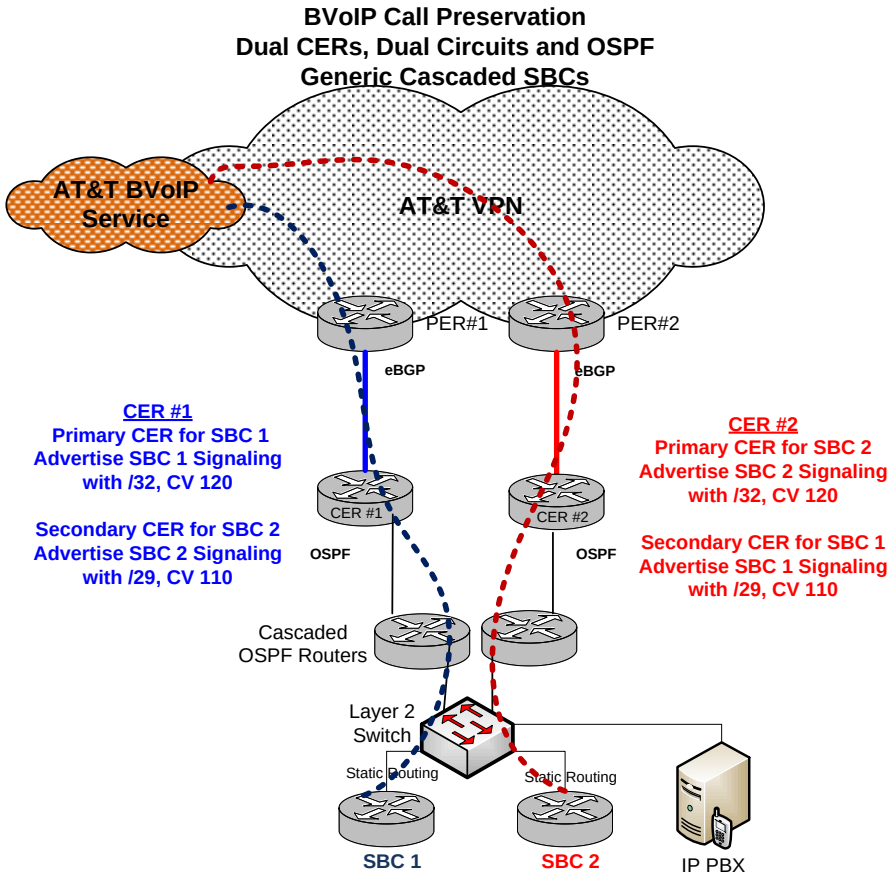
These two scenarios are illustrated in the following sections:

Note: These high level illustrations are specific to cascaded solutions. Combined CER/CUBE solutions are also supported and covered in chapter 4 of this document.

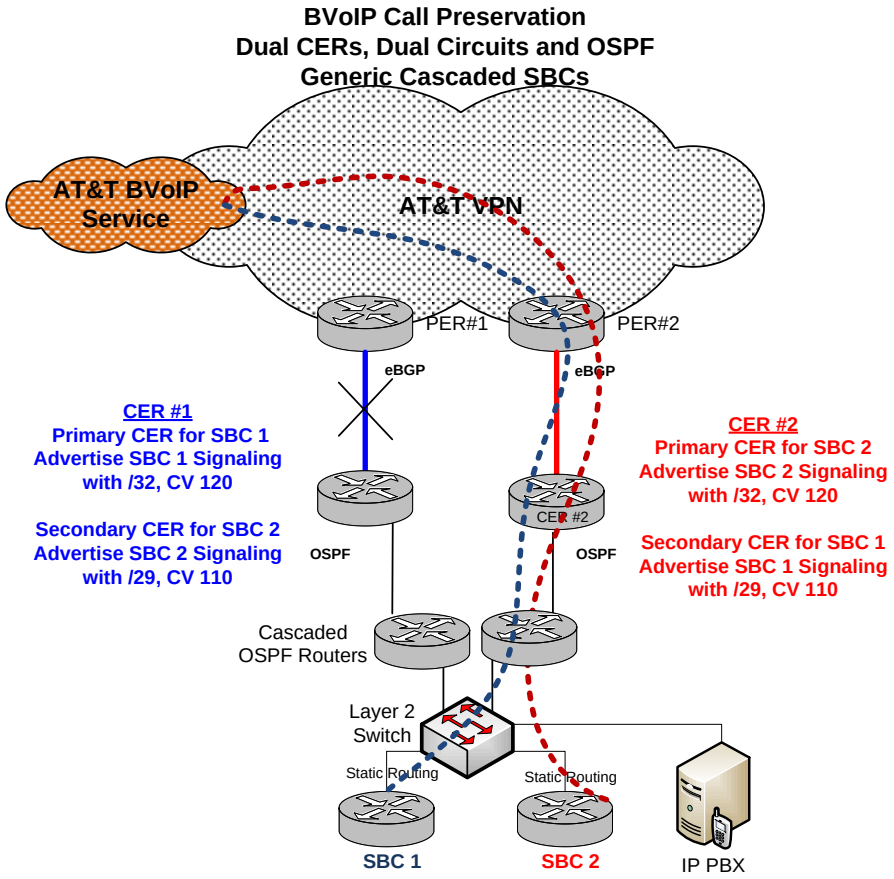
1.4.1.1 Cascaded SBCs with OSPF or EBGP Device

Most SBCs (except for CUBE) do not support configuration of the OSPF or EBGP routing protocol. In these cases, a cascaded router configured with OSPF or EBGP must be installed behind the CERs which front-end the SBCs.

The diagram below shows a sunny day scenario with generic SBCs and OSPF. This example shows two CERs.



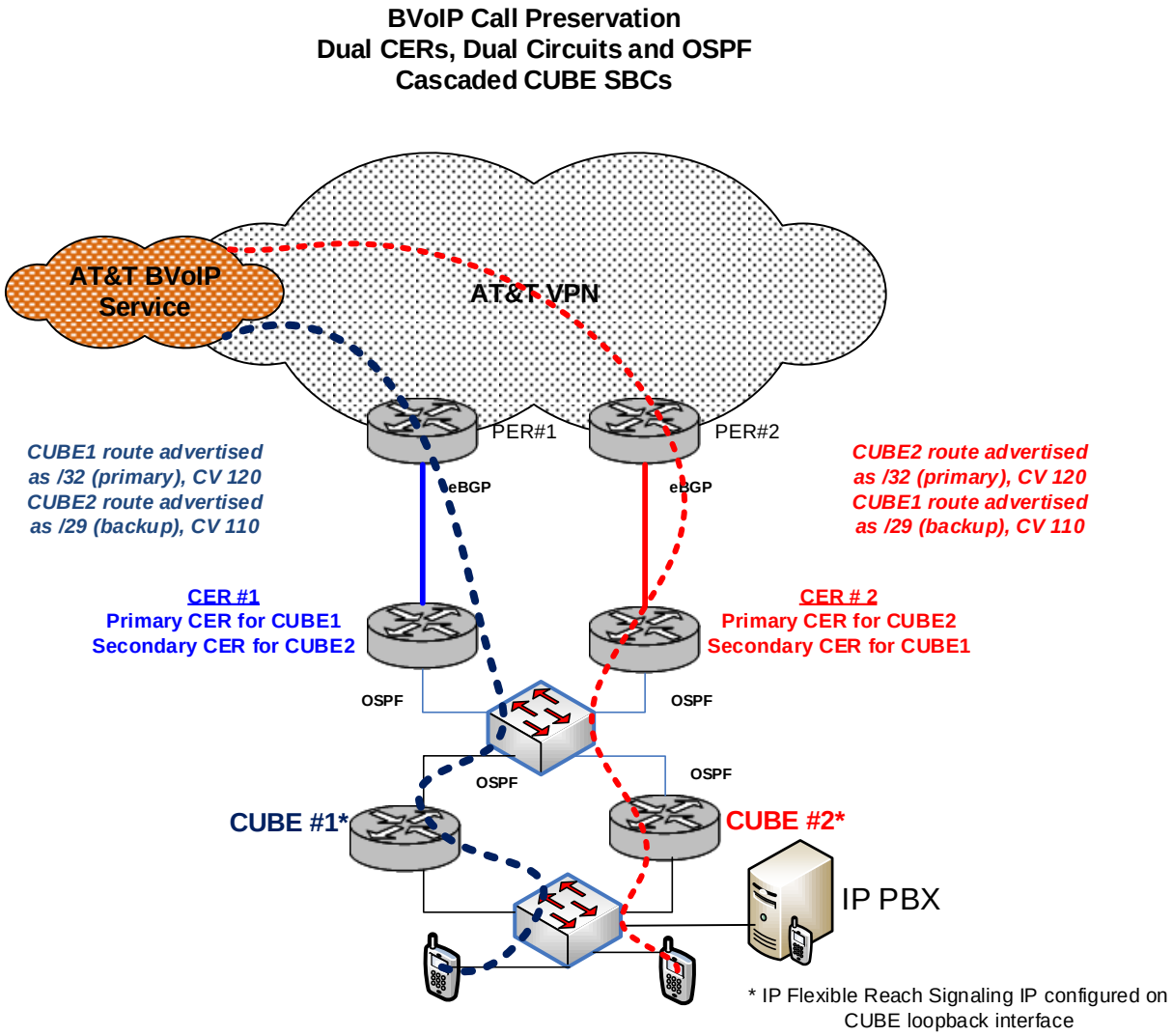
The diagram below shows a rainy day scenario with generic SBCs where the link to CER#1 has failed.



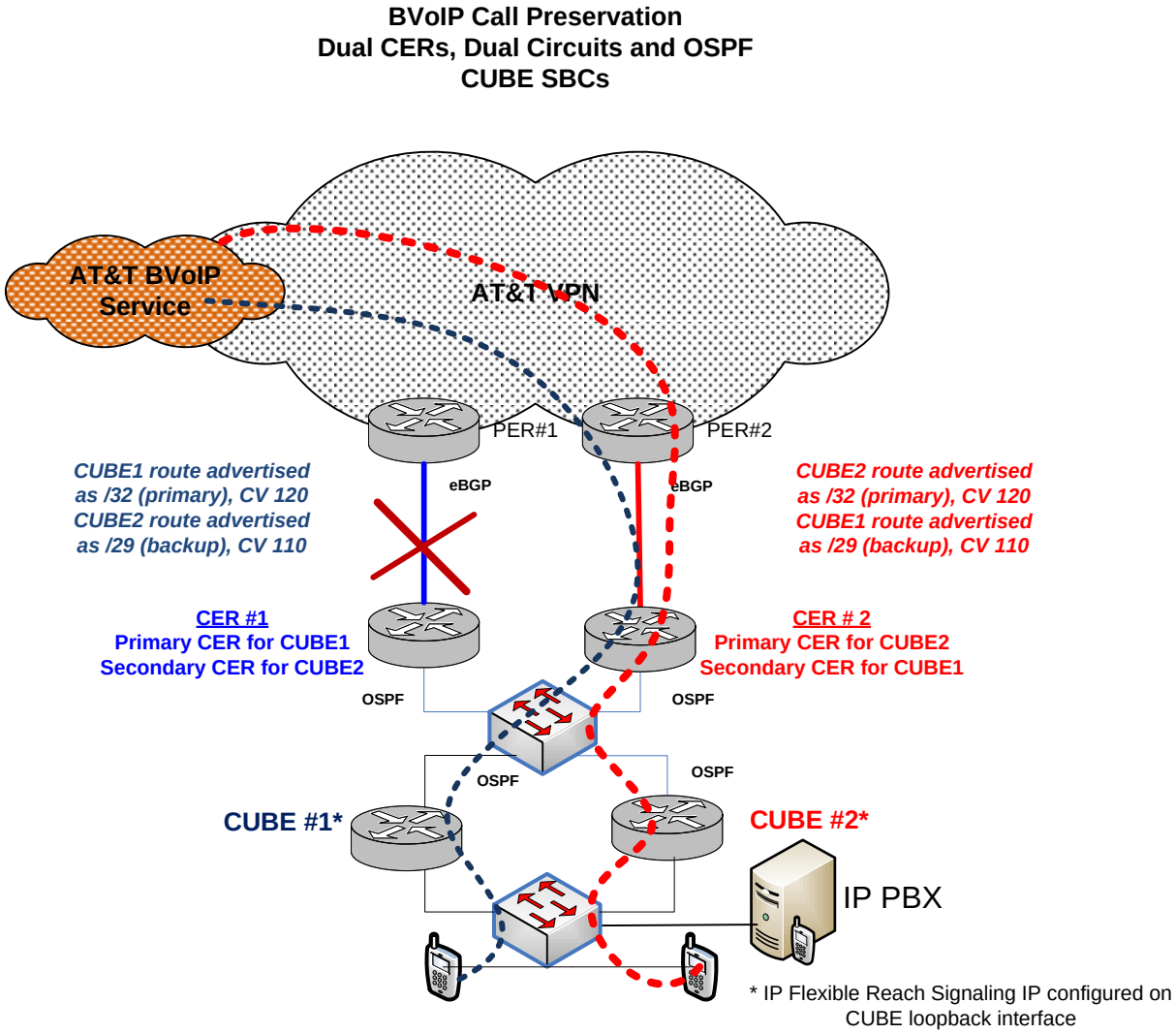
1.4.1.2 Cascaded CUBE SBCs with OSPF or EBGP

Because CUBE software runs on a router, OSPF or EBGP can be configured directly on the CUBE router. This eliminates the need for the cascaded OSPF/EBGP router.

The diagram below shows a sunny day scenario with CUBE SBCs and OSPF. This example shows two CERs.



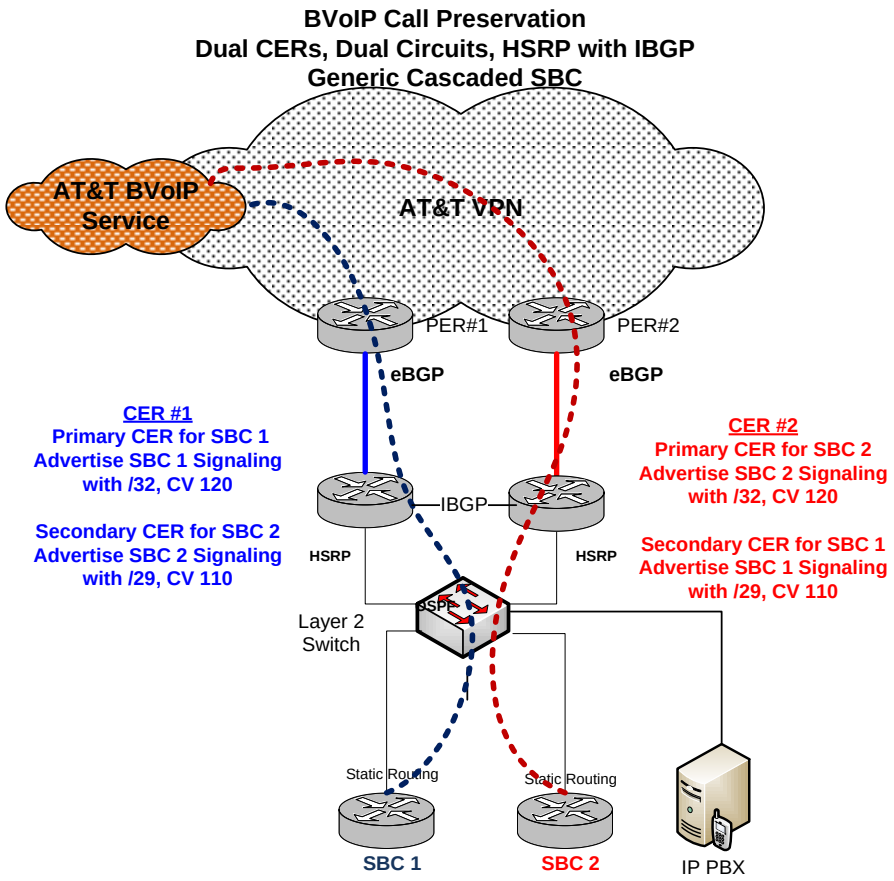
The diagram below shows a rainy day scenario with CUBE SBCs where the link to CER#1 has failed.



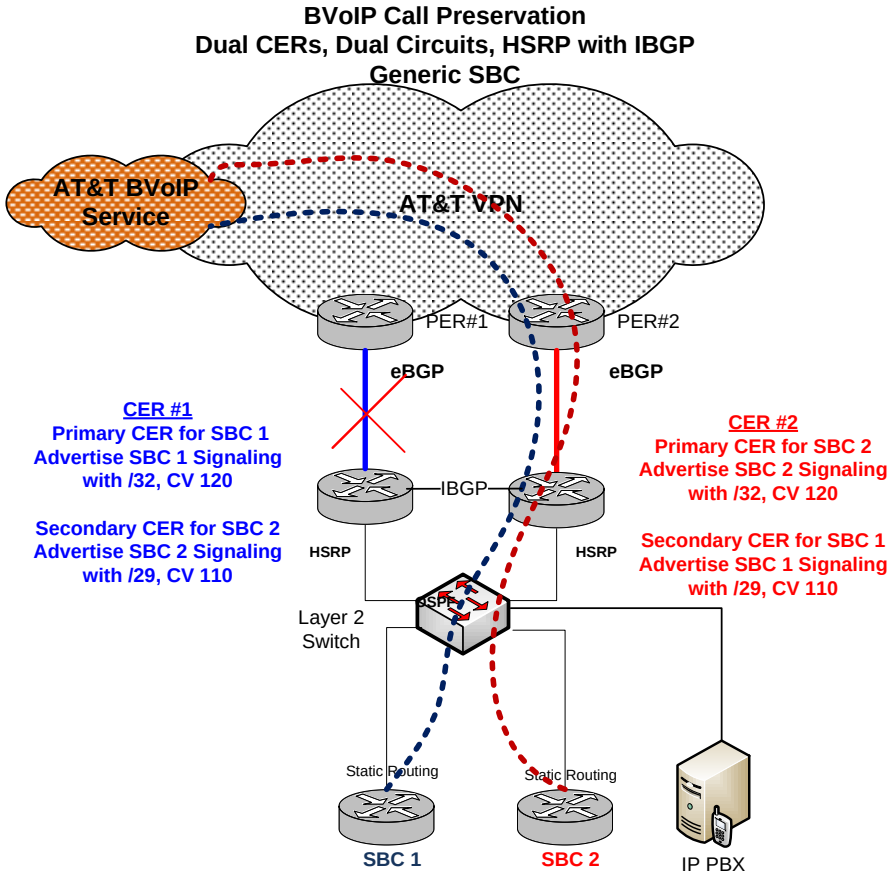
1.4.2 Cascaded CUBE SBCs with HSRP

Hot Standby Router Protocol (HSRP) is a Cisco proprietary redundancy protocol for establishing a fault-tolerant default gateway. By sharing an IP address and a MAC address (Layer 2), two or more routers can act as a single "virtual" router. The members of the virtual router group continually exchange status messages. This way, one router can assume the routing responsibility of another, should it go out of commission for either planned or unplanned reasons. Hosts continue to forward IP packets to a consistent IP and MAC address, and the changeover of devices doing the routing is transparent.

The diagram below shows a sunny day scenario with generic SBCs. This diagram can also be used when the SBC is CUBE.



The diagram below shows a rainy day scenario with generic SBCs where the link to CER#1 has failed. This diagram can also be used when the SBC is CUBE.



2. Network Design

Before implementing BGP-R with AT&T IP Flexible Reach and/or AT&T IP Toll-Free over AT&T VPN Service, it is critical to understand the voice requirements at each location and to plan accordingly. Improper design can ultimately lead to poor voice performance.

2.1 *Bandwidth Allocation*

The primary factors in determining the bandwidth design for AT&T IP Flexible Reach and/or AT&T IP Toll-Free over AT&T VPN Service are:

- The number of simultaneous voice calls in both sunny day and failure scenarios.
- The per call bandwidth (Codec type + overhead).
- Whether or not bandwidth reduction techniques are required.

Based on the above factors, the Class of Service (CoS) package can be selected including the calculation of the Committed Information Rate (CIR) and Real Time percentages.

For assistance in determining the bandwidth design, please refer to the following document for information: *"CER CCG for AT&T IP Flexible Reach Service and AT&T IP Toll-Free on AT&T VPN Service"* (*http://www.corp.att.com/bvoip/avpn/implementation/ (login: att, password: attvoip)*). Use the appropriate guide for your router platform.

3. Router Configurations for Cascaded SBC

This section provides templates and examples to configure the CERs to work with BGP-R with a cascaded SBC. Templates and examples will also be provided to configure OSPF, EBGP and HSRP for use with a generic SBC and on a CUBE SBC.

The following table is provided to assist with gathering information for the template variables:

CER entry	Where is information obtained?
Interface Configuration	
Loopback interface IP address	Private IP address determined by the customer. Used for BGP/OSPF router-id.
LAN sub-interface number	Determined by the customer
VLAN IDs	Determined by the customer
LAN interface IP address (link to Layer 2 switch)	Private IP address determined by the customer.
Routing Configuration	
BGP AS Number	Provided by customer with initial order for AT&T VPN service.

Loopback interface IP address for BGP/OSPF router-id	Private IP address determined by the customer.
AT&T PER IP address	Provided by customer with initial order for AT&T VPN service.
Remote AS number	Provided by AT&T.
SBC - Signaling IP addresses	Public IP Flexible Reach Signaling IP address. One Signaling IP address provided for each SBC.
IP address of IP Border Elements	IP address of one of the AT&T IP Border Elements (customer provided with at least two addresses). This is a public IP address provided by AT&T. Note: AT&T IP Border Element may have separate Signaling and Media IP addresses.

Note: If VQM is installed onsite, the VQM configuration statements must be included in the BGP-R configuration. If a VQM is not installed, disregard the VQM configuration statements.

3.1 *Router Configurations with OSPF*

This section provides templates and examples to configure the CERs to work with BGP-R with OSPF on the LAN. Templates and examples will also be provided to configure OSPF on a cascaded router for use with a generic SBC and on a CUBE SBC.

3.1.1 Configuration Templates for BGP-R with OSPF on LAN

The configurations provided in this section are in addition to the base CER configuration (see section 1.3 for links to the CER CCGs). Refer to section 1.3.1.1 for a diagram of CERs configured with BGP-R using OSPF.

For BGP-R configurations there will be ONE PRIMARY SBC per CER. There can be an unlimited amount of backup SBCs.

PRIMARY SBC:

Community Value = 120
SBC1 will be the PRIMARY SBC for the CER being configured. The primary SBC will be mapped to a prefix list called "**CV120**". The primary SBC will be configured with a fixed CV value of **120** and prefix of **/32**. It is mandatory to configure a primary SBC.

BACKUP SBCs:

Secondary Route, Community Value = 110: Any SBC(s) marked with a CV of 110 will be advertised as a secondary route on the CER being configured. These SBCs will be mapped

to a prefix list called "**CV110**". The SBCs will be configured with a fixed CV value of **110** and prefix of **/29**. Multiple SBCs can be configured with a secondary route on a CER.

Tertiary Route, Community Value = 100: Any SBC(s) marked with a CV value of 100 will be advertised as a tertiary route on the CER being configured. These SBCs will be mapped to a prefix list called **"CV100"**. The SBCs will be configured with a fixed CV value of **100** and prefix of **/29**. Multiple SBCs can be configured with a tertiary route on a CER.

Quaternary Route, Community Value = 90: Any SBC(s) marked with a CV value of 90 will be advertised as a quaternary (4th) route on the CER being configured. These SBCs will be mapped to a prefix list called "**CV90"**. The SBCs will be configured with a fixed CV value of **90** and prefix of **/29**. Multiple SBCs can be configured with a quaternary route on the CER.

Quinary Route, Community Value = 80: Any SBC(s) marked with a CV value of 80 will be advertised as a quinary (5th) route on the CER being configured. These SBCs will be mapped to a prefix list called **"CV80"**. The SBCs will be configured with a fixed CV value of **80** and prefix of **/29**. Multiple SBCs can be configured with a quinary route on the CER.

Note: In the configuration template the backup SBCs for each Community Value will be referred to as "SBC#-CV#". For example, if there are three SBCs mapped with a CV of 100 on a CER the SBC IP Flexible Reach Signaling IP addresses will be referred to as SBC1-CV100, SBC2-CV100, SBC3-CV100. Each SBC will have its own unique signaling IP Address.

Note: If the IP PBX and/or IP phone network is the same for multiple BGP-R CERs, the customer must choose one CER to advertise that network out as the primary (CV of 120). The IP PBX and/or IP phone network will not be advertised out any of the other BGP-R CERs.

Template for CER Configuration:

```
ip cef
!
interface Loopback0
 description – Loopback OSPF/BGP router-id -
 ip address <IP Address> 255.255.255.255
!
interface GigabitEthernet <interface number>
 no ip address
 !
interface GigabitEthernet <sub- interface number>
 description - Link to Layer 2/3 Device
 encapsulation dot1Q <VLAN ID>
 ip address <IP Address> <subnet mask>
!
```

IP Address used for OSPF & BGP router-id. Each CER participating in BGP-R must have a unique IP address.

```
int <ethernet interface connecting to the Voice Quality Monitor>
ip address <LAN IP address determined by VQM model> <mask>
!
router ospf 100
 router-id <Loopback 0 IP Address for OSPF router-id>
 redistribute bgp <AS number> subnets route-map bgp_to_ospf
 network <Loopback 0 IP Address for OSPF router-id> 0.0.0.0 area 0
 network <Gigabit Ethernet Sub-Interface IP Address> 0.0.0.0 area 0  **Int to Layer 2 switch**
 default-information originate metric 20 metric-type 1
!
router bgp <AS number>
 bgp router-id <Loopback 0 IP address for BGP router-id>
 timers bgp 3 9
 neighbor <AT&T PER IP Address> remote-as <remote AS number>
 !
 address-family ipv4
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map ospf_to_bgp
  network < Loopback 0 IP Address for OSPF/BGP router-id> mask 255.255.255.255
  network <VQM network> mask <subnet mask>
  network <IP Address of Network1> mask <subnet mask>
  network <IP Address of Network2> mask <subnet mask>
  network <IP Address of Network3> mask <subnet mask>
  ***** NOTE - There can be multiple network statements*****
  neighbor <AT&T PER IP Address> activate
  neighbor <AT&T PER IP Address> send-community both
  neighbor <AT&T PER IP Address>  advertisement-interval 3
  neighbor <AT&T PER IP Address> soft-reconfiguration inbound
  neighbor <AT&T PER IP Address> route-map AVPN_Routes-In in
  neighbor <AT&T PER IP Address> route-map Customer_SBC_Networks out
  neighbor <AT&T PER IP Address> filter-list 1 in
  no auto-summary
  no synchronization
 exit-address-family
!
!
route-map bgp_to_ospf  permit 10
```

Optional Line! Add if you want AT&T to originate the default route.

"Network" statements are needed for additional local hosts or networks that need to be redistributed with BGP. Network statements are also needed for VQM if present. NOTE: There may already be existing network statements in the BGP configuration. All networks statements will now need to be added into the "ip prefix-list SBC" portion of the configuration (see farther down in

```
 match ip address 1
 set metric 20
 set metric-type type-1
!
route-map bgp_to_ospf  permit 20
 match ip address 2
 set metric 100
 set metric-type type-2
!
route-map ospf_to_bgp  permit 10
 match ip address prefix-list OSPF_2_BGP
!
route-map AVPN_Routes-In permit 10
 match ip address 3
 set weight 64000
!
route-map Customer_SBC_Networks permit 10   **Route-map for Primary SBC**
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community <PER AS number>:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community <PER AS number>:110 additive
!
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community <PER AS number>:100 additive
!
route-map Customer_SBC_Networks permit 40
  match ip address prefix-list CV90
 set as-path prepend 64600
 set community <PER AS number>:90 additive
```

```
!
route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community <PER AS number>:80 additive
!
ip prefix-list OSPF_2_BGP description - Valid OSPF Routes To Be Sent To BGP
ip prefix-list OSPF_2_BGP seq 5 permit <Primary SBC Signaling IP Address>/32
 ***ADD ADDITIONAL LINES FOR ALL BACKUP SBC SIGNALING IPs  **
ip prefix-list OSPF_2_BGP seq 10 permit < SBC#–CV#>/29
ip prefix-list OSPF_2_BGP seq 15 permit < SBC#-CV#>/29
ip prefix-list OSPF_2_BGP seq 20 permit < SBC#-CV#>/29
** MAKE SURE TO INCREMENT SEQ # FOR EACH ADDITIONAL LINE**
ip prefix-list OSPF_2_BGP seq 95 permit <IP PBX and/or IP Phone network>/<Prefix Size>
ip prefix-list OSPF_2_BGP seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 5 permit <Primary SBC Signaling IP Address>/32
ip prefix-list CV120 seq 15 permit < Loopback 0 IP Address for OSPF router-id >/32
ip prefix list CV120 seq 18 permit <IP PBX and/or IP Phone network>/<Prefix Size>
ip prefix list CV120 seq 19 permit <VQM Network>/<Prefix Size>
ip prefix-list CV120 seq 20 permit <Network1>/<Prefix Size>
ip prefix-list CV120 seq 21 permit <Network2>/<Prefix Size>
ip prefix-list CV120 seq 22 permit <Network3>/<Prefix Size>
***NOTE - Insert additional prefix-list entries for each network statement***
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 5 permit <SBC1-CV110 Signaling IP Address>/29
ip prefix-list CV110 seq 10 permit <SBC2-CV110 Signaling IP Address>/29
*** CONTINUE TO ADD SEQUENCE LINES FOR EACH SBC WITH CV = 110***
***If  there are NO SBCs with CV value 110, only configure the deny statement shown below**
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
```

Insert one prefix list entry for each network statement that appears in the BGP section of the configuration. Start seq # at 20 and increase each "seq #" by 1.

ip prefix-list CV100 description – Backup SBCs with CV of 100

ip prefix-list CV100 seq 5 permit <SBC1-CV100 Signaling IP Address>/29

ip prefix-list CV100 seq 10 permit <SBC2-CV100 Signaling IP Address>/29

****** CONTINUE TO ADD SEQUENCE LINES FOR EACH SBC WITH CV = 100******

******If there are NO SBCs with CV value 100, only configure the deny statement shown below*****

ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32

!

ip prefix-list CV90 description – Backup SBCs with CV of 90

ip prefix-list CV90 seq 5 permit <SBC1-CV90 Signaling IP Address>/29

ip prefix-list CV90 seq 10 permit <SBC2-CV90 Signaling IP Address>/29

****** CONTINUE TO ADD SEQUENCE LINES FOR EACH SBC WITH CV = 90******

******If there are NO SBCs with CV value 90, only configure the deny statement shown below*****

ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32

!

ip prefix-list CV80 description – Backup SBCs with CV of 80

ip prefix-list CV80 seq 5 permit <SBC1-CV80 Signaling IP Address>/29

ip prefix-list CV80 seq 10 permit <SBC2-CV80 Signaling IP Address>/29

****** CONTINUE TO ADD SEQUENCE LINE FOR EACH SBC WITH CV = 80******

******If there are NO SBCs with CV value 80, only configure the deny statement shown below*****

ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32

!

ip bgp-community new-format

ip as-path access-list 1 deny _64600_

ip as-path access-list 1 permit .*

Called by "filter-list 1 in" (under router bgp)

!

******ACL1 is used to capture the IPBE addresses associated with the primary SBC******

access-list 1 permit <Signaling IP Address of 1st IP BE – For **Primary SBC**>

access-list 1 permit <Media IP Address of 1st IP BE – For **Primary SBC**>

access-list 1 permit <Signaling IP Address of 2nd IP BE – For **Primary SBC**>

access-list 1 permit <Media IP Address of 2nd IP BE – For **Primary SBC** >

access-list 1 deny any

******ACL2 is used to capture the IPBE addresses associated with ALL of the backup SBCs******

access-list 2 permit < IP BE Signaling IP address for SBC#-CV#>

An access-list entry is required for each pair of IP Border Element IP address assigned to the SBC(s). Border Elements could have one IP address for signaling and one for media – or one combined IP address used both signaling and media. These IP BE addresses need to be advertised to the customer network. Two or more pairs of IPBE addresses can be assigned per SBC. If SBC is assigned additional IP BE addresses, add more lines to the ACL. These ACLs can also be used to prioritize any AVPN data routes that customer wants advertised into the OSPF network.

```
access-list 2 permit < IP BE Media IP address for SBC#-CV#>
access-list 2 permit < IP BE Signaling IP address for SBC#-CV#>
access-list 2 permit < IP BE Media IP address for SBC#-CV#>
****CONTINUE TO REPEAT FOR ALL ADDITIONAL IPBE ADDRESSES*
***If there are no Backup SBCs, configure only the deny statement below***
access-list 2 deny any
!
access-list 3 permit any
```

3.1.1.1 Configuration Templates for BGP-R with OSPF on LAN Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

Note that only configuration sections and additional commands are shown.

Template Changes to Support MFA CER Configuration:

```
ip prefix-list OSPF_2_BGP description - Valid OSPF Routes To Be Sent To BGP
ip prefix-list OSPF_2_BGP seq 6 permit <vmen>/<prefix>
 ***ADD ADDITIONAL LINES FOR ALL BACKUP vmen WITH (prefix-1)  **
ip prefix-list OSPF_2_BGP seq 11 permit < vmen associated with SBC#–CV#>/<prefix-1>
ip prefix-list OSPF_2_BGP seq 16 permit < vmen associated with SBC#–CV#>/<prefix-1>
ip prefix-list OSPF_2_BGP seq 21 permit < vmen associated with SBC#–CV#>/<prefix-1>
!
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 6 permit <Primary vmen>/<prefix>
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 6 permit <vmen associated with Backup SBCs with CV of 110>/<prefix-1>
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 6 permit <vmen associated with Backup SBCs with CV of 100>/<prefix-1>
!
```

```
ip prefix-list CV90 description – Backup SBCs with CV of 90
ip prefix-list CV90 seq 6 permit <vmen associated with Backup SBCs with CV of 90>/<prefix-1>
!
ip prefix-list CV80 description – Backup SBCs with CV of 80
ip prefix-list CV80 seq 6 permit <vmen associated with Backup SBCs with CV of 80>/<prefix-1>
!
```

3.1.2 Example Configurations

The following information will be used to populate the sample configurations.

Summary of IP Flexible Reach Signaling IP addresses:

CER1 = NYC1

- Primary SBC = 135.16.200.2 (primary route)
- Backup SBC with CV value of 110 (SBC1-CV110)= 135.16.19.2 (secondary route)
- Backup SBC with CV value of 100 (SBC1-CV100)= 135.16.44.2 (tertiary route)

CER2 = NYC2

- Primary SBC = 135.16.19.2 (primary route)
- Backup SBC with CV value of 110 (SBC1-CV110) =135.16.200.2 (secondary route)
- Backup SBC with CV value of 110 (SBC2-CV110)= 135.16.44.2 (secondary route)

CER3 =JC1

- Primary SBC1=135.16.44.2 (primary route)
- Backup SBC with CV Value of 100 (SBC1-CV100) = 135.16.200.2 (tertiary route)
- Backup SBC3 with CV value of 100 (SBC2-CV100)=135.16.19.2 (tertiary route)

The following tables show the information that will need to be collected for BGP-R configurations:

CER Name	*NYC1*
Location Name	*Wall Street*
CER LAN information (facing SBC)	
Subinterface #	*Gi 0/1.1*
IP address & mask	*10.1.1.1 mask 255.255.255.252*
VLAN ID	*111*
OSPF/BGP Loopback IP address	*198.22.44.5*
IP PBX/IP Phone network & mask	*10.10.20.0 mask 255.255.255.0*
Primary SBC with CV Value = 120	
Signaling IP address	*135.16.200.2*
Associated IP BE addresses	*22.44.40.20, 22.44.30.20, 33.22.80.20, 33.22.90.20*
Backup SBC(s) with CV Value= 110	
Signaling IP address(es)	*135.16.19.2*
Associated IP BE addresses	*12.44.40.25, 12.44.30.25, 13.22.80.25, 13.22.90.25*
Backup SBC(s) with CV Value = 100	
Signaling IP address(es)	*135.16.44.2*
Associated IP BE addresses	*92.44.40.20, 92.44.30.20, 93.22.80.20, 93.22.90.20*
Backup SBC(s) with CV Value = 90	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 80	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Does customer want AT&T to advertise default route?	*Yes*

CER Name	*NYC2*
Location Name	*Wall Street*
CER LAN information (facing SBC)	
Subinterface #	*Gi 0/1.1*
IP address & mask	*10.2.1.1 mask 255.255.255.252*
VLAN ID	*121*
OSPF/BGP Loopback IP address	*197.77.44.10*
IP PBX/IP Phone network & mask	*10.10.20.0 mask 255.255.255.0*
Primary SBC with CV Value = 120	
Signaling IP address	*135.16.19.2*
Associated IP BE addresses	*12.44.40.25, 12.44.30.25, 13.22.80.25, 13.22.90.25*
Backup SBC(s) with CV Value = 110	
Signaling IP address(es)	*135.16.200.2, 135.16.44.2*
Associated IP BE addresses	*22.44.40.20, 22.44.30.20, 33.22.80.20, 33.22.90.20, 92.44.40.20, 92.44.30.20, 93.22.80.20, 93.22.90.20*
Backup SBC(s) with CV Value = 100	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 90	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 80	*N/A*
Signaling IP address(es)	
Associated IP BE addresses	
Does customer want AT&T to advertise default route?	*Yes*

CER Name	*JC1*
Location Name	*Jersey City*
CER LAN information (facing SBC)	
Subinterface #	*Gi 0/1.1*
IP address & mask	*10.3.1.1 mask 255.255.255.252*
VLAN ID	*131*
OSPF/BGP Loopback IP address	*192.45.44.21*
IP PBX/IP Phone network & mask	*10.50.50.0 mask 255.255.255.0*
Primary SBC with CV Value = 120	
Signaling IP address	*135.16.44.2*
Associated IP BE addresses	*92.44.40.20, 92.44.30.20, 93.22.80.20, 93.22.90.20*
Backup SBC(s) with CV Value = 110	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 100	
Signaling IP address(es)	*135.16.200.2, 135.16.19.2*
Associated IP BE addresses	*12.44.40.25, 12.44.30.25, 13.22.80.25, 13.22.90.25, 22.44.40.20, 22.44.30.20, 33.22.80.20, 33.22.90.20*
Backup SBC(s) with CV Value = 90	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 80	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Does customer want AT&T to advertise default route?	*Yes*

3.1.2.1 **NYC1**

Following is the BGP-R configuration for **NYC1.**

Note: The router commands shown in red are specific to the example.

Since CER1 and CER2 both have the same IP PBX/IP Phone network of 10.10.20.0, it can only be advertised out one of the CERs (with a CV of 120). CER1 was chosen to advertise this route.

```
!
 ip cef
!
interface Loopback0
 description – Loopback for OSPF/BGP router-id
 ip address 198.22.44.5 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 !
interface GigabitEthernet0/0.1
 description - Link to Layer 2/3 Device
 encapsulation dot1Q 111
 ip address 10.1.1.1 255.255.255.252
!
int GigabitEthernet0/1
 description VQM Interface
 ip address 32.95.22.1 255.255.255.252
!
router ospf 100
 router-id 198.22.44.5
 redistribute bgp 65000 subnets route-map bgp_to_ospf
 network 198.22.44.5  0.0.0.0 area 0
 network 10.1.1.1 0.0.0.0 area 0                          ** Link to Layer 2/3 Device **
 default-information originate metric 20 metric-type 1     **Optional - Advertises default route**
!
```

```
router bgp 65000
 bgp router-id 198.22.44.5
 timers bgp 3 9
 neighbor 196.96.1.18 remote-as 13979
 !
 address-family ipv4
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map ospf_to_bgp
  network 198.22.44.5 mask 255.255.255.255                **BGP/OSPF loopback**
  network 32.95.22.1 mask 255.255.255.252                  **VQM network**
  network 10.22.55.0 mask 255.255.255.0                    **existing data network**
  neighbor 196.96.1.18 activate
  neighbor 196.96.1.18  send-community both
  neighbor 196.96.1.18  advertisement-interval 3
  neighbor 196.96.1.18  soft-reconfiguration inbound
  neighbor 196.96.1.18  route-map AVPN_Routes-In in
  neighbor 196.96.1.18  route-map Customer_SBC_Networks out
  neighbor 196.96.1.18  filter-list 1 in
  no auto-summary
  no synchronization
 exit-address-family
!
!
route-map bgp_to_ospf permit 10
 match ip address 1
 set metric 20
 set metric-type type-1
!
route-map bgp_to_ospf permit 20
 match ip address 2
 set metric 100
 set metric-type type-2
!
route-map ospf_to_bgp permit 10
 match ip address prefix-list OSPF_2_BGP
!
```

```
!
route-map AVPN_Routes-In permit 10
 match ip address 3
 set weight 64000
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_SBC_Networks permit 40
  match ip address prefix-list CV90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community 13979:80 additive
!
ip prefix-list OSPF_2_BGP description - Valid OSPF Routes To Be Sent To BGP
ip prefix-list OSPF_2_BGP seq 5 permit 135.16.200.2/32          **Primary SBC – CV120**
ip prefix-list OSPF_2_BGP seq 10 permit 135.16.19.2/29          **SBC1 –CV110**
ip prefix-list OSPF_2_BGP seq 15 permit 135.16.44.2/29          **SBC1-CV100**
ip prefix-list OSPF_2_BGP seq 30 permit 10.10.20.0/24           **IP PBX/IP phone network* *
```

```
ip prefix-list OSPF_2_BGP seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 5 permit 135.16.200.2/32                **Primary SBC**
ip prefix-list CV120 seq 15 permit 198.22.44.5/32                **BGP/OSPF Loopback**
ip prefix list CV120 seq 18 permit 10.10.20.0/24                 **IP PBX/IP phone network* *
ip prefix list CV120 seq 19 permit 32.95.22.0/30                 **VQM network**
ip prefix-list CV120 seq 20 permit  10.22.55.0/24                **Existing Data network**
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 5 permit  135.16.19.2/29            **SBC1-CV110**
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 5 permit 135.16.44.2/29           **SBC1-CV100**
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description – Backup SBCs with CV of 90
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description – Backup SBCs with CV of 80
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
access-list 1 permit 22.44.40.20
access-list 1 permit 22.44.30.20
access-list 1 permit 33.22.80.20
access-list 1 permit 33.22.90.20
access-list 1 deny any
access-list 2 permit 12.44.40.25
```

```
access-list 2 permit 12.44.30.25
access-list 2 permit 13.22.80.25
access-list 2 permit 13.22.90.25
access-list 2 permit 92.44.40.20
access-list 2 permit 92.44.30.20
access-list 2 permit 93.22.80.20
access-list 2 permit 93.22.90.20
access-list 2 deny any
access-list 3 permit any
```

3.1.2.1.1 NYC1 Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

Note that only configuration sections and additional commands are shown.

```
ip prefix-list OSPF_2_BGP description - Valid OSPF Routes To Be Sent To BGP
ip prefix-list OSPF_2_BGP seq 35 permit 10.50.50.0/23    ** JC1 phone network with prefix-1**
!
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 10 permit  10.50.50.0/23          ** JC1 phone network with prefix-1**
```

3.1.2.2 NYC2

Following is the BGP-R configuration for **NYC2.**

Note: The router commands shown in red are specific to the example.

```
ip cef
!
interface Loopback0
 description – Loopback for OSPF/BGP router-id -
 ip address 197.77.44.10 255.255.255.255
!
```

```
interface GigabitEthernet0/0
 no ip address
 !
interface GigabitEthernet0/0.1
 description - Link to Layer 2/3 Device
 encapsulation dot1Q 121
 ip address 10.2.1.1 255.255.255.252
!
int GigabitEthernet0/1
 description VQM Interface
 ip address 32.95.35.1 255.255.255.252
!
router ospf 100
 router-id 197.77.44.10
 redistribute bgp 65000 subnets route-map bgp_to_ospf
 network 197.77.44.10 0.0.0.0 area 0
 network 10.2.1.1 0.0.0.0 area 0                    ** Link to Layer 2/3 Device **
 default-information originate metric 20 metric-type 1      **Optional - Advertises default route**
!
router bgp 65000
 bgp router-id 197.77.44.10
 timers bgp 3 9
 neighbor 197.97.1.18 remote-as 13979
 !
 address-family ipv4
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map ospf_to_bgp
  network 197.77.44.10 mask 255.255.255.255              **BGP/OSPF loopback**
  network 32.95.35.0 mask 255.255.255.252                **VQM network**
  neighbor 197.97.1.18 activate
  neighbor 197.97.1.18 send-community both
  neighbor 196.97.1.18  advertisement-interval 3
  neighbor 197.97.1.18 soft-reconfiguration inbound
  neighbor 197.97.1.18 route-map AVPN_Routes-In in
  neighbor 197.97.1.18 route-map Customer_SBC_Networks out
  neighbor 197.97.1.18 filter-list 1 in
  no auto-summary
  no synchronization
```

```
 exit-address-family
!
!
route-map bgp_to_ospf permit 10
 match ip address 1
 set metric 20
 set metric-type type-1
!
route-map bgp_to_ospf permit 20
 match ip address 2
 set metric 100
 set metric-type type-2
!
route-map ospf_to_bgp permit 10
 match ip address prefix-list OSPF_2_BGP
!
!
route-map AVPN_Routes-In permit 10
 match ip address 3
 set weight 64000
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community 13979:100 additive
```

```
!
route-map Customer_SBC_Networks permit 40
  match ip address prefix-list CV90
 set as-path prepend 64600
 set community 13979:90 additive
!

route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community 13979:80 additive
!
ip prefix-list OSPF_2_BGP description - Valid OSPF Routes To Be Sent To BGP
ip prefix-list OSPF_2_BGP seq 5 permit 135.16.19.2/32              **Primary SBC**
ip prefix-list OSPF_2_BGP seq 10 permit 135.16.200.2/29          **SBC1-CV110**
ip prefix-list OSPF_2_BGP seq 15 permit 135.16.44.2/29           **SBC2-CV110**
ip prefix-list OSPF_2_BGP seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 5 permit 135.16.19.2/32                    **Primary SBC**
ip prefix-list CV120 seq 15 permit 197.77.44.10/32                  **BGP/OSPF Loopback**
ip prefix list CV120 seq 19 permit 32.95.35.0/30                     **VQM network**
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 5 permit  135.16.200.2/29                   **SBC1-CV110**
ip prefix=list CV110 seq 10 permit 135.16.44.2/29                   **SBC2-CV110**
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description – Backup SBCs with CV of 90
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
```

```
!
ip prefix-list CV80 description – Backup SBCs with CV of 80
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32

!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
access-list 1 permit 12.44.40.25
access-list 1 permit 12.44.30.25
access-list 1 permit 13.22.80.25
access-list 1 permit 13.22.90.25
access-list 1 deny any
access-list 2 permit 22.44.40.20
access-list 2 permit 22.44.30.20
access-list 2 permit 33.22.80.20
access-list 2 permit 33.22.90.20
access-list 2 permit 92.44.40.20
access-list 2 permit 92.44.30.20
access-list 2 permit 93.22.80.20
access-list 2 permit 93.22.90.20
access-list 2 deny any
access-list 3 permit any
```

3.1.2.2.1 NYC2 Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

Note that only configuration sections and additional commands are shown.

```
ip prefix-list OSPF_2_BGP description - Valid OSPF Routes To Be Sent To BGP
ip prefix-list OSPF_2_BGP seq 20 permit 10.10.20.0/23    ** NYC1 phone network with prefix-1**
ip prefix-list OSPF_2_BGP seq 25 permit 10.50.50.0/23    ** JC1 phone network with prefix-1**
```

```
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 15 permit  10.10.20.0/23          ** NYC1 phone network with prefix-1**
ip prefix-list CV110 seq 20 permit  10.50.50.0/23          ** JC1 phone network with prefix-1**
```

3.1.2.3 **JC1**

Following is the BGP-R configuration for **JC1.**

Note: The router commands shown in red are specific to the example.

```
ip cef
!
interface Loopback0
 description – Loopback for OSPF/BGP router-id
 ip address 192.45.44.21 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 !
interface GigabitEthernet0/0.1
 description - Link to Layer 2/3 Device
 encapsulation dot1Q 131
 ip address 10.3.1.1 255.255.255.252
!
int GigabitEthernet0/1
 description VQM Interface
 ip address 32.95.63.1 255.255.255.252
!
router ospf 100
 router-id 192.45.44.21
 redistribute bgp 65000 subnets route-map bgp_to_ospf
 network 192.45.44.21 0.0.0.0 area 0
 network 10.3.1.1 0.0.0.0 area 0                          ** Link to Layer 2/3 Device **
 default-information originate metric 20 metric-type 1    **Optional - Advertises default route**
!
router bgp 65000
```

```
 bgp router-id 192.45.44.21
 timers bgp 3 9
 neighbor 197.22.9.18 remote-as 13979
 !
 address-family ipv4
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map ospf_to_bgp
  network 192.45.44.21 mask 255.255.255.255              **BGP/OSPF loopback**
  network 32.95.63.0 mask 255.255.255.252                **VQM network**
  neighbor 197.22.9.18 activate
  neighbor 197.22.9.18 send-community both
  neighbor 196.96.1.18  advertisement-interval 3
  neighbor 197.22.9.18 soft-reconfiguration inbound
  neighbor 197.22.9.18 route-map AVPN_Routes-In in
  neighbor 197.22.9.18 route-map Customer_SBC_Networks out
  neighbor 197.22.9.18 filter-list 1 in
  no auto-summary
  no synchronization
 exit-address-family
!
!
route-map bgp_to_ospf permit 10
 match ip address 1
 set metric 20
 set metric-type type-1
!
route-map bgp_to_ospf permit 20
 match ip address 2
 set metric 100
 set metric-type type-2
!
route-map ospf_to_bgp  permit 10
 match ip address prefix-list OSPF_2_BGP
!
!
route-map AVPN_Routes-In permit 10
```

```
 match ip address 3
 set weight 64000
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_SBC_Networks permit 40
  match ip address prefix-list CV90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community 13979:80 additive
!
ip prefix-list OSPF_2_BGP description - Valid OSPF Routes To Be Sent To BGP
ip prefix-list OSPF_2_BGP seq 5 permit 135.16.44.2/32          **Primary SBC**
ip prefix-list OSPF_2_BGP seq 10 permit 135.16.200.2/29        **SBC1-CV100**
ip prefix-list OSPF_2_BGP seq 15 permit 135.16.19.2/29         **SBC2-CV100**
ip prefix-list OSPF_2_BGP seq 30 permit 10.50.50.0/24          **IP PBX/IP phone network* *
ip prefix-list OSPF_2_BGP seq 100 deny 0.0.0.0/0 le 32
!
```

```
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 5 permit 135.16.44.2/32                **Primary SBC**
ip prefix-list CV120 seq 15 permit 192.45.44.21/32               **BGP/OSPF Loopback**
ip prefix list CV120 seq 18 permit 10.50.50.0/24                 **IP PBX/IP phone network* *
ip prefix list CV120 seq 19 permit 32.95.63/30                   **VQM network**
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 5 permit  135.16.200.2/29               **SBC1-CV100**
ip prefix-list CV100 seq 10 permit 135.16.19.2/29                **SBC2-CV100**
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description – Backup SBCs with CV of 90
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description – Backup SBCs with CV of 80
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32

!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
access-list 1 permit 92.44.40.20
access-list 1 permit 92.44.30.20
access-list 1 permit 93.22.80.20
access-list 1 permit 93.22.90.20
access-list 1 deny any
access-list 2 permit 22.44.40.20
access-list 2 permit 22.44.30.20
access-list 2 permit 33.22.80.20
```

```
access-list 2 permit 33.22.90.20
access-list 2 permit 12.44.40.25
access-list 2 permit 12.44.30.25
access-list 2 permit 13.22.80.25
access-list 2 permit 13.22.90.25
access-list 2 deny any
access-list 3 permit any
```

3.1.2.3.1 JC1 Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

Note that only configuration sections headers and additional commands are shown.

```
ip prefix-list OSPF_2_BGP description - Valid OSPF Routes To Be Sent To BGP
ip prefix-list OSPF_2_BGP seq 20 permit 10.10.20.0/23    ** NYC1 phone network with prefix-1**
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 15 permit  10.10.20.0/23          ** NYC1 phone network with prefix-1**
```

3.1.3 Configuration Template for a Cascaded OSPF Router (for use with a generic SBC)

The following template is provided to assist with configuring the cascaded OSPF Cisco router for use with BGP-R. The red highlighted entries are variables that are specific to the customer's environment. Refer to the diagram in section 1.3.1.1.

The cascaded OSPF router example is designed to have one physical interface facing the CERs and one physical interface facing the SBCs.

CER facing Interface: The interface facing the CERs will be configured with a sub interface for each corresponding CER.

SBC facing interface: The interface facing the SBCs will be configured with a sub-interface for each corresponding SBC. With this design, it is assumed that the SBC LAN interface is provisioned with the IP Flexible Reach Signaling IP address. Each sub-interface on the cascaded OSPF router will be on the same network as the SBC. It is recommended to use the IP Flexible Reach Signaling IP address minus one for the IP address of the cascaded OSPF router sub-interface. For example, if the SBC's IP Flexible Signaling IP address is 135.16.206.58, then the corresponding cascaded OSPF router sub-interface would be configured as 135.16.206.57.

The following sample configuration is for a single cascaded OSPF router with two SBCs (one primary and one backup with CV 110). The red highlighted entries are variables that are specific to the customer's environment.

```
ip cef
ip cef accounting load-balance-hash
ip cef load-sharing algorithm include-ports source
!
interface Loopback<number>
 description – Loopback for OSPF router-id -
 ip address <IP Address> 255.255.255.255
!
interface GigabitEthernet <main interface number>
 description - Link facing Customer Managed SBCs
 no ip address
  load-interval 30
  no keepalive
!
interface GigabitEthernet <sub-interface number #1 >
 description  - Link to SBC #1
 encapsulation dot1Q <VLAN ID 1 >
 ip address <IP Address>  255.255.255.248
 !
interface GigabitEthernet <sub-interface number #2>
 description - Link to SBC #2
 encapsulation dot1Q <VLAN ID 2>
 ip address <IP Address>  255.255.255.248
!
interface GigabitEthernet <main interface number>
 description - Link facing CERs
 no ip address
 load-interval 30
 no keepalive
!
interface GigabitEthernet <sub-interface number #1 >
 description Link to CER1
 encapsulation dot1Q <VLAN ID 1>
 ip address <IP Address> <subnet mask>
 !
interface GigabitEthernet <sub-interface number #2>
 description – Link to CER2
 encapsulation dot1Q <VLAN ID 2>
 ip address <IP Address> <subnet mask>
!
!
router ospf <process-id>
 router-id <Loopback IP Address>
 log-adjacency-changes
```

Required for outbound load balancing (CER to PER)

Customer defined IP address used for the OSPF router-id

```
redistribute connected metric 20 metric-type 1 subnets
redistribute static metric 20 metric-type 1 subnets
network <IP Address of  CER facing sub-interface #1> 0.0.0.0 area 0
network <IP Address of  CER facing sub-interface #2> 0.0.0.0 area 0
!
ip forward-protocol nd
ip route < SBC1 Signaling IP address > 255.255.255.255 VLAN<Associated VLAN#>
ip route < SBC2 Signaling IP address > 255.255.255.255 VLAN<Associated VLAN#>
```

3.1.3.1 Cascaded OSPF Router Changes to Support MFA

The caution in section 1.2 must be followed.

All voice media endpoint networks (vmen) that are announced from this site must be provided via OSPF to the CER with the correct prefix (network mask). This includes both local networks that use the CER as a primary path as well as networks that may use the CER as an alternate path. Keep in mind the caution noted in section 1.2 concering the use of shorter network prefix for redundant network advertisements.

3.1.4 Configuration Template for Cascaded CUBE

This template is provided to assist with configuring the additional OSPF commands on a cascaded CUBE for use with BGP-R. Refer to the diagram in section 1.3.1.2.

The red highlighted entries are variables.

```
interface Loopback0
 description –Loopback for SIP Signaling and Media
 ip address <AT&T IP Flexible Reach Signaling IP Address> 255.255.255.255
!
interface Loopback1
 description – Loopback for OSPF router-id -
 ip address <IP address> 255.255.255.255
!
interface GigabitEthernet <main interface number>
 description - Link to Layer 2 Customer Switch -
 no ip address
 load-interval 30
 no keepalive
!
interface GigabitEthernet <sub-interface number #1 >
 description - OSPF Link to WAN Router #1
 encapsulation dot1Q <VLAN ID>
 ip address <IP Address> <255.255.255.252>
 !
!
interface GigabitEthernet <sub-interface number #2>
 description - OSPF Link to WAN Router #2
 encapsulation dot1Q <VLAN ID>
 ip address <IP Address> <255.255.255.252>
!
router ospf 100
 router-id <OSPF router  ID>
 log-adjacency-changes
 redistribute static metric 20 metric-type 1 subnets
```

Unique private IP address used for the OSPF router-id.

```
network < AT&T IP Flexible Reach Signaling IP Address > 0.0.0.0 area 0
network <IP Address of sub-interface #1> 0.0.0.0 area 0
network <IP Address of sub-interface #2> 0.0.0.0 area 0
!
ip forward-protocol nd
!
ip address <AT&T IP Flexible Reach Signaling IP Address> 255.255.255.248 Null0
```

CUBE Signaling Address configured as a /29 – to be advertised out the Backup CE Router.

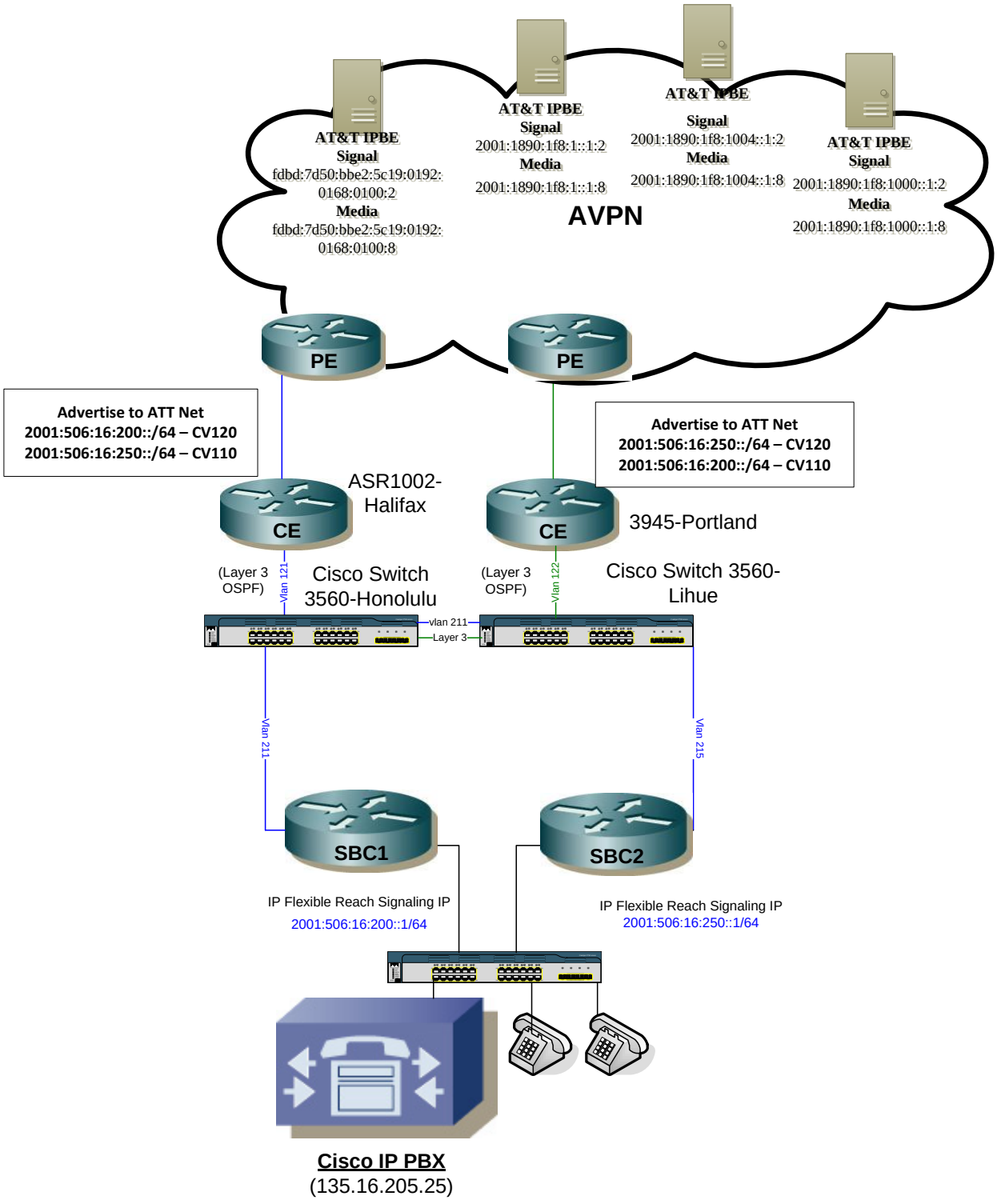
3.1.4.1 Cascaded CUBE Changes to Support MFA

The caution in section 1.2 must be followed.

All voice media endpoint networks (vmen) that are announced from this site must be provided via OSPF to the CER with the correct prefix (network mask). This includes both local networks that use the CER as a primary path as well as networks that may use the CER as an alternate path. Keep in mind the caution noted in section 1.2 concering the use of shorter network prefix for redundant network advertisements.

3.1.1 IPV6 Example Configurations

The following diagram will be used to populate the sample configurations.



ASR1002-Halifax Configuration Example:

```
ip cef
ipv6 cef
!
!
interface Loopback0
 description – BGP and OSPF Router ID
 ip address 192.168.0.8 255.255.255.255
 ipv6 address 2001:506:16:100::8/128
!
!
!
interface GigabitEthernet0/0/0
 description – WAN link
 mtu 1514
 no ip address
 load-interval 30
 negotiation auto
 cdp enable
!
interface GigabitEthernet0/0/0.100
 description Link To DCXRPE3 - Gig0/5/0/4.100
 encapsulation dot1Q 100
 ip address 195.18.32.37 255.255.255.252
 ipv6 address 2001:506:15:110::1/64
 bfd interval 999 min_rx 999 multiplier 3
 no bfd echo
!
interface GigabitEthernet0/0/1
 description - Trunk To 3560-Honolulu - Port gig0/1
 no ip address
 load-interval 30
 negotiation auto
 cdp enable
 hold-queue 2048 in
 hold-queue 2048 out
!
interface GigabitEthernet0/0/1.121
 description BGP-R OSPF Link to 3560-Honolulu
 encapsulation dot1Q 121
 ipv6 address 2002::121:101/126
 ipv6 enable
 ipv6 ospf 100 area 0
 ipv6 ospf priority 100
 ipv6 ospf cost 10
!
!
router bgp 65000
 bgp router-id 192.168.0.8
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 2001:506:15:110::2 remote-as 13979
 neighbor 2001:506:15:110::2 fall-over bfd
 neighbor 195.18.32.38 remote-as 13979
 !
```

```
 address-family ipv4
  network 172.41.0.0 mask 255.255.128.0
  network 192.168.0.8 mask 255.255.255.255
  no neighbor 2001:506:15:110::2 activate
  neighbor 195.18.32.38 activate
  neighbor 195.18.32.38 allowas-in
 exit-address-family
 !
 address-family ipv6
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map
OSPF_TO_BGP
  network 2001:506:15:110::/64
  network 2001:506:16:8::/64
  network 2001:506:16:100::8/128
  network 2002::121:100/126
  neighbor 2001:506:15:110::2 activate
  neighbor 2001:506:15:110::2 send-community both
  neighbor 2001:506:15:110::2 advertisement-interval 1
  neighbor 2001:506:15:110::2 allowas-in
  neighbor 2001:506:15:110::2 soft-reconfiguration inbound
  neighbor 2001:506:15:110::2 route-map AVPN_Routes_In_Primary in
  neighbor 2001:506:15:110::2 route-map Customer_Networks out
  neighbor 2001:506:15:110::2 filter-list 1 in
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
ipv6 router ospf 100
 router-id 192.168.0.8
 default-information originate metric 20 metric-type 1
 redistribute bgp 65000 route-map BGP_TO_OSPF
!
!
!
ipv6 prefix-list ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list ALLOW-ANY seq 100 permit ::/0 le 128
!
ipv6 prefix-list BGP-TO-OSPF-TYPE-1 description - BGP ROUTES -> OSPF E1 ROUTES
ipv6 prefix-list BGP-TO-OSPF-TYPE-1 seq 5 permit fdbc:7d50:bbe2:5c19::/64
ipv6 prefix-list BGP-TO-OSPF-TYPE-1 seq 10 permit 2001:1890:01F8:1000::/64
ipv6 prefix-list BGP-TO-OSPF-TYPE-1 seq 100 deny ::/0 le 128
!
ipv6 prefix-list BGP-TO-OSPF-TYPE-2 description - BGP ROUTES -> OSPF E2 ROUTES
ipv6 prefix-list BGP-TO-OSPF-TYPE-2 seq 5 permit 2001:1890:1f8:1004::/64
ipv6 prefix-list BGP-TO-OSPF-TYPE-2 seq 10 permit 2001:1890:1f8:1000::/64
ipv6 prefix-list BGP-TO-OSPF-TYPE-2 seq 100 deny ::/0 le 128
!
ipv6 prefix-list OSPF-TO-BGP description - IBGP Routes Allowed In
ipv6 prefix-list OSPF-TO-BGP seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list OSPF-TO-BGP seq 10 permit 2001:506:16:250::/64
ipv6 prefix-list OSPF-TO-BGP seq 15 permit 2001:506:16:100::150/128
ipv6 prefix-list OSPF-TO-BGP seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list WAN-CV-Value-120 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list WAN-CV-Value-120 seq 10 permit 2001:506:16:100::8/128
ipv6 prefix-list WAN-CV-Value-120 seq 15 permit 2001:506:16:8::/64
ipv6 prefix-list WAN-CV-Value-120 seq 20 permit 2002::121:100/126
```

```
ipv6 prefix-list WAN-CV-Value-120 seq 25 permit 2001:506:16:100::150/128
ipv6 prefix-list WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list WAN-CV-Value-110 seq 5 permit 2001:506:16:250::/64
ipv6 prefix-list WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list WAN-CV-Value-80 seq 100 deny ::/0 le 128
!
!
route-map AVPN_Routes_In_Primary permit 10
 match ipv6 address prefix-list ALLOW-ANY
 set weight 64000
!
route-map OSPF_TO_BGP permit 10
 match ipv6 address prefix-list OSPF-TO-BGP
!
route-map BGP_TO_OSPF permit 10
 match ipv6 address prefix-list BGP-TO-OSPF-TYPE-1
 set metric 20
 set metric-type type-1
!
route-map BGP_TO_OSPF permit 20
 match ipv6 address prefix-list BGP-TO-OSPF-TYPE-2
 set metric 100
 set metric-type type-2
!
route-map Customer_Networks permit 10
 match ipv6 address prefix-list WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_Networks permit 20
 match ipv6 address prefix-list WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_Networks permit 30
 match ipv6 address prefix-list WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_Networks permit 40
 match ipv6 address prefix-list WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_Networks permit 50
 match ipv6 address prefix-list WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
!
```

3945 Portland Configuration Example:

```
ip cef
ipv6 cef
!
!
interface Loopback0
 description – BGP and OSPF Router ID
 ip address 192.168.0.15 255.255.255.255
 ipv6 address 2001:506:16:100::15/128
!
!
!
interface GigabitEthernet0/2
 description - IPv6 GIG-WAN Link
 no ip address
 load-interval 30
 duplex auto
 speed auto
!
interface GigabitEthernet0/2.2813
 description Link To SFCHXRPE4 - Port 0/10/0/4.2813
 encapsulation dot1Q 2813
 ip address 192.168.130.41 255.255.255.252
 ip virtual-reassembly in
 ipv6 address 2001:506:15:32::2/64
 bfd interval 999 min_rx 999 multiplier 3
 no bfd echo
!
interface GigabitEthernet0/3
 description - Trunk To 3560-Lihue - Fa0/19
 no ip address
 load-interval 30
 duplex full
 speed auto
 hold-queue 2048 in
 hold-queue 2048 out
!
interface GigabitEthernet0/3.122
 description BGP-R OSPF Link to 3560-Lihue
 encapsulation dot1Q 122
 ipv6 address 2002::122:101/126
 ipv6 enable
 ipv6 ospf 100 area 0
 ipv6 ospf cost 10
!
!
router bgp 65000
 bgp router-id 192.168.0.15
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 2001:506:15:32::1 remote-as 13979
 neighbor 2001:506:15:32::1 fall-over bfd
 neighbor 192.168.130.42 remote-as 13979
 !
 address-family ipv4
  network 192.168.0.15 mask 255.255.255.255
  neighbor 192.168.130.42 activate
```

```
  neighbor 192.168.130.42 allowas-in
 exit-address-family
 !
 address-family ipv6
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map
OSPF_TO_BGP
  network 2001:506:15:32::/64
  network 2001:506:16:15::/64
  network 2001:506:16:100::15/128
  network 2002::122:100/126
  neighbor 2001:506:15:32::1 activate
  neighbor 2001:506:15:32::1 send-community both
  neighbor 2001:506:15:32::1 advertisement-interval 1
  neighbor 2001:506:15:32::1 allowas-in
  neighbor 2001:506:15:32::1 soft-reconfiguration inbound
  neighbor 2001:506:15:32::1 route-map AVPN_Routes_In_Primary in
  neighbor 2001:506:15:32::1 route-map Customer_Networks out
  neighbor 2001:506:15:32::1 filter-list 1 in
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
ipv6 router ospf 100
 router-id 192.168.0.15
 default-information originate metric 20 metric-type 1
 redistribute bgp 65000 route-map BGP_TO_OSPF
!
!
!
ipv6 prefix-list ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list ALLOW-ANY seq 100 permit ::/0 le 128
!
ipv6 prefix-list BGP-TO-OSPF-TYPE-1 description - BGP ROUTES -> OSPF E1 ROUTES
ipv6 prefix-list BGP-TO-OSPF-TYPE-1 seq 5 permit 2001:1890:1f8:1004::/64
ipv6 prefix-list BGP-TO-OSPF-TYPE-1 seq 10 permit 2001:1890:1f8:1000::/64
ipv6 prefix-list BGP-TO-OSPF-TYPE-1 seq 100 deny ::/0 le 128
!
ipv6 prefix-list BGP-TO-OSPF-TYPE-2 description - BGP ROUTES -> OSPF E2 ROUTES
ipv6 prefix-list BGP-TO-OSPF-TYPE-2 seq 5 permit fdbc:7d50:bbe2:5c19::/64
ipv6 prefix-list BGP-TO-OSPF-TYPE-2 seq 10 permit 2001:1890:01F8:1000::/64
ipv6 prefix-list BGP-TO-OSPF-TYPE-2 seq 100 deny ::/0 le 128
!
ipv6 prefix-list OSPF-TO-BGP description - OSPF Routes Allowed In
ipv6 prefix-list OSPF-TO-BGP seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list OSPF-TO-BGP seq 10 permit 2001:506:16:250::/64
ipv6 prefix-list OSPF-TO-BGP seq 15 permit 2001:506:16:100::151/128
ipv6 prefix-list OSPF-TO-BGP seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list WAN-CV-Value-120 seq 5 permit 2001:506:16:250::/64
ipv6 prefix-list WAN-CV-Value-120 seq 10 permit 2001:506:16:100::15/128
ipv6 prefix-list WAN-CV-Value-120 seq 15 permit 2001:506:16:15::/64
ipv6 prefix-list WAN-CV-Value-120 seq 20 permit 2002::122:100/126
ipv6 prefix-list WAN-CV-Value-120 seq 25 permit 2001:506:16:100::151/128
ipv6 prefix-list WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
!
ipv6 prefix-list WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
```

```
ipv6 prefix-list WAN-CV-Value-110 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list WAN-CV-Value-80 seq 100 deny ::/0 le 128
!

route-map AVPN_Routes_In_Primary permit 10
 match ipv6 address prefix-list ALLOW-ANY
 set weight 64000
!
route-map OSPF_TO_BGP permit 10
 match ipv6 address prefix-list OSPF-TO-BGP
!
route-map BGP_TO_OSPF permit 10
 match ipv6 address prefix-list BGP-TO-OSPF-TYPE-1
 set metric 20
 set metric-type type-1
!
route-map BGP_TO_OSPF permit 20
 match ipv6 address prefix-list BGP-TO-OSPF-TYPE-2
 set metric 100
 set metric-type type-2
!
route-map Customer_Networks permit 10
 match ipv6 address prefix-list WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_Networks permit 20
 match ipv6 address prefix-list WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_Networks permit 30
 match ipv6 address prefix-list WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_Networks permit 40
 match ipv6 address prefix-list WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_Networks permit 50
 match ipv6 address prefix-list WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
!
```

3.1.1.1 IPV6 MFA Support

MFA is not supported with IPv6 at this time.

3.2 *Router Configurations with EBGP*

3.2.1 CER Configuration (BGP-R and EBGP) Template

In BGP-R configurations there will be ONE PRIMARY SBC per CER. There can be an unlimited amount of backup SBCs.

PRIMARY SBC:

Community Value = 120: SBC1 will be the PRIMARY SBC for the CER being configured. The primary SBC will be mapped to a prefix list called "**CV120**". The primary SBC will be configured with a fixed CV value of **120**, prefix of **/32**. It is mandatory to configure a primary SBC.

BACKUP SBCs:

Secondary Route, Community Value = 110: Any SBC(s) marked with a CV of 110 will be advertised as a secondary route on the CER being configured. These SBCs will be mapped to a prefix list called "**CV110**". The SBCs will be configured with a fixed CV value of **110** and prefix of **/29**. Multiple SBCs can be configured with a secondary route on a CER.

Tertiary Route, Community Value = 100: Any SBC(s) marked with a CV value of 100 will be advertised as a tertiary route on the CER being configured. These SBCs will be mapped to a prefix list called **"CV100"**. The SBCs will be configured with a fixed CV value of **100** and prefix of **/29**. Multiple SBCs can be configured with a tertiary route on a CER

Quaternary Route, Community Value = 90: Any SBC(s) marked with a CV value of 90 will be advertised as a quaternary (4th) route on the CER being configured. These SBCs will be mapped to a prefix list called "**CV90"**. The SBCs will be configured with a fixed CV value of **90** and prefix of **/29**. Multiple SBCs can be configured with a quaternary route on the CER.

Quinary Route – Community Value = 80: Any SBC(s) marked with a CV value of 80 will be advertised as a quinary (5th) route on the CER being configured. These SBCs will be mapped to a prefix list called **"CV80"**. The SBCs will be configured with a fixed CV value of **80** and prefix of **/29**. Multiple SBCs can be configured with a quinary route on the CER.

Note: In the configuration template, the Backup SBCs for each Community Value will be referred to as "SBC#-CV#". For example, if there are three SBCs mapped with a CV of 100 on a CER, the SBC IP Flexible Reach Signaling IP addresses will be referred to as SBC1-CV100, SBC2-CV100, SBC3-CV100. Each SBC will have its own unique signaling IP.

Note: If the IP PBX and/or IP Phone network is the same for multiple BGP-R CERs, the customer must choose one CER to advertise that network out as the primary (CV of 120). The IP PBX and/or IP Phone network will not be advertised out any of the other BGP-R CERs.

Assumption: All routes to customer network will be provided by customer via EBGP.

EBGP Template

```
ip cef
!
interface Loopback0
 description – Loopback BGP router-id -
 ip address <IP address> 255.255.255.255
!
interface GigabitEthernet <interface number>
 no ip address
 !
interface GigabitEthernet <sub- interface number>
 description - Link to Layer 2/3 Device
 encapsulation dot1Q <VLAN ID>
 ip address <IP Address>  <subnet mask>
!
int <ethernet interface connecting to the Voice Quality Monitor>

ip address <LAN IP address determined by VQM model> <mask>
!
router bgp <AS number>
 bgp router-id <Loopback 0 IP address for BGP router-id>
 timers bgp 3 9
 neighbor <AT&T PER IP Address> remote-as <remote AS number>
 neighbor <EBGP Neighbor IP Address> remote-as <EBP AS number>
 !
 address-family ipv4
  network < Loopback 0 IP Address for BGP router-id> mask 255.255.255.255
  network <VQM network> mask <subnet mask>
  neighbor <AT&T PER IP Address> activate
```

IP Address used for BGP router-id. Each CER participating in BGP-R must be configured with a unique IP address.

The EBGP Neighbor is located in the customer's network.

```
 neighbor <AT&T PER IP Address> send-community both
 neighbor <AT&T PER IP Address>  advertisement-interval 3
 neighbor <AT&T PER IP Address> soft-reconfiguration inbound
 neighbor <AT&T PER IP Address> route-map AVPN_Routes_In in
 neighbor <AT&T PER IP Address> route-map Customer_SBC_Networks out
 neighbor <AT&T PER IP Address> filter-list 1 in
 neighbor <EBGP Neighbor IP Address> activate
 neighbor <EBGP Neighbor IP Address> send-community both
 neighbor <EBGP Neighbor IP Address>  advertisement-interval 3
 neighbor <EBGP Neighbor IP Address> soft-reconfiguration inbound
 neighbor <EBGP Neighbor IP Address> route-map EBGP_In in
 neighbor <EBGP Neighbor IP Address> route-map EBGP_Out out
 neighbor < EBGP Neighbor IP Address > filter-list 1 in
 no auto-summary
 no synchronization
exit-address-family
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map EBGP_In permit 10
 match ip address prefix-list EBGP-In
!
route-map EBGP_Out permit 10
 match ip address prefix-list EBGP-Out-CV120
 set as-path prepend 64600
 set community <EBGP AS Number>:120 additive
!
route-map EBGP_Out permit 20
 match ip address prefix-list EBGP-Out-CV110
 set as-path prepend 64600
 set community <EBGP AS Number>:110 additive
!
route-map EBGP_Out permit 30
 match ip address prefix-list EBGP-Out-CV100
 set as-path prepend 64600
 set community <EBGP AS Number>:100 additive
```

```
!
route-map EBGP_Out permit 40
 match ip address prefix-list EBGP-Out-CV90
 set as-path prepend 64600
 set community <EBGP AS Number>:90 additive
!
route-map EBGP_Out permit 50
 match ip address prefix-list EBGP-Out-CV80
 set as-path prepend 64600
 set community <EBGP AS Number>:80 additive
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community <PER AS number>:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community <PER AS number>:110 additive
!
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community <PER AS number>:100 additive
!
route-map Customer_SBC_Networks permit 40
  match ip address prefix-list CV90
 set as-path prepend 64600
 set community <PER AS number>:90 additive
!
route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community <PER AS number>:80 additive
!
!
ip prefix-list CV120 description – Primary SBC Route
```

```
ip prefix-list CV120 seq 5 permit <Primary SBC Signaling IP Address>/32
ip prefix-list CV120 seq 10 permit < Loopback 0 IP Address for BGP router-id >/32
ip prefix list CV120 seq 15 permit <IP PBX and/or IP Phone network>/<Prefix Size>
ip prefix list CV120 seq 20 permit <VQM Network>/<Prefix Size>
ip prefix-list CV120 seq 25 permit <Data Network1>/<Prefix Size>
ip prefix-list CV120 seq 30 permit <Data Network2>/<Prefix Size>
ip prefix-list CV120 seq 35 permit <Data Network3>/<Prefix Size>
***NOTE - Insert additional prefix-list entries for each network statement***
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 5 permit <SBC1-CV110 Signaling IP Address>/29
ip prefix-list CV110 seq 10 permit <SBC2-CV110 Signaling IP Address>/29
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH SBC WITH CV = 110***
***If  there are NO SBCs with CV value 110, only configure the deny statement shown below**
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 5 permit <SBC1-CV100 Signaling IP Address>/29
ip prefix-list CV100 seq 10 permit <SBC2-CV100 Signaling IP Address>/29
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH SBC WITH CV = 100***
***If  there are NO SBCs with CV value 100, only configure the deny statement shown below**
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description – Backup SBCs with CV of 90
ip prefix-list CV90 seq 5 permit <SBC1-CV90 Signaling IP Address>/29
ip prefix-list CV90 seq 10 permit <SBC2-CV90  Signaling IP Address>/29
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH SBC WITH CV = 90***
***If  there are NO SBCs with CV value 90, only configure the deny statement shown below**
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description – Backup SBCs with CV of 80
ip prefix-list CV80 seq 5 permit <SBC1-CV80 Signaling IP Address>/29
ip prefix-list CV80 seq 10 permit <SBC2-CV80 Signaling IP Address>/29
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH SBC WITH CV = 80***
***If  there are NO SBCs with CV value 80, only configure the deny
statement shown below**
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
```

Customer must configure network and prefix size for all the data networks to be redistributed into AT&T VPN service.

The EBGP-Out-CV# prefix lists can also be used to prioritize any AVPN data routes that customer wants advertised into the OSPF network .

```
!
ip prefix-list EBGP-Out-CV120 description – IP BE Routes sent to LAN with CV 120
ip prefix-list EBGP-Out-CV120 seq 5 permit <IPBE #1 Signaling  IP address mapped to Primary SBC>/32
ip prefix-list EBGP-Out-CV120 seq 10 permit <IPBE #1Media  IP address mapped to Primary SBC>/32
ip prefix-list EBGP-Out-CV120 seq 15 permit <IPBE #2 Signaling  IP address mapped to Primary SBC>/32
ip prefix-list EBGP-Out-CV120 seq 20 permit <IPBE #2 Media  IP address mapped to Primary SBC>/32
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH IP BE mapped to Primary SBC***
ip prefix-list EBGP-Out-CV120 seq 95 permit 0.0.0.0/0
ip prefix-list EBGP-Out-CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV110 description – IP BE Routes sent to LAN with CV 110
ip prefix-list EBGP-Out-CV110 seq 5 permit <IPBE #1 Signaling IP address mapped to SBC1-CV110>/32
ip prefix-list EBGP-Out-CV110 seq 10 permit <IPBE #1 Media  IP address mapped to SBC1-CV110>/32
ip prefix-list EBGP-Out-CV110 seq 15 permit <IPBE #2 Signaling IP address mapped to SBC1-CV110>/32
ip prefix-list EBGP-Out-CV110 seq 20 permit <IPBE #2 Media  IP address mapped to SBC1-CV110>/32
ip prefix-list EBGP-Out-CV110 seq 25 permit <IPBE #1 Signaling IP address mapped to SBC2-CV110>/32
ip prefix-list EBGP-Out-CV110 seq 30 permit <IPBE #1 Media IP address mapped to SBC2-CV110>/32
ip prefix-list EBGP-Out-CV110 seq 35 permit <IPBE #2 Signaling IP address mapped to SBC2-CV110>/32
ip prefix-list EBGP-Out-CV110 seq 35 permit <IPBE #2 Media IP address mapped to SBC2-CV110>/32
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH IP BE mapped to SBC with CV of 110***
***If  there are NO SBCs with CV value 110, only configure the deny statement shown below**
ip prefix-list EBGP-Out-CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV100 description – IP BE Routes sent to LAN with CV 100
ip prefix-list EBGP-Out-CV100 seq 5 permit <IPBE #1 Signaling IP address mapped to SBC1-CV100>/32
ip prefix-list EBGP-Out-CV100 seq 10 permit <IPBE #1 Media  IP address mapped to SBC1-CV100>/32
ip prefix-list EBGP-Out-CV100 seq 15 permit <IPBE #2 Signaling IP address mapped to SBC1-CV100>/32
ip prefix-list EBGP-Out-CV100 seq 25 permit <IPBE #2 Media IP address mapped to SBC1-CV100>/32
ip prefix-list EBGP-Out-CV100 seq 30 permit <IPBE #1 Signaling IP address mapped to SBC2-CV100>/32
ip prefix-list EBGP-Out-CV100 seq 35 permit <IPBE #1 Media IP address mapped to SBC2-CV100>/32
ip prefix-list EBGP-Out-CV100 seq 40 permit <IPBE #2 Signaling IP address mapped to SBC2-CV100>/32
ip prefix-list EBGP-Out-CV100 seq 45 permit <IPBE #2 Media IP address mapped to SBC2-CV100>/32
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH IP BE mapped to SBC with CV of 100***
***If  there are NO SBCs with CV value 100, only configure the deny statement shown below**
ip prefix-list EBGP-Out-CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV90 description – IP BE Routes sent to LAN with CV 90
ip prefix-list EBGP-Out-CV90 seq 5 permit <IPBE #1 Signaling IP address mapped to SBC1-CV90>/32
```

ip prefix-list EBGP-Out-CV90 seq 10 permit <IPBE #1 Media IP address mapped to SBC1-CV90>/32

ip prefix-list EBGP-Out-CV90 seq 15 permit <IPBE #2 Signaling IP address mapped to SBC1-CV90>/32

ip prefix-list EBGP-Out-CV90 seq 20 permit <IPBE #2 Media IP address mapped to SBC1-CV90>/32

ip prefix-list EBGP-Out-CV90 seq 25 permit <IPBE #1 Signaling IP address mapped to SBC2-CV90>/32

ip prefix-list EBGP-Out-CV90 seq 30 permit <IPBE #1 IP Media address mapped to SBC2-CV90>/32

ip prefix-list EBGP-Out-CV90 seq 35 permit <IPBE #2 IP Signaling address mapped to SBC2-CV90>/32

ip prefix-list EBGP-Out-CV90 seq 40 permit <IPBE #2 IP Media address mapped to SBC2-CV90>/32

****** CONTINUE TO ADD SEQUENCE LINE FOR EACH IP BE mapped to SBC with CV of 90******

******If there are NO SBCs with CV value 90, only configure the deny statement shown below*****

ip prefix-list EBGP-Out-CV90 seq 100 deny 0.0.0.0/0 le 32

!

ip prefix-list EBGP-Out-CV80 description – IP BE Routes sent to LAN with CV 80

ip prefix-list EBGP-Out-CV80 seq 5 permit <IPBE #1 Signaling IP address mapped to SBC1-CV80>/32

ip prefix-list EBGP-Out-CV80 seq 10 permit <IPBE #1 Media IP address mapped to SBC1-CV80>/32

ip prefix-list EBGP-Out-CV80 seq 15 permit <IPBE #2 Signaling IP address mapped to SBC1-CV80>/32

ip prefix-list EBGP-Out-CV80 seq 20 permit <IPBE #2 Media IP address mapped to SBC1-CV 80>/32

ip prefix-list EBGP-Out-CV80 seq 25 permit <IPBE #1 Signaling IP address mapped to SBC2-CV 80>/32

ip prefix-list EBGP-Out-CV80 seq 30 permit <IPBE #1 Media IP address mapped to SBC2-CV80>/32

ip prefix-list EBGP-Out-CV80 seq 35 permit <IPBE #2 Signaling IP address mapped to SBC2-CV80>/32

ip prefix-list EBGP-Out-CV80 seq 40 permit <IPBE #2 Media IP address mapped to SBC2-CV80>/32

****** CONTINUE TO ADD SEQUENCE LINE FOR EACH IP BE mapped to SBC with CV of 80******

******If there are NO SBCs with CV value 80, only configure the deny statement shown below*****

ip prefix-list EBGP-Out-CV80 seq 100 deny 0.0.0.0/0 le 32

!

!

ip prefix-list EBGP-In description - Valid LAN Routes To Be Sent To WAN

ip prefix-list EBGP-In seq 5 permit <Primary SBC Signaling IP Address>/32

******ADD ADDITIONAL LINES FOR ALL BACKUP SBC SIGNALING IPs *****

ip prefix-list EBGP-In seq 10 permit <SBC#– CV# Signaling IP>/29

ip prefix-list EBGP-In seq 15 permit <SBC#– CV# Signaling IP>/29

ip prefix-list EBGP-In seq 20 permit <SBC#– CV# Signaling IP>/29

ip prefix-list EBGP-In seq 25 permit <IP PBX and/or IP Phone network>/<Prefix Size>

ip prefix-list EBGP-In seq 30 permit <Data Network1>/<Prefix Size>

ip prefix-list EBGP-In seq 35 permit <Data Network2>/<Prefix Size>

ip prefix-list EBGP-In seq 40 permit <Data Network3>/<Prefix Size>

Customer must configure network and prefix size for all the data networks to be redistributed into AT&T VPN service.

****NOTE - Insert additional prefix-list entries for each network statement****

ip prefix-list EBGP-In seq 100 deny 0.0.0.0/0 le 32

!

```
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
access-list 3 permit any
```

Called by "filter-list 1 in" (under router bgp)

3.2.1.1 CER Configuration (BGP-R and EBGP) Template Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

Note that only configuration sections and additional commands are shown.

```
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 6 permit <Primary vmen>/<prefix>
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 6 permit <vmen associated with Backup SBCs with CV of 110>/<prefix-1>
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 6 permit <vmen associated with Backup SBCs with CV of 100>/<prefix-1>
!
ip prefix-list CV900 description – Backup SBCs with CV of 90
ip prefix-list CV90 seq 6 permit <vmen associated with Backup SBCs with CV of 90>/<prefix-1>
!
ip prefix-list CV80 description – Backup SBCs with CV of 80
ip prefix-list CV80 seq 6 permit <vmen associated with Backup SBCs with CV of 80>/<prefix-1>
!
ip prefix-list EBGP-In description - Valid LAN Routes To Be Sent To WAN
ip prefix-list EBGP-In seq 6 permit <Primary vmen>/<prefix>
ip prefix-list EBGP-In seq 7 permit <vmen associated with Backup SBCs with CV of #>/<prefix-1>
!
```

3.2.2 Example Configurations

The following information will be used to populate the sample configurations.

Summary of IP Flexible Reach Signaling IP addresses:

CER1 = NYC1

- Primary SBC = 135.16.200.2 (primary route)
- Backup SBC with CV value of 110 (SBC1-CV110)= 135.16.19.2 (secondary route)
- Backup SBC with CV value of 100 (SBC1-CV100)= 135.16.44.2 (tertiary route)

CER2 = NYC2

- Primary SBC = 135.16.19.2 (primary route)
- Backup SBC with CV value of 110 (SBC1-CV110) =135.16.200.2 (secondary route)
- Backup SBC with CV value of 110 (SBC2-CV110)= 135.16.44.2 (secondary route)

CER3 =JC1

- Primary SBC1=135.16.44.2 (primary route)
- Backup SBC with CV Value of 100 (SBC1-CV100) = 135.16.200.2 (tertiary route)
- Backup SBC3 with CV value of 100 (SBC2-CV100)=135.16.19.2 (tertiary route)

The following tables show the information that will need to be collected for BGP-R configurations:

CER Name	*NYC1*
Location Name	*Wall Street*
CER LAN information (facing SBC)	
Subinterface #	*Gi 0/1.1*
IP address & mask	*10.1.1.1 mask 255.255.255.252*
VLAN ID	*111*
OSPF/BGP Loopback IP address	*198.22.44.5*
IP PBX/IP Phone network & mask	*10.10.20.0 mask 255.255.255.0*
Primary SBC with CV Value = 120	
Signaling IP address	*135.16.200.2*
Associated IP BE addresses	*22.44.40.20, 22.44.30.20, 33.22.80.20, 33.22.90.20*
Backup SBC(s) with CV Value= 110	
Signaling IP address(es)	*135.16.19.2*
Associated IP BE addresses	*12.44.40.25, 12.44.30.25, 13.22.80.25, 13.22.90.25*
Backup SBC(s) with CV Value = 100	
Signaling IP address(es)	*135.16.44.2*
Associated IP BE addresses	*92.44.40.20, 92.44.30.20, 93.22.80.20, 93.22.90.20*
Backup SBC(s) with CV Value = 90	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 80	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Does customer want AT&T to advertise default route?	*Yes*

CER Name	*NYC2*
Location Name	*Wall Street*
CER LAN information (facing SBC)	
Subinterface #	*Gi 0/1.1*
IP address & mask	*10.2.1.1 mask 255.255.255.252*
VLAN ID	*121*
OSPF/BGP Loopback IP address	*197.77.44.10*
IP PBX/IP Phone network & mask	*10.10.20.0 mask 255.255.255.0*
Primary SBC with CV Value = 120	
Signaling IP address	*135.16.19.2*
Associated IP BE addresses	*12.44.40.25, 12.44.30.25, 13.22.80.25, 13.22.90.25*
Backup SBC(s) with CV Value = 110	
Signaling IP address(es)	*135.16.200.2, 135.16.44.2*
Associated IP BE addresses	*22.44.40.20, 22.44.30.20, 33.22.80.20, 33.22.90.20, 92.44.40.20, 92.44.30.20, 93.22.80.20, 93.22.90.20*
Backup SBC(s) with CV Value = 100	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 90	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 80	*N/A*
Signaling IP address(es)	
Associated IP BE addresses	
Does customer want AT&T to advertise default route?	*Yes*

CER Name	*JC1*
Location Name	*Jersey City*
CER LAN information (facing SBC)	
Subinterface #	*Gi 0/1.1*
IP address & mask	*10.3.1.1 mask 255.255.255.252*
VLAN ID	*131*
OSPF/BGP Loopback IP address	*192.45.44.21*
IP PBX/IP Phone network & mask	*10.50.50.0 mask 255.255.255.0*
Primary SBC with CV Value = 120	
Signaling IP address	*135.16.44.2*
Associated IP BE addresses	*92.44.40.20, 92.44.30.20, 93.22.80.20, 93.22.90.20*
Backup SBC(s) with CV Value = 110	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 100	
Signaling IP address(es)	*135.16.200.2, 135.16.19.2*
Associated IP BE addresses	*12.44.40.25, 12.44.30.25, 13.22.80.25, 13.22.90.25, 22.44.40.20, 22.44.30.20, 33.22.80.20, 33.22.90.20*
Backup SBC(s) with CV Value = 90	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 80	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Does customer want AT&T to advertise default route?	*Yes*

3.2.2.1 **NYC1**

Following is the BGP-R configuration for **NYC1.**

Note - The router commands shown in red are specific to the example.

```
ip cef
!
interface Loopback0
 description – Loopback for Management & BGP router-id -
 ip address 192.22.44.5 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 !
interface GigabitEthernet0/0.1
 description - Link to Layer 2/3 Device
 encapsulation dot1Q 111
 ip address 10.1.1.1 255.255.255.252
!
int GigabitEthernet0/1
 description VQM interface
 ip address 32.95.22.1 255.255.255.252
!
router bgp 65000
 bgp router-id 198.22.44.5
 timers bgp 3 9
 neighbor 196.96.1.18 remote-as 13979              **AT&T PER**
 neighbor 195.18.32.218  remote-as 65527           **EBGP neighbor**
 !
 address-family ipv4
  network 198.22.44.5 mask 255.255.255.255        **BGP Loopback**
  network 32.95.22.1  mask 255.255.255.252         **VQM Network**
  neighbor 196.96.1.18 activate
  neighbor 196.96.1.18 send-community both
  neighbor 196.96.1.18  advertisement-interval 3
```

```
 neighbor 196.96.1.18 soft-reconfiguration inbound
 neighbor 196.96.1.18 route-map AVPN_Routes_In in
 neighbor 196.96.1.18 route-map Customer_SBC_Networks out
 neighbor 196.96.1.18 filter-list 1 in
 neighbor 195.18.32.218  activate
 neighbor 195.18.32.218  send-community both
 neighbor 195.18.32.218  advertisement-interval 3
 neighbor 195.18.32.218  soft-reconfiguration inbound
 neighbor 195.18.32.218  route-map EBGP_In in
 neighbor 195.18.32.218  route-map EBGP_Out out
 neighbor 195.18.32.218  filter-list 1 in
 no auto-summary
 no synchronization
exit-address-family
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map EBGP_In permit 10
 match ip address prefix-list EBGP-In
!
route-map EBGP_Out permit 10
 match ip address prefix-list EBGP-Out-CV120
 set as-path prepend 64600
 set community 65527:120 additive
!
route-map EBGP_Out permit 20
 match ip address prefix-list EBGP-Out-CV110
 set as-path prepend 64600
 set community 65527:110 additive
!
route-map EBGP_Out permit 30
 match ip address prefix-list EBGP-Out-CV100
 set as-path prepend 64600
```

```
 set community 65527:100 additive
!
route-map EBGP_Out permit 40
 match ip address prefix-list EBGP-Out-CV90
 set as-path prepend 64600
 set community 65527:90 additive
!
route-map EBGP_Out permit 50
 match ip address prefix-list EBGP-Out-CV80
 set as-path prepend 64600
 set community 65527:80 additive
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_SBC_Networks permit 40
  match ip address prefix-list CV90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
```

```
 set community 13979:80 additive
!
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 5 permit 135.16.200.2/32          **Primary SBC**
ip prefix-list CV120 seq 10 permit 198.22.44.5/32          **BGP Loopback**
ip prefix list CV120 seq 15 permit 10.10.20.0/24           **IP PBX/IP Phone network**
ip prefix list CV120 seq 20 permit 32.95.22.0/30           **VQM Network**
ip prefix-list CV120 seq 25 permit 10.22.55.0/24           **Existing Data Network**
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 5 permit 135.16.19.2/29           **SBC1-CV110**
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 5 permit 135.16.44.2/29           **SBC1-CV100**
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description – Backup SBCs with CV of 90
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description – Backup SBCs with CV of 80
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV120 description – IP BE Routes sent to LAN with CV 120
ip prefix-list EBGP-Out-CV120 seq 5 permit 22.44.40.20/32
ip prefix-list EBGP-Out-CV120 seq 10 permit 22.44.30.20/32
ip prefix-list EBGP-Out-CV120 seq 15 permit 33.22.80.20/32
ip prefix-list EBGP-Out-CV120 seq 20 permit 33.22.90.20/32
ip prefix-list EBGP-Out-CV120 seq 95 permit 0.0.0.0/0
ip prefix-list EBGP-Out-CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV110 description – IP BE Routes sent to LAN with CV 110
ip prefix-list EBGP-Out-CV110 seq 5 permit 12.44.40.25/32
```

```
ip prefix-list EBGP-Out-CV110 seq 10 permit 12.44.30.25/32
ip prefix-list EBGP-Out-CV110 seq 15 permit 13.22.80.25/32
ip prefix-list EBGP-Out-CV110 seq 20 permit 13.22.90.25/32
ip prefix-list EBGP-Out-CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV100 description – IP BE Routes sent to LAN with CV 100
ip prefix-list EBGP-Out-CV100 seq 5 permit 92.44.40.20/32
ip prefix-list EBGP-Out-CV100 seq 10 permit 92.44.30.20/32
ip prefix-list EBGP-Out-CV100 seq 15 permit 93.22.80.20/32
ip prefix-list EBGP-Out-CV100 seq 20 permit 93.22.90.20/32
ip prefix-list EBGP-Out-CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV90 description – IP BE Routes sent to LAN with CV 90
ip prefix-list EBGP-Out-CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV80 description – IP BE Routes sent to LAN with CV 80
ip prefix-list EBGP-Out-CV80 seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list EBGP-In description - Valid LAN Routes To Be Sent To WAN
ip prefix-list EBGP-In seq 5 permit 135.16.200.2/32   **Primary SBC**
***ADD ADDITIONAL LINES FOR ALL BACKUP SBC SIGNALING IPs  **
ip prefix-list EBGP-In seq 10 permit 135.16.19.2/29   **SBC1-CV 110**
ip prefix-list EBGP-In seq 15 permit 135.16.44.2/29    **SBC1-CV 100 **
ip prefix-list EBGP-In seq 25 permit 10.10.20.0/24      **IP PBX/IP Phone network**
ip prefix-list EBGP-In seq 30 permit 10.22.55.0/24       **Existing Data Network**
ip prefix-list EBGP-In seq 100 deny 0.0.0.0/0 le 32
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
access-list 3 permit any
```

3.2.2.1.1 NYC1Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

Note that only configuration sections and additional commands are shown.

```
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 10 permit  10.50.50.0/23            ** JC1 phone network with prefix-1**
!
ip prefix-list EBGP-In description - Valid LAN Routes To Be Sent To WAN
ip prefix-list EBGP-In seq 40 permit  10.50.50.0/23           ** JC1 phone network with prefix-1**
```

3.2.2.2 NYC2

Following is the BGP-R configuration for **NYC2.**

Note: The router commands shown in red are specific to the example.

```
ip cef
!
interface Loopback0
 description – Loopback for Management & BGP router-id -
 ip address 197.77.44.10 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 !
interface GigabitEthernet0/0.1
 description - Link to Layer 2/3 Device
 encapsulation dot1Q 121
 ip address 10.2.1.1 255.255.255.252
!
int GigabitEthernet0/1
 description VQM Interface
 ip address 32.95.35.1 255.255.255.252
```

```
!
router bgp 65000
 bgp router-id 197.77.44.10
 timers bgp 3 9
 neighbor 197.97.1.18  remote-as 13979                  **AT&T PER**
 neighbor 195.18.32.222 remote-as 65527                 **EBGP Neighbor**
 !
 address-family ipv4
  network 197.77.44.10 mask 255.255.255.255             **BGP loopback**
  network 32.95.35.0 mask 255.255.255.252               **VQM network**
  neighbor 197.97.1.18 activate
  neighbor 197.97.1.18 send-community both
  neighbor 197.97.1.18  advertisement-interval 3
  neighbor 197.97.1.18  soft-reconfiguration inbound
  neighbor 197.97.1.18  route-map AVPN_Routes_In in
  neighbor 197.97.1.18  route-map Customer_SBC_Networks out
  neighbor 197.97.1.18  filter-list 1 in
  neighbor 195.18.32.222 activate
  neighbor 195.18.32.222 send-community both
  neighbor 195.18.32.222 advertisement-interval 3
  neighbor 195.18.32.222 soft-reconfiguration inbound
  neighbor 195.18.32.222 route-map EBGP_In in
  neighbor 195.18.32.222 route-map EBGP_Out out
  neighbor 195.18.32.222 filter-list 1 in
  no auto-summary
  no synchronization
 exit-address-family
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map EBGP_In permit 10
 match ip address prefix-list EBGP-In
!
```

```
route-map EBGP_Out permit 10
 match ip address prefix-list EBGP-Out-CV120
 set as-path prepend 64600
 set community 65527:120 additive
!
route-map EBGP_Out permit 20
 match ip address prefix-list EBGP-Out-CV110
 set as-path prepend 64600
 set community 65527:110 additive
!
route-map EBGP_Out permit 30
 match ip address prefix-list EBGP-Out-CV100
 set as-path prepend 64600
 set community 65527:100 additive
!
route-map EBGP_Out permit 40
 match ip address prefix-list EBGP-Out-CV90
 set as-path prepend 64600
 set community 65527:90 additive
!
route-map EBGP_Out permit 50
 match ip address prefix-list EBGP-Out-CV80
 set as-path prepend 64600
 set community 65527:80 additive
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
```

```
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_SBC_Networks permit 40
  match ip address prefix-list CV90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community 13979 80 additive
!
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 5 permit 135.16.19.2/32            **Primary SBC**
ip prefix-list CV120 seq 10 permit 197.77.44.10/32          **BGP Loopback**
ip prefix list CV120 seq 20 permit 32.95.35.0/30            **VQM Network**
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 5 permit 135.16.200.2/29           **SBC1-CV110**
ip prefix-list CV110 seq 10 permit 135.16.44.2/29           **SBC2-CV110**
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description – Backup SBCs with CV of 90
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description – Backup SBCs with CV of 80
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
```

```
!
ip prefix-list EBGP-Out-CV120 description – IP BE Routes sent to LAN with CV 120
ip prefix-list EBGP-Out-CV120 seq 5 permit 12.44.40.25/32
ip prefix-list EBGP-Out-CV120 seq 10 permit 12.44.30.25/32
ip prefix-list EBGP-Out-CV120 seq 15 permit 13.22.80.25/32
ip prefix-list EBGP-Out-CV120 seq 20 permit 13.22.90.25/32
ip prefix-list EBGP-Out-CV120 seq 95 permit 0.0.0.0/0
ip prefix-list EBGP-Out-CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV110 description – IP BE Routes sent to LAN with CV 110
ip prefix-list EBGP-Out-CV110 seq 5 permit 22.44.40.20/32
ip prefix-list EBGP-Out-CV110 seq 10 permit 22.44.30.20/32
ip prefix-list EBGP-Out-CV110 seq 15 permit 33.22.80.20/32
ip prefix-list EBGP-Out-CV110 seq 20 permit 33.22.90.20/32
ip prefix-list EBGP-Out-CV110 seq 25 permit 92.44.40.20/32
ip prefix-list EBGP-Out-CV110 seq 30 permit 92.44.30.20/32
ip prefix-list EBGP-Out-CV110 seq 35 permit 93.22.80.20/32
ip prefix-list EBGP-Out-CV110 seq 35 permit 93.22.90.20 /32
ip prefix-list EBGP-Out-CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV100 description – IP BE Routes sent to LAN with CV 100
ip prefix-list EBGP-Out-CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV90 description – IP BE Routes sent to LAN with CV 90
ip prefix-list EBGP-Out-CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV80 description – IP BE Routes sent to LAN with CV 80
ip prefix-list EBGP-Out-CV80 seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list EBGP-In description - Valid LAN Routes To Be Sent To WAN
ip prefix-list EBGP-In seq 5 permit 135.16.19.2/32        **Primary SBC**
ip prefix-list EBGP-In seq 10 permit 135.16.200.2/29      **SBC1-CV110**
ip prefix-list EBGP-In seq 15 permit <135.16.44.2/29      **SBC2-CV110**
ip prefix-list EBGP-In seq 100 deny 0.0.0.0/0 le 32
```

```
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
access-list 3 permit any
```

3.2.2.2.1 NYC2 Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

Note that only configuration sections and additional commands are shown.

```
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 15 permit  10.10.20.0/23          ** NYC1 phone network with prefix-1**
ip prefix-list CV110 seq 20 permit  10.50.50.0/23          ** JC1 phone network with prefix-1**
!
ip prefix-list EBGP-In description - Valid LAN Routes To Be Sent To WAN
ip prefix-list EBGP-In seq seq 20 permit  10.10.20.0/23    ** NYC1 phone network with prefix-1**
ip prefix-list EBGP-In seq seq 25 permit  10.50.50.0/23    ** JC1 phone network with prefix-1**
```

3.2.2.3 JC1

Following is the BGP-R configuration for **JC1.**

Note: The router commands shown in red are specific to the example.

```
ip cef
!
interface Loopback0
 description – Loopback for Management & BGP router-id -
 ip address 192.45.44.21 255.255.255.255
```

```
!
interface GigabitEthernet0/0
 no ip address
 !
interface GigabitEthernet0/0.1
 description - Link to Layer 2/3 Device
 encapsulation dot1Q 131
 ip address 10.3.1.1 255.255.255.252
!
Interface GigabitEthernet0/1
description VQM interface
ip address 32.95.63.1 255.255.255.252
!
router bgp 65000
 bgp router-id 192.45.44.21
 timers bgp 3 9
 neighbor 197.22.9.18 remote-as 13979                    **AT&T PER **
 neighbor 195.18.32.234 remote-as 65527                  **EBGP Neighbor**
 !
 address-family ipv4
  network 192.45.44.21 mask 255.255.255.255             **BGP Loopback**
  network 32.95.63.0 mask 255.255.255.252               **VQM Network**
  neighbor 197.22.9.18 activate
  neighbor 197.22.9.18 send-community both
  neighbor 197.22.9.18  advertisement-interval 3
  neighbor 197.22.9.18 soft-reconfiguration inbound
  neighbor 197.22.9.18 route-map AVPN_Routes_In in
  neighbor 197.22.9.18 route-map Customer_SBC_Networks out
  neighbor 197.22.9.18 filter-list 1 in
  neighbor 195.18.32.234 activate
  neighbor 195.18.32.234 send-community both
  neighbor 195.18.32.234  advertisement-interval 3
  neighbor 195.18.32.234 soft-reconfiguration inbound
  neighbor 195.18.32.234 route-map EBGP_In in
  neighbor 195.18.32.234 route-map EBGP_Out out
  neighbor 195.18.32.234 filter-list 1 in
  no auto-summary
```

```
 no synchronization
 exit-address-family
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map EBGP_In permit 10
 match ip address prefix-list EBGP-In
!
route-map EBGP_Out permit 10
 match ip address prefix-list EBGP-Out-CV120
 set as-path prepend 64600
 set community 65527:120 additive
!
route-map EBGP_Out permit 20
 match ip address prefix-list EBGP-Out-CV110
 set as-path prepend 64600
 set community 65527:110 additive
!
route-map EBGP_Out permit 30
 match ip address prefix-list EBGP-Out-CV100
 set as-path prepend 64600
 set community 65527:100 additive
!
route-map EBGP_Out permit 40
 match ip address prefix-list EBGP-Out-CV90
 set as-path prepend 64600
 set community 65527:90 additive
!
route-map EBGP_Out permit 50
 match ip address prefix-list EBGP-Out-CV80
 set as-path prepend 64600
 set community 65527:80 additive
!
```

```
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_SBC_Networks permit 40
  match ip address prefix-list CV90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community 13979:80 additive
!
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 5 permit 135.16.44.2/32          **Primary SBC**
ip prefix-list CV120 seq 10 permit 192.45.44.21/32        **BGP Loopback**
ip prefix list CV120 seq 15 permit 10.50.50.0/24          **IP PBX/IP phone network**
ip prefix list CV120 seq 20 permit 32.95.63/30            **VQM Network**
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Backup SBCs with CV of 110
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
```

```
!
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 5 permit 135.16.200.2/29                **SBC1-CV100**
ip prefix-list CV100 seq 10 permit 135.16.19.2/29                **SBC2-CV100**
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description – Backup SBCs with CV of 90
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description – Backup SBCs with CV of 80
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV120 description – IP BE Routes sent to LAN with CV 120
ip prefix-list EBGP-Out-CV120 seq 5 permit 92.44.40.20/32
ip prefix-list EBGP-Out-CV120 seq 10 permit 92.44.30.20/32
ip prefix-list EBGP-Out-CV120 seq 15 permit 93.22.80.20/32
ip prefix-list EBGP-Out-CV120 seq 20 permit 93.22.90.20/32
ip prefix-list EBGP-Out-CV120 seq 95 permit 0.0.0.0/0
ip prefix-list EBGP-Out-CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV110 description – IP BE Routes sent to LAN with CV 110
ip prefix-list EBGP-Out-CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV100 description – IP BE Routes sent to LAN with CV 100
ip prefix-list EBGP-Out-CV100 seq 5 permit 22.44.40.20/32
ip prefix-list EBGP-Out-CV100 seq 10 permit 22.44.30.20/32
ip prefix-list EBGP-Out-CV100 seq 15 permit 33.22.80.20/32
ip prefix-list EBGP-Out-CV100 seq 20 permit 33.22.90.20/32
ip prefix-list EBGP-Out-CV100 seq 25 permit 12.44.40.25/32
ip prefix-list EBGP-Out-CV100 seq 30 permit 12.44.30.25/32
ip prefix-list EBGP-Out-CV100 seq 35 permit 13.22.80.25/32
ip prefix-list EBGP-Out-CV100 seq 40 permit 13.22.90.25/32
ip prefix-list EBGP-Out-CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV90 description – IP BE Routes sent to LAN with CV 90
```

```
ip prefix-list EBGP-Out-CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV80 description – IP BE Routes sent to LAN with CV 80
ip prefix-list EBGP-Out-CV80 seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list EBGP-In description - Valid LAN Routes To Be Sent To WAN
ip prefix-list EBGP-In seq 5 permit 135.16.44.2/32                **Primary SBC**
ip prefix-list EBGP-In seq 10 permit 135.16.200.2/29              **SBC1-CV100**
ip prefix-list EBGP-In seq 15 permit 135.16.19.2/29               **SBC2-CV100**
ip prefix-list EBGP-In seq 25 permit 10.50.50.0/24                **IP PBX/IP phone network* *
ip prefix-list EBGP-In seq 100 deny 0.0.0.0/0 le 32
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
access-list 3 permit any
```

3.2.2.3.1 JC1 Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

Note that only configuration sections and additional commands are shown.

```
ip prefix-list CV100 description – Backup SBCs with CV of 100
ip prefix-list CV100 seq 15 permit  10.10.20.0/23          ** NYC1 phone network with prefix-1**
!
ip prefix-list EBGP-In description - Valid LAN Routes To Be Sent To WAN
ip prefix-list EBGP-In seq seq 30 permit  10.10.20.0/23    ** NYC1 phone network with prefix-1**
```

3.2.3 Configuration Example for Cascaded EBGP Device (for use with generic SBC)

This section will provide an example to assist with configuring the cascaded EBGP device for use with BGP-R.

In the following example, there will be two cascaded layer 2/3 Cisco switches for EBGP. Each switch is designed to have one physical interface facing the CER and one physical interface facing the SBC. Each switch will be an EBGP neighbor to one of the CERs. In addition, the switches will have a cross-over cable between them for IBGP.

CER facing Interface: The EBGP device will have an interface that faces one or more CERs. That interface will be configured as a main interface or sub-interface for each corresponding CER that it is connected to.

SBC facing interface: The EBGP device will have an interface that faces one or more SBCs. That interface will be configured as a main interface or sub-interface for each corresponding SBC that is it connected to. With this design it is assumed that the SBC LAN interface is provisioned with the IP Flexible Reach Signaling IP address. Each interface/sub-interface on the EBGP device will be on the same network as the SBC. It is recommended to use the IP Flexible Reach Signaling IP address minus one for the IP address of the EBGP device interface/sub-interface. For example, if the SBC's IP Flexible Signaling IP address is 135.16.206.58, then the corresponding EBGP device interface would be configured as 135.16.206.57.

Example for a two cascaded EBGP devices. The red highlighted entries are variables that are specific to the customer's environment.

EBGP Device 1

```
!
interface Loopback0
 ip address <IP address used for EBGP router ID> 255.255.255.255
!
vlan <VLAN ID # CER1 >
 name EBGP_to_CER1
!
vlan <VLAN ID #  SBC1>
 name Link_to_SBC1
!
vlan <VLAN ID #  SBC2>
```

```
 name Link_to_SBC2
!
vlan <VLAN ID #  IBGP Link>
 name IBGP_Link_to_EBGP_Device2
!
!
interface FastEthernet0/#
 description – EBGP to CER1
 switchport access vlan <VLAN ID # CER1>
 switchport mode access
 duplex full
!
interface FastEthernet0/#
 description - Link To SBC1
 switchport access vlan <VLAN ID # SBC1>
 switchport mode access
 duplex full
!
interface FastEthernet0/#
 description – Trunk to EBGP device #2
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan <VLAN ID # SBC1>,<VLAN ID# SBC2>, <VLAN ID #  IBGP Link>
 switchport mode trunk
!
interface Vlan<VLAN ID # CER1 >
 ip address <IP address> <subnet mask>
!
interface Vlan<VLAN ID # SBC1 >
 ip address <Available IP address from IP Flex Signaling network – SBC1> 255.255.255.248
!
interface Vlan<VLAN ID # SBC2 >
 ip address <Available IP address from IP Flex Signaling network – SBC2> 255.255.255.248
!
```

```
interface Vlan<VLAN ID # IBGP Link >
 ip address <IP address> <subnet mask>
!
router bgp <AS number>
 bgp router-id <EBGP router ID>
 bgp log-neighbor-changes
  neighbor <EBGP Neighbor IP address CER 1>  remote-as <AS number>
  neighbor <IBGP Neighbor IP address>  remote-as <AS number>
!
 address-family ipv4
  redistribute connected
  redistribute static metric 20 route-map BGP_Routes_Static
  neighbor <IBGP Neighbor IP address> activate
  neighbor <IBGP Neighbor IP address> next-hop-self
  neighbor <IBGP Neighbor IP address> route-map IBGP_Routes_In in
   neighbor <EBGP Neighbor IP address - CER1>  activate
  neighbor <EBGP Neighbor IP address - CER1>  send-community
  neighbor <EBGP Neighbor IP address – CER1>  route-map Incoming_WAN_Routes in
  neighbor <EBGP Neighbor IP address – CER1>   route-map LAN_To_WAN_Routes out
  no auto-summary
  no synchronization
 exit-address-family
!
ip route <SBC1 IP Flex Signaling IP> 255.255.255.255 Vlan <VLAN ID # for SBC1>
!
ip bgp-community new-format
ip community-list 10 permit 13979:120
ip community-list 20 permit 13979:110
ip community-list 30 permit 13979:90
ip community-list 40 permit 13979:80
!
!
ip prefix-list BGP-Routes-Static description - BGP Static Routes
```

```
ip prefix-list BGP-Routes-Static seq 5 permit <SBC1 IP Flex Signaling IP>/32
ip prefix-list BGP-Routes-Static seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list Incoming-WAN-Routes description - Incoming WAN Routes
ip prefix-list Incoming-WAN-Routes seq 5 permit <IPBE #1 Signaling – SBC1> /32
ip prefix-list Incoming-WAN-Routes seq 10 permit <IPBE #1 Media – SBC1> /32
ip prefix-list Incoming-WAN-Routes seq 15 permit <IPBE #2 Signaling – SBC1> /32
ip prefix-list Incoming-WAN-Routes seq 20 permit <IPBE #2 Media – SBC1> /32
ip prefix-list Incoming-WAN-Routes seq 95 permit 0.0.0.0/0
ip prefix-list Incoming-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IBGP-Routes-In description - IBGP In Routes
ip prefix-list IBGP-Routes-In seq 5 deny <SBC#2 IP Flex Signaling IP>/32
ip prefix-list IBGP-Routes-In seq 100 permit 0.0.0.0/0 le 32
!
ip prefix-list LAN-To-WAN-Routes description - Valid LAN Routes To Be Sent To WAN CER1
ip prefix-list LAN-To-WAN-Routes seq 5 permit <SBC#1 IP Flex Signaling IP >/32
ip prefix-list LAN-To-WAN-Routes seq 20 permit <SBC#2 IP Flex Signaling IP network>/29
ip prefix-list LAN-To-WAN-Routes seq 25 permit <IP PBX/IP Phone network>/<prefix size>
ip prefix-list LAN-To-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
!
route-map BGP_Routes_Static permit 10
 match ip address prefix-list BGP-Routes-Static
!
route-map Incoming_WAN_Routes permit 10
 match ip address prefix-list Incoming-WAN-Routes
 match community 10
 set local-preference 120
!
route-map Incoming_WAN_Routes permit 20
 match ip address prefix-list Incoming-WAN-Routes
 match community 20
```

```
 set local-preference 110
!
route-map Incoming_WAN_Routes permit 30
 match ip address prefix-list Incoming-WAN-Routes
 match community 30
 set local-preference 90
!
route-map Incoming_WAN_Routes permit 40
 match ip address prefix-list Incoming-WAN-Routes
 match community 40
 set local-preference 80
!
route-map Incoming_WAN_Routes permit 50
 match ip address prefix-list Incoming-WAN-Routes
 set local-preference 100
!
route-map LAN_To_WAN_Routes permit 10
 match ip address prefix-list LAN-To-WAN-Routes
!
!
```

EBGP Device 2

```
!
interface Loopback0
 ip address <IP address used for EBGP router ID> 255.255.255.255
!
vlan <VLAN ID # CER2 >
 name EBGP_to_CER2
!
vlan <VLAN ID #  SBC1>
 name Link_to_SBC1
!
vlan <VLAN ID #  SBC2>
```

```
 name Link_to_SBC2
!
vlan <VLAN ID #  IBGP Link>
 name IBGP_Link_to_EBGP_Device2
!
interface FastEthernet0/#
 description – EBGP to CER2
 switchport access vlan <VLAN ID # CER2>
 switchport mode access
 duplex full
!
interface FastEthernet0/#
 description - Link To SBC2
 switchport access vlan <VLAN ID # SBC2>
 switchport mode access
 duplex full
!
interface FastEthernet0/#
 description – Trunk to EBGP device #1
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan <VLAN ID # SBC1>,<VLAN ID# SBC2>, <VLAN ID #  IBGP Link>
 switchport mode trunk
!
interface Vlan<VLAN ID # CER2 >
 ip address <IP address> <subnet mask>
!
interface Vlan<VLAN ID # SBC1 >
 ip address <Available IP address from IP Flex Signaling network – SBC1> 255.255.255.248
!
interface Vlan<VLAN ID # SBC2 >
 ip address <Available IP address from IP Flex Signaling network – SBC2> 255.255.255.248
!
interface Vlan<VLAN ID # IBGP Link >
```

```
 ip address <IP address> <subnet mask>
!
router bgp <AS number>
 bgp router-id <EBGP router ID>
 bgp log-neighbor-changes
  neighbor <EBGP Neighbor IP address CER 2>  remote-as <AS number>
  neighbor <IBGP Neighbor IP address>  remote-as <AS number>
!
 address-family ipv4
  redistribute connected
  redistribute static metric 20 route-map BGP_Routes_Static
  neighbor <IBGP Neighbor IP address> activate
  neighbor <IBGP Neighbor IP address> next-hop-self
  neighbor <IBGP Neighbor IP address> route-map IBGP_Routes_In in
   neighbor <EBGP Neighbor IP address – CER2>  activate
  neighbor <EBGP Neighbor IP address – CER2>  send-community
  neighbor <EBGP Neighbor IP address – CER2>  route-map Incoming_WAN_Routes in
  neighbor <EBGP Neighbor IP address – CER2>   route-map LAN_To_WAN_Routes out
  no auto-summary
  no synchronization
 exit-address-family
!
ip route <SBC2 IP Flex Signaling IP> 255.255.255.255 Vlan<VLAN ID # for SBC2>
!
ip bgp-community new-format
ip community-list 10 permit 13979:120
ip community-list 20 permit 13979:110
ip community-list 30 permit 13979:90
ip community-list 40 permit 13979:80
!
!
ip prefix-list BGP-Routes-Static description - BGP Static Routes
ip prefix-list BGP-Routes-Static seq 5 permit <SBC2 IP Flex Signaling IP>/32
```

```
ip prefix-list BGP-Routes-Static seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list Incoming-WAN-Routes description - Incoming WAN Routes
ip prefix-list Incoming-WAN-Routes seq 5 permit <IPBE #1 Signaling – SBC2> /32
ip prefix-list Incoming-WAN-Routes seq 10 permit <IPBE #1 Media – SBC2> /32
ip prefix-list Incoming-WAN-Routes seq 15 permit <IPBE #2 Signaling – SBC2> /32
ip prefix-list Incoming-WAN-Routes seq 20 permit <IPBE #2 Media – SBC2> /32
ip prefix-list Incoming-WAN-Routes seq 95 permit 0.0.0.0/0
ip prefix-list Incoming-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IBGP-Routes-In description - IBGP In Routes
ip prefix-list IBGP-Routes-In seq 5 deny <SBC#1 IP Flex Signaling IP>/32
ip prefix-list IBGP-Routes-In seq 100 permit 0.0.0.0/0 le 32
!
ip prefix-list LAN-To-WAN-Routes description - Valid LAN Routes To Be Sent To WAN CER1
ip prefix-list LAN-To-WAN-Routes seq 5 permit <SBC #2 IP Flex Signaling IP >/32
ip prefix-list LAN-To-WAN-Routes seq 20 permit <SBC #1 IP Flex Signaling IP network>/29
ip prefix-list LAN-To-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
!
route-map BGP_Routes_Static permit 10
 match ip address prefix-list BGP-Routes-Static
!
route-map Incoming_WAN_Routes permit 10
 match ip address prefix-list Incoming-WAN-Routes
 match community 10
 set local-preference 120
!
route-map Incoming_WAN_Routes permit 20
 match ip address prefix-list Incoming-WAN-Routes
 match community 20
 set local-preference 110
!
```

```
route-map Incoming_WAN_Routes permit 30
 match ip address prefix-list Incoming-WAN-Routes
 match community 30
 set local-preference 90
!
route-map Incoming_WAN_Routes permit 40
 match ip address prefix-list Incoming-WAN-Routes
 match community 40
 set local-preference 80
!
route-map Incoming_WAN_Routes permit 50
 match ip address prefix-list Incoming-WAN-Routes
 set local-preference 100
!
route-map LAN_To_WAN_Routes permit 10
 match ip address prefix-list LAN-To-WAN-Routes
!
!
```

3.2.3.1 Configuration Example for Cascaded EBGP Device (for use with generic SBC) Changes to Support MFA

The caution in section 1.2 must be followed.

All voice media endpoint networks (vmen) that are announced from this site must be provided via EBGP to the CER with the correct prefix (network mask). This includes both local networks that use the CER as a primary path as well as networks that may use the CER as an alternate path. Keep in mind the caution noted in section 1.2 concering the use of shorter network prefix for redundant network advertisements.

3.2.4 Cascaded CUBE Template

The following template is provided to assist with adding the additional EBGP commands to a cascaded CUBE.

The following table provides default values for many of the router configurations fields. The fields correspond to the LAN sub-interface on the CUBE (which matches up to the appropriate CER link).

The red highlighted entries are variables.

```
ip cef
ip cef accounting load-balance-hash
ip cef load-sharing algorithm include-ports source
!
interface Loopback0
 description – Existing Loopback for used for SIP Signaling and Media -
 ip address <IP Address> 255.255.255.255
!
interface Loopback1
 description – Loopback for OSPF router-id -
 ip address <IP address> 255.255.255.255
!
interface GigabitEthernet <main interface number>
 description - Link to Customer Switch -
 no ip address
 load-interval 30
 no keepalive
!
interface GigabitEthernet <sub-interface number #1 >
 description - BGP-R OSPF Link to WAN Router #1
 encapsulation dot1Q <VLAN ID>
 ip address <IP Address> <255.255.255.252>
```

Required for outbound load balancing (CER to PER)

Private IP address used for the OSPF router-id.

```
!
!
interface GigabitEthernet <sub-interface number #2>
 description - BGP-R OSPF Link to WAN Router #2
 encapsulation dot1Q <VLAN ID>
 ip address <IP Address> <255.255.255.252>
!
!
router ospf 100
 router-id <IP address>
 log-adjacency-changes
 redistribute static metric 20 metric-type 1 subnets
 network <IP Address for SIP Signaling > 0.0.0.0 area 0
 network <IP Address of sub-interface #1> 0.0.0.0 area 0
 network <IP Address of sub-interface #2> 0.0.0.0 area 0
!
ip forward-protocol nd
!
ip address <SBC Signaling IP Address> 255.255.255.248 Null0
```

SBC Address configured as a /29 – to be advertised out the Backup CE Router.

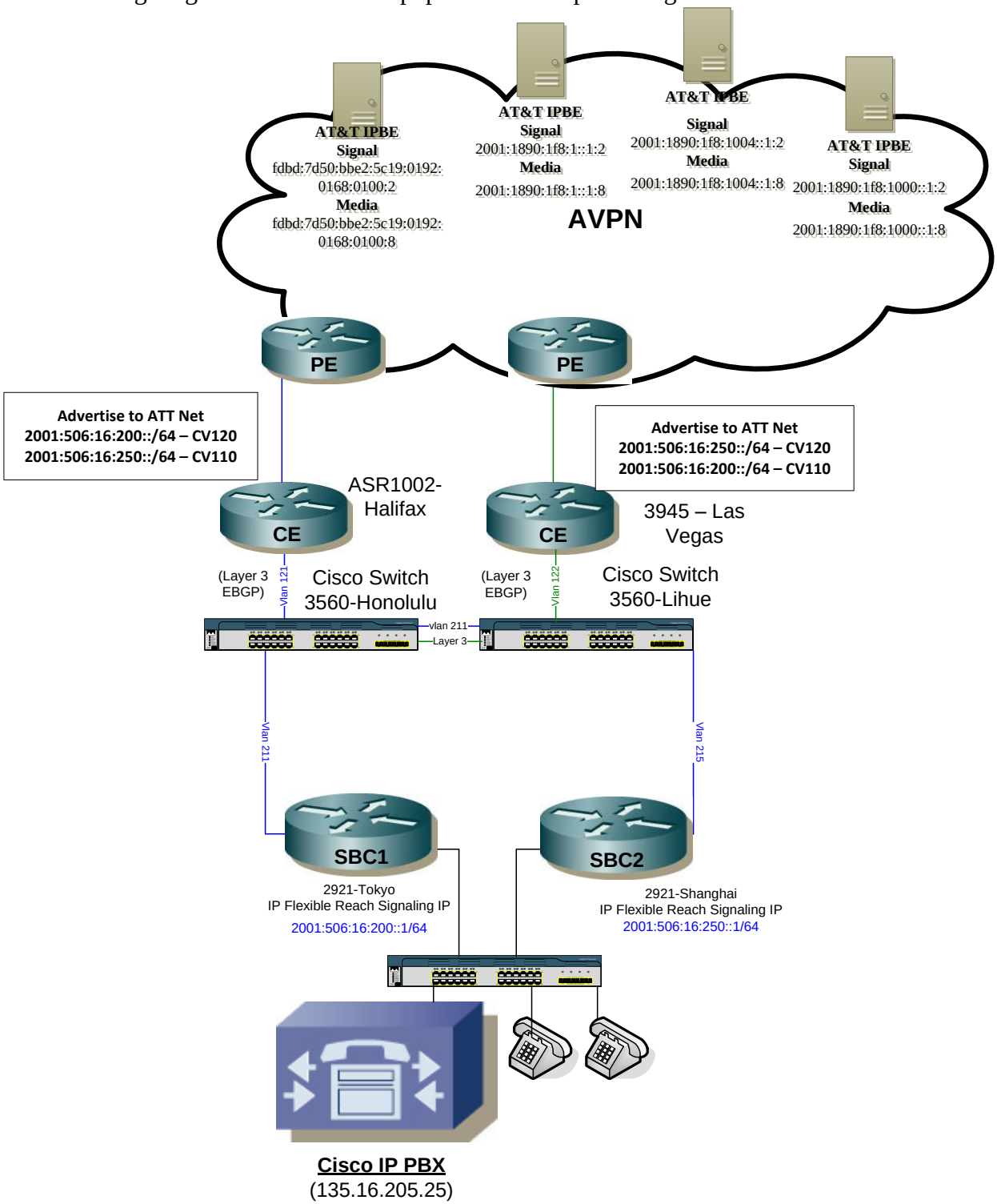
3.2.4.1 Cascaded CUBE Template Changes to Support MFA

The caution in section 1.2 must be followed.

All voice media endpoint networks (vmen) that are announced from this site must be provided via EBGP to the CER with the correct prefix (network mask). This includes both local networks that use the CER as a primary path as well as networks that may use the CER as an alternate path. Keep in mind the caution noted in section 1.2 concering the use of shorter network prefix for redundant network advertisements.

3.2.1 IPV6 Example Configurations

The following diagram will be used to populate the sample configurations.



ASR 1002 Halifax

```
ip cef
ipv6 cef
!
!
!
interface Loopback0
 description – BGP Router ID
 ip address 192.168.0.178 255.255.255.255
 ipv6 address 2001:506:16:100::178/128
!
!
!
interface GigabitEthernet0/0/2
 description - Trunk To LAN 3560-Honolulu - Port gig0/1
 no ip address
 load-interval 30
 negotiation auto
!
interface GigabitEthernet0/0/2.131
 description BGP-R OSPF Link to 3560-Honolulu
 encapsulation dot1Q 131
 ipv6 address 2002::131:101/126
 ipv6 enable
!
!
interface Serial1/0/0
 description – WAN Link
 bandwidth 41992
 ip address 195.18.32.9 255.255.255.252
 encapsulation ppp
 ipv6 address 2001:506:15:102::1/64
 dsu bandwidth 44210
 scramble
 framing c-bit
 cablelength 10
 hold-queue 32768 out
!
!
router bgp 65000
 bgp router-id 192.168.0.178
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 2001:506:15:102::2 remote-as 13979
 neighbor 2002::131:102 remote-as 65527
 neighbor 195.18.32.10 remote-as 13979
 !
 address-family ipv4
  network 172.50.128.0 mask 255.255.128.0
  network 192.168.0.178 mask 255.255.255.255
  network 195.18.32.8 mask 255.255.255.252
  neighbor 195.18.32.10 activate
  neighbor 195.18.32.10 allowas-in
 exit-address-family
 !
 address-family ipv6
  network 2001:506:15:102::/64
  network 2001:506:16:100::178/128
  network 2001:506:16:178::/64
```

```
  network 2002::131:100/126
  neighbor 2001:506:15:102::2 activate
  neighbor 2001:506:15:102::2 send-community both
  neighbor 2001:506:15:102::2 advertisement-interval 1
  neighbor 2001:506:15:102::2 allowas-in
  neighbor 2001:506:15:102::2 soft-reconfiguration inbound
  neighbor 2001:506:15:102::2 route-map AVPN_Routes_In in
  neighbor 2001:506:15:102::2 route-map Customer_Networks out
  neighbor 2001:506:15:102::2 filter-list 1 in
  neighbor 2002::131:102 activate
  neighbor 2002::131:102 send-community both
  neighbor 2002::131:102 soft-reconfiguration inbound
  neighbor 2002::131:102 route-map LAN_To_WAN_Routes in
  neighbor 2002::131:102 route-map WAN_To_LAN_Routes out
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
!
!
ipv6 prefix-list ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list ALLOW-ANY seq 100 permit ::/0 le 128
!
!
!
ipv6 prefix-list LAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list LAN-CV-Value-120 seq 5 permit fdbc:7d50:bbe2:5c19::/64
ipv6 prefix-list LAN-CV-Value-120 seq 10 permit 2001:1890:01F8:1000::/64
ipv6 prefix-list LAN-CV-Value-120 seq 15 permit ::/0
ipv6 prefix-list LAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list LAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list LAN-CV-Value-110 seq 5 permit 2001:1890:1f8:1004::/64
ipv6 prefix-list LAN-CV-Value-110 seq 10 permit 2001:1890:1f8:1000::/64
ipv6 prefix-list LAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list LAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list LAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list LAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list LAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list LAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list LAN-CV-Value-80 seq 100 deny ::/0 le 128
!
!
ipv6 prefix-list LAN-TO-WAN-Routes description - LAN Routes Allowed Into WAN
ipv6 prefix-list LAN-TO-WAN-Routes seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list LAN-TO-WAN-Routes seq 5 permit 2001:506:16:250::/64
ipv6 prefix-list LAN-TO-WAN-Routes seq 10 permit 2001:506:16:100::150/128
ipv6 prefix-list LAN-TO-WAN-Routes seq 100 deny ::/0 le 128
!
!
ipv6 prefix-list WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list WAN-CV-Value-120 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list WAN-CV-Value-120 seq 10 permit 2001:506:16:100::178/128
ipv6 prefix-list WAN-CV-Value-120 seq 15 permit 2001:506:16:178::/64
```

```
ipv6 prefix-list WAN-CV-Value-120 seq 20 permit 2002::131:100/126
ipv6 prefix-list WAN-CV-Value-120 seq 25 permit 2001:506:16:100::150/128
ipv6 prefix-list WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list WAN-CV-Value-110 seq 5 permit 2001:506:16:250::/64
ipv6 prefix-list WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list WAN-CV-Value-80 seq 100 deny ::/0 le 128
!
route-map AVPN_Routes_In permit 10
 match ipv6 address prefix-list ALLOW-ANY
 set weight 64000
!
route-map WAN_To_LAN_Routes permit 10
 match ipv6 address prefix-list LAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map WAN_To_LAN_Routes permit 20
 match ipv6 address prefix-list LAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map WAN_To_LAN_Routes permit 30
 match ipv6 address prefix-list LAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map WAN_To_LAN_Routes permit 40
 match ipv6 address prefix-list LAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map WAN_To_LAN_Routes permit 50
 match ipv6 address prefix-list LAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map LAN_To_WAN_Routes permit 10
 match ipv6 address prefix-list LAN-TO-WAN-Routes
!
route-map Customer_Networks permit 10
 match ipv6 address prefix-list WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_Networks permit 20
 match ipv6 address prefix-list WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_Networks permit 30
 match ipv6 address prefix-list WAN-CV-Value-100
```

```
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_Networks permit 40
 match ipv6 address prefix-list WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_Networks permit 50
 match ipv6 address prefix-list WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
```

3945 Las Vegas

```
ip cef
ipv6 cef
!
!
!
interface Loopback0
 description – BGP Loopback
 ip address 192.168.0.11 255.255.255.255
 ipv6 address 2001:506:16:100::11/128
!
!
interface GigabitEthernet0/0
 description - WAN Link
 no ip address
 load-interval 30
 duplex full
 speed 1000
 hold-queue 512 in
!
interface GigabitEthernet0/0.2815
 encapsulation dot1Q 2815
 ip address 192.168.130.49 255.255.255.252
 ip virtual-reassembly in
 ipv6 address 2001:506:15:34::2/64
 bfd interval 999 min_rx 999 multiplier 3
 no bfd echo
!
!
interface GigabitEthernet0/2
 description LAN interface
 no ip address
 load-interval 30
 duplex full
 speed 100
 media-type rj45
!
interface GigabitEthernet0/2.132
 description BGP-R OSPF Link to 3560-Lihue
 encapsulation dot1Q 132
 ipv6 address 2002::132:101/126
 ipv6 enable
!
!
router bgp 65000
 bgp router-id 192.168.0.11
 bgp log-neighbor-changes
```

```
 timers bgp 3 9
 neighbor 2001:506:15:34::1 remote-as 13979
 neighbor 2001:506:15:34::1 fall-over bfd
 neighbor 2002::132:102 remote-as 65527
 neighbor 192.168.130.50 remote-as 13979
 !
 address-family ipv4
  network 172.23.64.0 mask 255.255.192.0
  network 192.168.0.11 mask 255.255.255.255
  network 192.168.130.48 mask 255.255.255.252
  no neighbor 2001:506:15:34::1 activate
  no neighbor 2002::132:102 activate
  neighbor 192.168.130.50 activate
  neighbor 192.168.130.50 allowas-in
 exit-address-family
 !
 address-family ipv6
  network 2001:506:15:34::/64
  network 2001:506:16:11::/64
  network 2001:506:16:100::11/128
  network 2002::132:100/126
  neighbor 2001:506:15:34::1 activate
  neighbor 2001:506:15:34::1 send-community both
  neighbor 2001:506:15:34::1 allowas-in
  neighbor 2001:506:15:34::1 soft-reconfiguration inbound
  neighbor 2001:506:15:34::1 route-map AVPN_Routes_In in
  neighbor 2001:506:15:34::1 route-map Customer_Networks out
  neighbor 2001:506:15:34::1 filter-list 1 in
  neighbor 2002::132:102 activate
  neighbor 2002::132:102 send-community both
  neighbor 2002::132:102 soft-reconfiguration inbound
  neighbor 2002::132:102 route-map LAN_To_WAN_Routes in
  neighbor 2002::132:102 route-map WAN_To_LAN_Routes out
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
ipv6 prefix-list ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list ALLOW-ANY seq 100 permit ::/0 le 128
!
!
!
ipv6 prefix-list LAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list LAN-CV-Value-120 seq 5 permit 2001:1890:1f8:1004::/64
ipv6 prefix-list LAN-CV-Value-120 seq 10 permit 2001:1890:1f8:1000::/64
ipv6 prefix-list LAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list LAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list LAN-CV-Value-110 seq 5 permit fdbc:7d50:bbe2:5c19::/64
ipv6 prefix-list LAN-CV-Value-110 seq 10 permit 2001:1890:01F8:1000::/64
ipv6 prefix-list LAN-CV-Value-110 seq 15 permit ::/0
ipv6 prefix-list LAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list LAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list LAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list LAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list LAN-CV-Value-90 seq 100 deny ::/0 le 128
```

```
!
ipv6 prefix-list LAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list LAN-CV-Value-80 seq 100 deny ::/0 le 128
!
ipv6 prefix-list LAN-TO-WAN description - LAN Routes Allowed Into WAN
ipv6 prefix-list LAN-TO-WAN seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list LAN-TO-WAN seq 10 permit 2001:506:16:250::/64
ipv6 prefix-list LAN-TO-WAN seq 15 permit 2001:506:16:100::151/128
ipv6 prefix-list LAN-TO-WAN seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list WAN-CV-Value-110 seq 5 permit 2001:506:16:250::/64
ipv6 prefix-list WAN-CV-Value-120 seq 10 permit 2001:506:16:100::11/128
ipv6 prefix-list WAN-CV-Value-120 seq 15 permit 2001:506:16:11::/64
ipv6 prefix-list WAN-CV-Value-120 seq 20 permit 2002::132:100/126
ipv6 prefix-list WAN-CV-Value-120 seq 25 permit 2001:506:16:100::151/128
ipv6 prefix-list WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list WAN-CV-Value-110 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list WAN-CV-Value-80 seq 100 deny ::/0 le 128
!
route-map AVPN_Routes_In permit 10
 match ipv6 address prefix-list ALLOW-ANY
 set weight 64000
!
route-map WAN_To_LAN_Routes permit 10
 match ipv6 address prefix-list LAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map WAN_To_LAN_Routes permit 20
 match ipv6 address prefix-list LAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map WAN_To_LAN_Routes permit 30
 match ipv6 address prefix-list LAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map WAN_To_LAN_Routes permit 40
 match ipv6 address prefix-list LAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map WAN_To_LAN_Routes permit 50
 match ipv6 address prefix-list LAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map LAN_To_WAN_Routes permit 10
```

```
 match ipv6 address prefix-list LAN-TO-WAN-Routes
!
route-map Customer_Networks permit 10
 match ipv6 address prefix-list WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_Networks permit 20
 match ipv6 address prefix-list WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_Networks permit 30
 match ipv6 address prefix-list WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_Networks permit 40
 match ipv6 address prefix-list WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_Networks permit 50
 match ipv6 address prefix-list WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
```

3.2.1.1 IPV6 MFA Support

MFA is not supported with IPv6 at this time.

3.3 *Router Configurations with HSRP*

This section provides templates and examples to configure the CERs to work with Call Preservation with HSRP on the LAN.

3.3.1 Configuration Templates for Call Preservation with HSRP on LAN

The configurations provided in this section are in addition to the base CER configuration (see section 1.3 for links to the CER CCGs).

Refer to section 1.3.2 for a diagram of CERs with Call Preservation using HSRP.

The table below is provided to assist with gathering information for the template variables.

CER entry	Where is information obtained?
Interface Configuration	
Loopback interface IP address	Private IP address determined by the customer. Used for BGP/OSPF router-id.
LAN sub-interface numbers	Determined by the customer
VLAN IDs	Determined by the customer.
LAN interface IP addresses (link to layer 2 switch)	For an SBC with IP Flexible Reach public IP address configured on the SBC LAN interface, the LAN interface IP address is another public IP address from that network. Note: A /29 is provided by AT&T for the IP Flexible Reach signaling/media network. Note: The third useable address in the /29 should not be used as it can conflict with the BGP advertisement of the /29 IP Flexible Reach Signaling IP address.
HSRP IP Address	For a SBC with IP Flexible Reach public IP address configured on the SBC LAN interface, the LAN interface IP address is another public IP address from that network. Note: A /29 is provided by AT&T for the IP Flexible Reach signaling/media network. Note: The third useable address in the /29 should not be used as it can conflict with the BGP advertisement of the /29 IP Flexible Reach Signaling IP address.
HSRP Tracking Interface	This should be the WAN interface. Use WAN sub-interface if available.
Routing Configuration	
BGP AS Number	Number provided by customer with initial

	order for AT&T VPN service.
Loopback IP address for BGP router-id	This is the Loopback interface IP address. Determined by customer.
AT&T PER IP address	Provided by customer with initial order for AT&T VPN service.
Remote AS number	Provided by AT&T.
SBC IP Flexible Reach Signaling IP address	Public AT&T IP Flexible Reach Signaling IP address for the SBC.
IP address of LAN interface for each SBC's VLAN	IP address required for each LAN interface that is on the same network as the CER.
IP Address of IP Border Elements	IP address of one of the AT&T IP Border Elements (customers are provided with at least two addresses). This is a public IP address that is provided by AT&T. Note: AT&T IP Border Element may have separate Signaling and Media IP addresses.

3.3.2 CER Configuration (BGP-R and HSRP) Template

Assumptions:

- The solution supports only two CERs connected by via an IBGP link. One router will be CER1 and the other router will be CER2.
- The SBC's LAN interface will be configured with the AT&T IP Flexible Reach Signaling IP address.

HSRP Template:

```
ip cef
!
track 1 interface <WAN Interface with IP address> line-protocol
!
interface Loopback0
 description – Loopback for Management & BGP router-id -
ip address <IP address> 255.255.255.255
!
interface GigabitEthernet <interface number>
 no ip address
 !
interface GigabitEthernet <sub- interface number for Primary SBC>
 description - Link to Customer's Layer 2/3 Device
```

IP Address used for BGP router-id. Each CER participating in BGP-R will get a unique IP address.

encapsulation dot1Q <VLAN ID>
ip address <IP Address> <subnet mask>
standby 1 ip <HSRP IP Address>
standby 1 timers 1 3
standby 1 priority 120
standby 1 preempt delay minimum 60
standby 1 track 1 decrement 50
!
interface GigabitEthernet <sub- interface number for Secondary SBC>
description - Link to Layer 2/3 Device
encapsulation dot1Q <VLAN ID>
ip address <IP Address> <subnet mask>
standby 1 ip <HSRP IP Address>
standby 1 timers 1 3
standby 1 priority 90
standby 1 preempt
standby 1 track 1 decrement 50
!

Subinterface IP address and HSRP IP address provided by customer. Subnet mask should be /29.

Subinterface IP address and HSRP IP address provided by customer. Subnet mask should be /29.

****OPTION 1 for BGP Healing Link (RECOMMENDED OPTION) : Use this option if both CERs in HSRP group each have spare Gigabit Ethernet port. These ports will be used to directly connect the CERs. ****

interface GigabitEthernet<interface number>
description - BGP Healing Link for HSRP
ip address 1.1.1.<1 or 2> 255.255.255.252
!

Suggestion:
CER1 can use IP address of 1.1.1.1.
CER2 can use IP address of 1.1.1.2.

****OPTION 2 for BGP Healing Link: Use this option if the CERs in the HSRP group do NOT each have a spare Gigabit Ethernet port. In this case, the only option is to create another subinterface off the LAN port already connected to the customer's Layer 2/3 device****

interface GigabitEthernet0/0/1.500
description - BGP Healing Link for HSRP
encapsulation dot1Q 500
ip address 1.1.1.<1 or 2> 255.255.255.252
!
!
int <ethernet interface connecting to the Voice Quality Monitor>
ip address <LAN IP address determined by VQM model> <mask>

Check to make sure VLAN ID of 500 is not in already in use.

Suggestion:
CER1 can use IP address of 1.1.1.1.
CER2 can use IP address of 1.1.1.2

```
!
router bgp <AS number>
 bgp router-id <Loopback 0 IP address for BGP router-id>
 timers bgp 3 9
 neighbor <AT&T PER IP Address> remote-as <remote AS number>
 neighbor 1.1.1.<1 or 2> remote-as 6500
 !
 address-family ipv4
  network <Primary SBC IP address> mask 255.255.255.255
  network <Secondary SBC IP address> mask 255.255.255.248
  network <Loopback 0 IP Address for BGP/management ID> mask 255.255.255.255
  network <IP PBX and/or IP Phone network> mask <subnet mask>
  network <VQM network > mask <subnet mask>
  network <IP Address of Network1> mask <subnet mask>
  network <IP Address of Network2> mask <subnet mask>
  network <IP Address of Network3> mask <subnet mask>
  ***** NOTE - There can be multiple network statements*****
  neighbor <AT&T PER IP Address> activate
  neighbor <AT&T PER IP Address> send-community both
  neighbor <AT&T PER IP Address> soft-reconfiguration inbound
  neighbor <AT&T PER IP Address> route-map AVPN_Routes_In in
  neighbor <AT&T PER IP Address> route-map Customer_SBC_Networks out
  neighbor <AT&T PER IP Address> filter-list 1 in
  neighbor <IBGP Neighbor IP Address> activate
  neighbor <IBGP Neighbor IP Address> route-map IBGP_In in
  neighbor <IBGP Neighbor IP Address> next-hop-self
  no auto-summary
  no synchronization
 exit-address-family
!
ip route <Primary SBC IP address> 255.255.255.255 GigabitEthernet<subinterface for Primary SBC>
!
!
route-map AVPN_Routes_In permit 10
 match ip address 3
```

IBGP neighbor:
CER1 can use a neighbor IP address of 1.1.1.2.
CER2 can use a neighbor IP address of 1.1.1.1.

"Network" statements for additional local hosts or networks that need to be redistributed with BGP. Network statements needed for VQM if present, are provided by AT&T. NOTE: There may already be existing network statements in the BGP configuration. All networks statements will now need to be added into the "ip prefix-list CV120" portion of the configuration (see farther down in template).

IBGP neighbor:
CER1 can use a neighbor IP address of 1.1.1.2.
CER2 can use a neighbor IP address of 1.1.1.1.

```
 set weight 64000
!
route-map IBGP_In permit 10
 match ip address prefix-list IBGP-In
!
!
route-map Customer_SBC_Networks permit 10   **Route-map for Primary SBC**
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community <PER AS number>:120 additive
!
route-map Customer_SBC_Networks permit 20      ** Route-map for Secondary SBC**
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community <PER AS number>:110 additive
!
!
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 5 permit <Primary SBC Signaling IP Address>/32
ip prefix list CV120 seq 18 permit <IP PBX and/or IP Phone network>/<Prefix Size>
ip prefix list CV120 seq 19 permit <VQM Network>/<Prefix Size>
ip prefix-list CV120 seq 20 permit <Network1>/<Prefix Size>
ip prefix-list CV120 seq 21 permit <Network2>/<Prefix Size>
ip prefix-list CV120 seq 22 permit <Network3>/<Prefix Size>
***NOTE - Insert additional prefix-list entries for each network statement***
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Secondary SBC with CV of 110
ip prefix-list CV110 seq 5 permit <Secondary SBC Signaling IP Address>/29
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IBGP-In description - IBGP Routes Allowed In
ip prefix-list IBGP-In seq 5 deny <Primary SBC IP address>/32
ip prefix-list IBGP-In seq 10 deny <Secondary SBC IP address>/29
```

Insert one prefix list entry for each network statement that appears in the BGP section of the configuration. Start seq # at 20 and increase each "seq #" by 1.

```
ip prefix-list IBGP-In seq 100 permit 0.0.0.0/0 le 32
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
access-list 3 permit any
```

Called by "filter-list 1 in" (under router bgp)

3.3.2.1 CER Configuration (BGP-R and HSRP) Template Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

Note that only configuration sections and additional commands are shown.

```
router bgp <AS number>
 address-family ipv4
  network <Primary vmen> mask <prefix>
  network <Backup vmen> mask <prefix -1>
!
ip route <Primary vmen> <prefix> <interface for next hop, not required if local>
ip route <Secondary vmen> <prefix-1> <interface for next hop or null0 if local>
!
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 23 permit <Primary vmen>/<prefix>
!
ip prefix-list CV110 description – Secondary SBC with CV of 110
ip prefix-list CV110 seq 10 permit <Backup vmen>/<prefix - 1>
!
ip prefix-list IBGP-In description - IBGP Routes Allowed In
ip prefix-list IBGP-In seq 15 deny <Primary vmen>/<prefix>
```

```
ip prefix-list IBGP-In seq 20 permit <Backup vmen>/<prefix - 1>
!
```

3.3.3 Example Configurations

Summary of IP Flexible Reach Signaling IP addresses:

CER1 = NYC1

- Primary SBC = 135.16.206.58 (primary route)
- Backup SBC with CV value of 110 (SBC1-CV110)= 135.16.206.66 (secondary route)

CER2 = NYC2

- Primary SBC = 135.16.206.66 (primary route)
- Backup SBC with CV value of 110 (SBC1-CV110) =135.16.206.58 (secondary route)

The following tables show the information that will need to be collected for BGP-R configurations:

CER Name	*NYC1*
Location Name	*Wall Street*
CER LAN information (facing SBC)	
Subinterface #	*Gi 0/0.1*
IP address & mask	*135.16.206.59 mask 255.255.255.248*
HSRP IP address	*135.16.206.57*
VLAN ID	*111*
Subinterface #	*Gi 0/0.2*
IP address & mask	*135.16.206.68 mask 255.255.255.248*
HSRP IP address	*135.16.206.65*
VLAN ID	*121*
OSPF/BGP Loopback IP address	*198.22.44.5*
IP PBX/IP Phone network & mask	*10.10.20.0 mask 255.255.255.0*
Primary SBC with CV Value = 120	
Signaling IP address	*135.16.206.58*
Associated IP BE addresses	*22.44.40.20, 22.44.30.20, 33.22.80.20, 33.22.90.20*
Backup SBC(s) with CV Value= 110	
Signaling IP address(es)	*135.16.206.66*
Associated IP BE addresses	*12.44.40.25, 12.44.30.25, 13.22.80.25,*

	13.22.90.25
Does customer want AT&T to advertise default route?	*Yes*

CER Name	*NYC2*
Location Name	*Wall Street*
CER LAN information (facing SBC)	
Subinterface #	*Gi 0/0.1*
IP address & mask	*135.16.206.67 mask 255.255.255.252*
HSRP IP Address	*135.16.206.65*
VLAN ID	*121*
Subinterface #	*Gi 0/0.1*
IP address & mask	*135.16.206.60 mask 255.255.255.252*
HSRP IP Address	*135.16.206.57*
VLAN ID	*121*
OSPF/BGP Loopback IP address	*197.77.44.10*
IP PBX/IP Phone network & mask	*10.10.20.0 mask 255.255.255.0*
Primary SBC with CV Value = 120	
Signaling IP address	*135.16.206.66*
Associated IP BE addresses	*12.44.40.25, 12.44.30.25, 13.22.80.25, 13.22.90.25*
Backup SBC(s) with CV Value = 110	
Signaling IP address(es)	*135.16.206.58*
Associated IP BE addresses	*22.44.40.20, 22.44.30.20, 33.22.80.20, 33.22.90.20,*
Does customer want AT&T to advertise default route?	*Yes*

3.3.3.1 NYC1

Router Name: NYC1

```
ip cef
!
track 1 interface Serial2/0 line-protocol
!
interface Loopback0
 description – Loopback for BGP router-id -
 ip address 198.22.44.5 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 !
interface GigabitEthernet0/0.1
 description - Link to Customer's Layer 2 Switch
 encapsulation dot1Q 111
 ip address 135.16.206.59 255.255.255.248
 standby 1 ip 135.16.206.57
 standby 1 timers 1 3
 standby 1 priority 120
 standby 1 preempt delay minimum 60
 standby 1 track 1 decrement 50
!
interface GigabitEthernet0/0.2
 description - Link to Layer 2 Switch
 encapsulation dot1Q 121
 ip address 135.16.206.68 255.255.255.248
 standby 1 ip 135.16.206.65
 standby 1 timers 1 3
 standby 1 priority 90
 standby 1 preempt
 standby 1 track 1 decrement 50
```

```
!
interface GigabitEthernet0/1
 description - BGP Healing Link for HSRP
 ip address 1.1.1.1 255.255.255.252
!
int GigabitEthernet0/2
 description VQM interface
 ip address 32.95.22.1 255.255.255.252
!
router bgp 65000
 bgp router-id 198.22.44.5
 timers bgp 3 9
 neighbor 195.18.32.14 remote-as 13979
 neighbor 1.1.1.2  remote-as 65000
 !
 address-family ipv4
  network 135.16.206.58 mask 255.255.255.255          **Primary SBC**
  network 135.16.206.64 mask 255.255.255.248          **Secondary SBC**
  network  198.22.44.5 mask 255.255.255.255           **Loopback Interface**
  network 10.10.20.0 mask 255.255.255.0               **IP PBX/IP phone network**
  network 32.95.22.1  mask 255.255.255.252             **VQM Network**
  neighbor 195.18.32.14 activate
  neighbor 195.18.32.14  send-community both
  neighbor 195.18.32.14  soft-reconfiguration inbound
  neighbor 195.18.32.14  route-map AVPN_Routes_In in
  neighbor 195.18.32.14  route-map Customer_SBC_Networks out
  neighbor 195.18.32.14  filter-list 1 in
  neighbor 1.1.1.2  activate
  neighbor 1.1.1.2   route-map IBGP_In in
  neighbor 1.1.1.2   next-hop-self
  no auto-summary
  no synchronization
 exit-address-family
!
ip route 135.16.206.58 255.255.255.255 GigabitEthernet0/0.1
!
```

```
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map IBGP_In permit 10
 match ip address prefix-list IBGP-In
!
!
route-map Customer_SBC_Networks permit 10            **Route-map for Primary SBC**
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20            ** Route-map for Secondary SBC**
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
!
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 5 permit 135.16.206.58/32                **Primary SBC**
ip prefix list CV120 seq 18 permit 10.10.20.0/24                  **IP PBX/IP Phone network**
ip prefix list CV120 seq 19 permit 32.95.22.0/30                  **VQM network**
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Secondary SBC with CV of 110
ip prefix-list CV110 seq 5 permit  135.16.206.66/29
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IBGP-In description - IBGP Routes Allowed In
ip prefix-list IBGP-In seq 5 deny 135.16.206.58/32                **Primary SBC**
ip prefix-list IBGP-In seq 10 deny  135.16.206.66/29              **Secondary SBC**
ip prefix-list IBGP-In seq 100 permit 0.0.0.0/0 le 32
```

```
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
access-list 3 permit any
```

Called by "filter-list 1 in" (under router bgp)

3.3.3.1.1 NYC1 Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

Note that only configuration sections and additional commands are shown.

The network 10.10.30.0/24 is added to the NYC2 example configuration as a phone network to highlight the advertisement of networks on alternate paths.

```
router bgp 65000
 address-family ipv4
  network 10.10.30.0 mask 255.255.254.0                    **NYC2 phone network**
!
ip route 10.10.20.0 255.255.255.0 GigabitEthernet0/0.1
ip route 10.10.30.0 255.255.254.0 GigabitEthernet0/0.2
!
ip prefix-list CV110 description – Secondary SBC with CV of 110
ip prefix list CV110 seq 20 permit 10.10.30.0/23           **NYC2 phone network**
!
ip prefix-list IBGP-In description - IBGP Routes Allowed In
ip prefix-list IBGP-In seq 15 deny  10.10.20.0/24          **NYC1 phone network**
ip prefix-list IBGP-In seq 20 deny  10.10.30.0/23          **NYC2 phone network**
```

3.3.3.2 NYC2

Router Name: NYC2

```
ip cef
!
track 1 interface Serial2/0 line-protocol
!
interface Loopback0
 description – Loopback for BGP router-id -
 ip address 197.77.44.10 255.255.255.255
!
interface GigabitEthernet0/0
 no ip address
 !
interface GigabitEthernet0/0.1
 description - Link to Customer's Layer 2 Switch
 encapsulation dot1Q 121
 ip address 135.16.206.67 255.255.255.248
 standby 1 ip 135.16.206.65
 standby 1 timers 1 3
 standby 1 priority 120
 standby 1 preempt delay minimum 60
 standby 1 track 1 decrement 50
!
interface GigabitEthernet0/0.2
 description - Link to Layer 2 Switch
 encapsulation dot1Q 111
 ip address 135.16.206.60 255.255.255.248
 standby 1 ip 135.16.206.57
 standby 1 timers 1 3
 standby 1 priority 90
 standby 1 preempt
 standby 1 track 1 decrement 50
!
interface GigabitEthernet0/1
 description - BGP Healing Link for HSRP
 ip address 1.1.1.2 255.255.255.252
!
```

```
int GigabitEthernet0/2
 description VQM interface
 ip address  32.95.35.1 255.255.255.252
!
router bgp 65000
 bgp router-id 197.77.44.10
 timers bgp 3 9
 neighbor 197.97.1.18  remote-as 13979
 neighbor 1.1.1.1  remote-as 65000
 !
 address-family ipv4
  network 135.16.206.66 mask 255.255.255.255          **Primary SBC**
  network 135.16.206.56 mask 255.255.255.248          **Secondary SBC**
  network 197.77.44.10 mask 255.255.255.255           **Loopback Interface**
  network 32.95.35.0 mask 255.255.255.252             **VQM Network**
  neighbor 197.97.1.18  activate
  neighbor 197.97.1.18  send-community both
  neighbor 197.97.1.18  soft-reconfiguration inbound
  neighbor 197.97.1.18  route-map AVPN_Routes_In in
  neighbor 197.97.1.18  route-map Customer_SBC_Networks out
  neighbor 197.97.1.18  filter-list 1 in
  neighbor 1.1.1.1  activate
  neighbor 1.1.1.1   route-map IBGP_In in
  neighbor 1.1.1.1   next-hop-self
  no auto-summary
  no synchronization
 exit-address-family
!
ip route 135.16.206.66 255.255.255.255 GigabitEthernet0/0.1
!
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map IBGP_In permit 10
```

```
 match ip address prefix-list IBGP-In
!
route-map Customer_SBC_Networks permit 10          **Route-map for Primary SBC**
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20          ** Route-map for Secondary SBC**
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix-list CV120 seq 5 permit 135.16.206.66/32          **Primary SBC**
ip prefix list CV120 seq 19 permit 32.95.35.0/30            **VQM network**
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description – Secondary SBC with CV of 110
ip prefix-list CV110 seq 5 permit  135.16.206.58/29
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IBGP-In description - IBGP Routes Allowed In
ip prefix-list IBGP-In seq 5 deny 135.16.206.66/32          **Primary SBC**
ip prefix-list IBGP-In seq 10 deny  135.16.206.58/29        **Secondary SBC**
ip prefix-list IBGP-In seq 100 permit 0.0.0.0/0 le 32
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
access-list 3 permit any
```

Called by "filter-list 1 in" (under router bgp)

3.3.3.2.1 NYC2 Changes to Support MFA

The caution in section 1.2 must be followed.

Following are changes to support MFA operation.

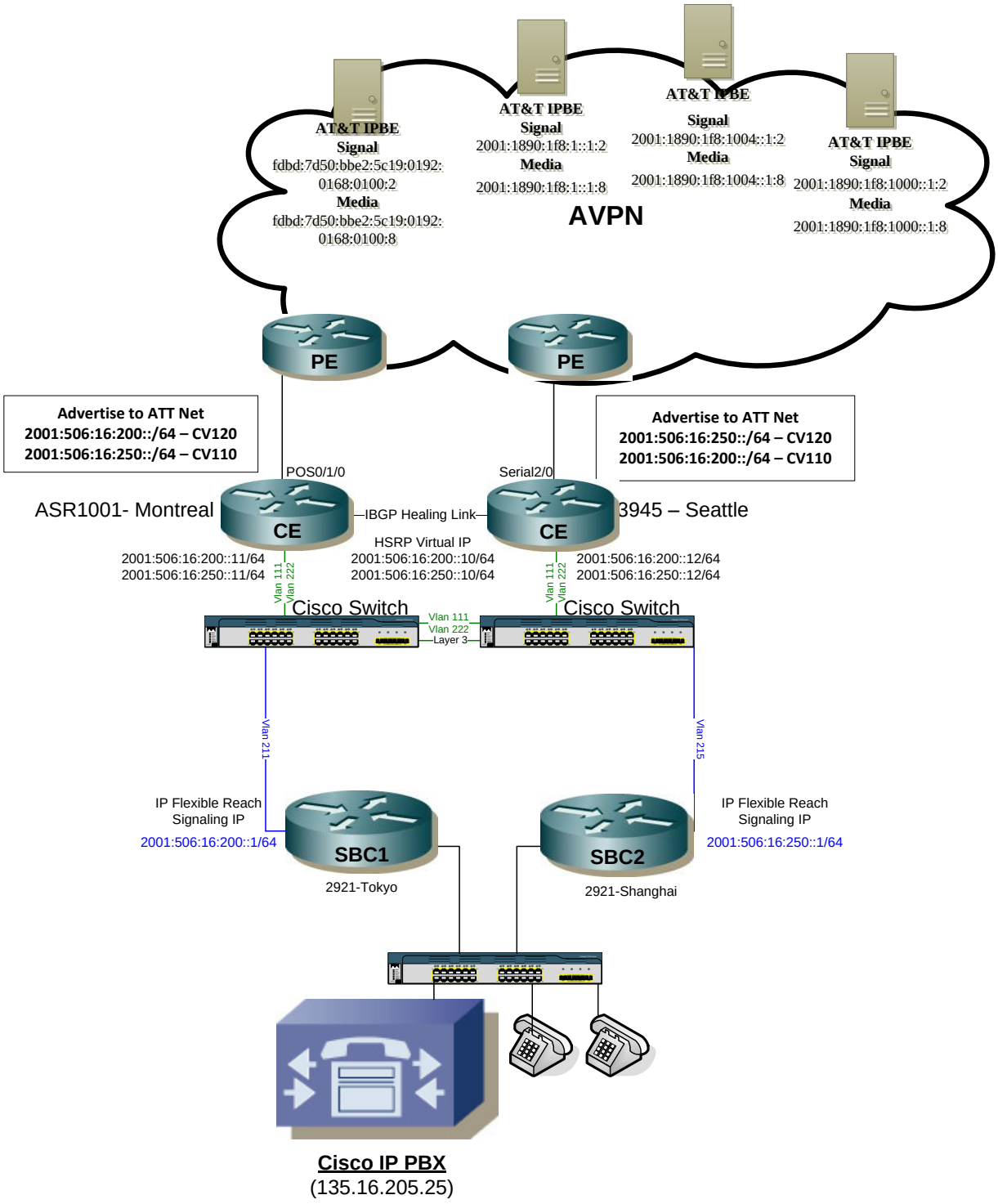
Note that only configuration sections and additional commands are shown.

The network 10.10.30.0/24 is added to the NYC2 example configuration as a phone network to highlight the advertisement of networks on alternate paths.

```
router bgp 65000
 address-family ipv4
  network 10.10.30.0 mask 255.255.255.0                **NYC2 phone network**
  network 10.10.20.0 mask 255.255.254.0                **NYC1 phone network**
!
ip route 10.10.30.0 255.255.255.0 GigabitEthernet0/0.1
ip route 10.10.20.0 255.255.254.0 GigabitEthernet0/0.2
!
ip prefix-list CV120 description – Primary SBC Route
ip prefix list CV120 seq 20 permit 10.10.30.0/24          **NYC2 phone network**
!
ip prefix-list CV110 description – Secondary SBC with CV of 110
ip prefix-list CV110 seq 10 permit  10.10.20.0/23         **NYC1 phone network**
!
ip prefix-list IBGP-In description - IBGP Routes Allowed In
ip prefix-list IBGP-In seq 15 deny  10.10.30.0/24         **NYC2 phone network**
ip prefix-list IBGP-In seq 20 deny  10.10.20.0/23         **NYC1 phone network**
```

3.3.4 IPV6 Example Configurations

The following diagram will be used to populate the sample configurations.



ASR1001 Montreal:

```
hostname ASR1001-Montreal
!
!
track 1 interface POS0/1/0 line-protocol
!
!
interface Loopback0
 description – Loopback for Management & BGP router-id
 ip address 192.168.0.5 255.255.255.255
 ipv6 address 2001:506:16:100::5/128
!
interface GigabitEthernet0/0/0
 description - Physical Interface
 no ip address
!
interface GigabitEthernet0/0/0.500
 description - IBGP Healing Link To CE # 2
 encapsulation dot1Q 500
 ipv6 address 2002::101:101/126
!
interface GigabitEthernet0/0/1
 description - Physical Interface
 no ip address
!
interface GigabitEthernet0/0/1.111
 description SBC #1 - LAN
 encapsulation dot1Q 111
 standby version 2
 standby 1 ipv6 2001:506:16:200::10/64
 standby 1 timers 1 3
 standby 1 priority 120
 standby 1 preempt delay minimum 30
 standby 1 track 1 decrement 50
 ipv6 address 2001:506:16:200::11/64
!
interface GigabitEthernet0/0/1.222
 description SBC #2 - LAN
 encapsulation dot1Q 222
 standby version 2
 standby 2 ipv6 2001:506:16:250::10/64
 standby 2 timers 1 3
 standby 2 priority 110
 standby 2 preempt
 standby 2 track 1 decrement 50
 ipv6 address 2001:506:16:250::11/64
!
interface POS0/1/0
 description - WAN Connection
 ip address 195.18.32.13 255.255.255.252
 ipv6 address 2001:506:15:103::1/64
!
!
!
router bgp 65000
 bgp router-id 192.168.0.5
 bgp log-neighbor-changes
```

```
 timers bgp 3 9
 neighbor 2001:506:15:103::2 remote-as 13979
 neighbor 2002::101:102 remote-as 65000
 neighbor 195.18.32.14 remote-as 13979
 !
 address-family ipv4
  network 172.30.0.0 mask 255.255.128.0
  network 192.168.0.5 mask 255.255.255.255
  neighbor 195.18.32.14 activate
  neighbor 195.18.32.14 allowas-in
 exit-address-family
 !
 address-family ipv6
  network 2001:506:15:103::/64
  network 2001:506:16:5::/64
  network 2001:506:16:100::/64
  network 2001:506:16:200::/64
  network 2001:506:16:250::/64
  neighbor 2001:506:15:103::2 activate
  neighbor 2001:506:15:103::2 send-community both
  neighbor 2001:506:15:103::2 allowas-in
  neighbor 2001:506:15:103::2 soft-reconfiguration inbound
  neighbor 2001:506:15:103::2 route-map AVPN_Routes_In_Primary in
  neighbor 2001:506:15:103::2 route-map Customer_Networks out
  neighbor 2001:506:15:103::2 filter-list 1 in
  neighbor 2002::101:102 activate
  neighbor 2002::101:102 next-hop-self
  neighbor 2002::101:102 route-map IBGP_Routes_In in
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
ipv6 prefix-list ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list ALLOW-ANY seq 100 permit ::/0 le 128
!
ipv6 prefix-list IBGP-Routes-In description - IBGP Routes Allowed In
ipv6 prefix-list IBGP-Routes-In seq 5 deny 2001:506:16:200::1/64
ipv6 prefix-list IBGP-Routes-In seq 10 deny 2001:506:16:250::1/64
ipv6 prefix-list IBGP-Routes-In seq 15 deny 2001:506:16:200::/64
ipv6 prefix-list IBGP-Routes-In seq 100 permit ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list WAN-CV-Value-120 seq 5 permit 2001:506:16:200::1/64
ipv6 prefix-list WAN-CV-Value-120 seq 10 permit 2001:506:16:100::5/64
ipv6 prefix-list WAN-CV-Value-120 seq 15 permit 2001:506:16:5::/64
ipv6 prefix-list WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list WAN-CV-Value-110 seq 5 permit 2001:506:16:250::/64
ipv6 prefix-list WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
```

```
ipv6 prefix-list WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list WAN-CV-Value-80 seq 100 deny ::/0 le 128
!
route-map IBGP_Routes_In permit 10
 match ipv6 address prefix-list IBGP-Routes-In
!
route-map AVPN_Routes_In_Primary permit 10
 match ipv6 address prefix-list ALLOW-ANY
 set weight 64000
!
route-map Customer_Networks permit 10
 match ipv6 address prefix-list WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_Networks permit 20
 match ipv6 address prefix-list WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_Networks permit 30
 match ipv6 address prefix-list WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_Networks permit 40
 match ipv6 address prefix-list WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_Networks permit 50
 match ipv6 address prefix-list WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
```

3945 Seattle:

```
hostname 3945-Seattle
!
!
track 1 interface Serial2/0 line-protocol
!
!
interface Loopback0
 description – Loopback for Management & BGP router-id
 ip address 192.168.0.10 255.255.255.255
 ipv6 address 2001:506:16:100::10/128
!
interface GigabitEthernet0/1
 description - Physical Interface
 no ip address
!
interface GigabitEthernet0/1.500
 description - IBGP Healing Link To CE # 1
 encapsulation dot1Q 500
 ipv6 address 2002::101:102/126
!
```

```
interface GigabitEthernet0/2
 description - Physical Interface
 no ip address
!
interface GigabitEthernet0/2.111
 description SBC #1 - LAN
 encapsulation dot1Q 111
 standby version 2
 standby 1 ipv6 2001:506:16:200::10/64
 standby 1 timers 1 3
 standby 1 priority 110
 standby 1 preempt
 standby 1 track 1 decrement 50
 ipv6 address 2001:506:16:200::12/64
!
interface GigabitEthernet0/2.222
 description SBC #2 - LAN
 encapsulation dot1Q 222
 standby version 2
 standby 2 ipv6 2001:506:16:250::10/64
 standby 2 timers 1 3
 standby 2 priority 120
 standby 2 preempt delay minimum 30
 standby 2 track 1 decrement 50
 ipv6 address 2001:506:16:250::12/64
!
interface Serial2/0
 description - WAN Connection
 ip address 195.18.32.21 255.255.255.252
 ipv6 address 2001:506:15:106::1/64
!
!
!
router bgp 65000
 bgp router-id 192.168.0.10
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 2001:506:15:106::2 remote-as 13979
 neighbor 2002::101:101 remote-as 65000
 neighbor 195.18.32.22 remote-as 13979
 !
 address-family ipv4
  network 172.23.0.0 mask 255.255.192.0
  network 192.168.0.10 mask 255.255.255.255
  neighbor 195.18.32.22 activate
  neighbor 195.18.32.22 allowas-in
 exit-address-family
 !
 address-family ipv6
  network 2001:506:15:106::/64
  network 2001:506:16:10::/64
  network 2001:506:16:100::/64
  network 2001:506:16:200::/64
  network 2001:506:16:250::/64
  neighbor 2001:506:15:106::2 activate
  neighbor 2001:506:15:106::2 send-community both
  neighbor 2001:506:15:106::2 allowas-in
  neighbor 2001:506:15:106::2 soft-reconfiguration inbound
  neighbor 2001:506:15:106::2 route-map AVPN_Routes_In_Primary in
  neighbor 2001:506:15:106::2 route-map Customer_Networks out
  neighbor 2001:506:15:106::2 filter-list 1 in
```

```
  neighbor 2002::101:101 activate
  neighbor 2002::101:101 next-hop-self
  neighbor 2002::101:101 route-map IBGP_Routes_In in
 exit-address-family
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
ipv6 prefix-list ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list ALLOW-ANY seq 100 permit ::/0 le 128
!
ipv6 prefix-list IBGP-Routes-In description - IBGP Routes Allowed In
ipv6 prefix-list IBGP-Routes-In seq 5 deny 2001:506:16:200::1/64
ipv6 prefix-list IBGP-Routes-In seq 10 deny 2001:506:16:250::1/64
ipv6 prefix-list IBGP-Routes-In seq 15 deny 2001:506:16:200::/64
ipv6 prefix-list IBGP-Routes-In seq 100 permit ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list WAN-CV-Value-120 seq 5 permit 2001:506:16:250::1/64
ipv6 prefix-list WAN-CV-Value-120 seq 10 permit 2001:506:16:100::10/64
ipv6 prefix-list WAN-CV-Value-120 seq 15 permit 2001:506:16:10::/64
ipv6 prefix-list WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list WAN-CV-Value-110 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list WAN-CV-Value-80 seq 100 deny ::/0 le 128
!
route-map IBGP_Routes_In permit 10
 match ipv6 address prefix-list IBGP-Routes-In
!
route-map AVPN_Routes_In_Primary permit 10
 match ipv6 address prefix-list ALLOW-ANY
 set weight 64000
!
route-map Customer_Networks permit 10
 match ipv6 address prefix-list WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_Networks permit 20
 match ipv6 address prefix-list WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_Networks permit 30
 match ipv6 address prefix-list WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_Networks permit 40
```

```
 match ipv6 address prefix-list WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_Networks permit 50
 match ipv6 address prefix-list WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
3945-Seattle#
```

3.3.4.1 IPV6 MFA Support

MFA is not supported with IPv6 at this time.

4. Router Configurations for CER with Integrated CUBE or TDM Gateway

This section provides templates and examples to configure the CERs to work with BGP-R with an integrated CUBE or integrated TDM Gateway. Templates and examples will be provided to configure OSPF, EBGP and HSRP (does not apply to integrated TDM Gateway).

NOTE – Templates and examples are provided for CERs with integrated CUBE. The same templates and examples can be used for integrated TDM Gateway. However, for integrated TDM Gateway configurations, disregard the configuration lines that refer to IP PBX and IP phone networks.

If a VQM is installed onsite (customer premise), the VQM configuration statements must be included in the BGP-R configuration. If a VQM is not installed onsite (in the network or not at all), disregard the VQM configuration statements.

4.1 *Router Configurations with OSPF*

This section provides templates and examples to configure the CERs to work with BGP-R with OSPF on the LAN. An example will also be provided to configure OSPF on a cascaded layer 3 switch.

The following table is provided to assist with gathering information for the template variables:

CER entry	Where is information obtained?
Interface Configuration	

Loopback interface IP address for management	Private IP address determined by the customer. Also used for BGP/OSPF router-id.
Loopback interface (60000) IP address for IP Flexible Reach Signaling	Public IP Flexible Reach Signaling IP address. One Signaling IP address provided for each CUBE.
LAN sub-interface number	Determined by the customer
VLAN IDs	Determined by the customer
LAN interface IP address (link to Layer 2 switch)	Private IP address determined by the customer.
Routing Configuration	
BGP AS Number	Provided by customer with initial order for AT&T VPN service.
Loopback interface IP address for BGP/OSPF router-id	Private IP address determined by the customer.
AT&T PER IP address	Provided by customer with initial order for AT&T VPN service.
Remote AS number	Provided by AT&T.
Loopback 60000 IP Flexible Reach IP address	Public IP Flexible Reach Signaling IP address. One Signaling IP address provided for each SBC.
IP addresses of IP Border Elements	IP addresses of the AT&T IP Border Elements. This is a public IP address provided by AT&T. Note: AT&T IP Border Elements may have separate Signaling and Media IP addresses.

4.1.1 Configuration Templates for BGP-R with OSPF on LAN

The configurations provided in this section are in addition to the base CER configuration (see section 1.3 for links to the CER CCGs).

OSPF with integrated CUBE

Template for CER/CUBE Configuration:

```
ip cef
!
interface Loopback0
 description – Loopback OSPF/BGP router-id -
 ip address <IP Address> 255.255.255.255
!
interface Loopback60000
 description IP Flexible Reach Signaling IP address
 ip address <IP Address> 255.255.255.255
!
```

IP Address used for OSPF & BGP router-id. Each CER participating in BGP-R must have a unique IP address.

```
interface GigabitEthernet <interface number>
 no ip address
 !
interface GigabitEthernet <sub- interface number>
 description - Link to Layer 2/3 Device - LAN
 encapsulation dot1Q <VLAN ID>
 ip address <IP Address> <subnet mask>
!
int <ethernet interface connecting to the Voice Quality Monitor>
ip address <LAN IP address determined by VQM model> <mask>
!
router ospf 100
 router-id <Loopback 0 IP Address for OSPF router-id>
 redistribute bgp <AS number> subnets route-map bgp_to_ospf
 network <Loopback 0 IP Address for OSPF router-id> 0.0.0.0 area 0
 network <Loopback 60000 IP Flexible Reach Signaling IP address> 0.0.0.0 area 0
 network <Gigabit Ethernet Sub-Interface IP Address> 0.0.0.0 area 0  **Int to Layer 2 switch**
 default-information originate metric 20 metric-type 1
!
router bgp <AS number>
 bgp router-id <Loopback 0 IP address for BGP router-id>
 timers bgp 3 9
 neighbor <AT&T PER IP Address> remote-as <remote AS number>
 !
 address-family ipv4
  network < Loopback 0 IP Address for OSPF/BGP router-id> mask 255.255.255.255
  network < Loopback 60000 IP Flexible Reach Signaling IP address>  255.255.255.255
  network < IP Flexible Reach Signaling network Backup #1>  255.255.255.248
  network < IP Flexible Reach Signaling network Backup #2>  255.255.255.248
  network <VQM network> mask <subnet mask>
 ******Continue to add IP Flexible Reach Backups as necessary*****
  network < Data network #1 directly connected to CER > mask <subnet mask>
  network < Data network #2 directly connected to CER > mask <subnet mask>
  ***** Add multiple network statements for data networks *****
 redistribute ospf 100 metric 20 match internal external 1 external 2 route-map ospf_to_bgp
  neighbor <AT&T PER IP Address> activate
```

Optional Line! Add if you want AT&T to originate the default route.

"Network" statements are needed for additional local hosts or networks that need to be redistributed with BGP. NOTE: There may already be existing network statements in the BGP configuration. All networks statements will now need to be added into the "ip prefix-list SBC" portion of the configuration (see farther down in template).

```
 neighbor <AT&T PER IP Address> send-community both
 neighbor <AT&R PER IP Address>  advertisement-interval 3
 neighbor <AT&T PER IP Address> soft-reconfiguration inbound
 neighbor <AT&T PER IP Address> route-map AVPN_Routes_In in
 neighbor <AT&T PER IP Address> route-map Customer_SBC_Networks out
 neighbor <AT&T PER IP Address> filter-list 1 in
 no auto-summary
 no synchronization
 exit-address-family
!
ip route <IP Flexible Reach Signaling network Backup #1> 255.255.255.248 GigabitEthernet<LAN subinterface>
ip route <IP Flexible Reach Signaling network Backup #2> 255.255.255.248 GigabitEthernet<LAN subinterface>
!
route-map bgp_to_ospf  permit 10
 match ip address 1
 set metric 20
 set metric-type type-1
!
route-map bgp_to_ospf  permit 20
 match ip address 2
 set metric 100
 set metric-type type-2
!
route-map ospf_to_bgp  permit 10
 match ip address prefix-list OSPF_2_BGP
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community <PER AS number>:120 additive
```

Add a static route for each backup IP Flexible Reach Signaling network

The bgp_to_ospf route map is used to prioritize routes to AVPN out of a particular CER. Metric 20 has a higher preference than metric 100. Metric 20 = OSPF E1 route and Metric 100 = OSPF E2 route

```
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community <PER AS number>:110 additive
!
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community <PER AS number>:100 additive
!
route-map Customer_SBC_Networks permit 40
  match ip address prefix-list CV90
 set as-path prepend 64600
 set community <PER AS number>:90 additive
!
route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community <PER AS number>:80 additive
!
ip prefix-list OSPF_2_BGP description - Valid OSPF Routes To Be Sent To BGP
ip prefix-list OSPF_2_BGP seq 10 permit <IP PBX and/or IP Phone network>/<Prefix Size>  **Optional**
ip prefix-list OSPF_2_BGP seq 20 permit <Data network X advertised via OSPF>/<Prefix Size>
ip prefix-list OSPF_2_BGP seq 30 permit <Data network Y advertised via OSPF>/<Prefix Size>
 **ADD ADDITIONAL LINES FOR ANY DATA NETWORKS ADVERTISED VIA OSPF THAT SHOULD BE REDISTRIBUTED TO AVPN VIA BGP  **
** MAKE SURE TO INCREMENT SEQ # FOR EACH ADDITIONAL LINE**
ip prefix-list OSPF_2_BGP seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list CV120 description Primary Routes with CV120
ip prefix-list CV120 seq 5 permit <Loopback 60000 IP Flexible Reach Signaling IP address>/32
ip prefix-list CV120 seq 15 permit < Loopback 0 IP Address for OSPF router-id >/32
ip prefix list CV120 seq 18 permit <IP PBX and/or IP Phone network>/<Prefix Size>  **optional**
ip prefix list CV120 seq 19 permit <VQM Network>/<Prefix Size>
```

ip prefix-list CV120 seq 20 permit < Data network #1 directly connected to CER >/<Prefix Size>

ip prefix-list CV120 seq 21 permit < Data network #2 directly connected to CER >/<Prefix Size>

ip prefix-list CV120 seq 22 permit < Data network X advertised via OSPF >/<Prefix Size>

ip prefix-list CV120 seq 23 permit < Data network Y advertised via OSPF >/<Prefix Size>

****NOTE - Insert additional prefix-list entries for each data network statement****

ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32

!

!

!

Insert one prefix list entry for each network statement that appears in the BGP section of the configuration. Start seq # at 20 and increase each "seq #" by 1.

ip prefix-list CV110 description Secondary Backup Routes with CV of 110

ip prefix-list CV110 seq 5 permit < Backup A IP Flexible Reach Signaling network >/29

ip prefix-list CV110 seq 10 permit < Backup B IP Flexible Reach Signaling network >/29

****** CONTINUE TO ADD SEQUENCE LINES FOR EACH IP Flexible Reach Signaling network WITH CV = 110******

******If there are NO IP Flexible Reach Signaling IP networks with CV value 110, only configure the deny statement shown below*****

ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32

!

!

ip prefix-list CV100 description Tertiary Backup Routes with CV of 100

ip prefix-list CV100 seq 5 permit < Backup C IP Flexible Reach Signaling network >/29

ip prefix-list CV100 seq 10 permit < Backup D IP Flexible Reach Signaling network >/29

****** CONTINUE TO ADD SEQUENCE LINES FOR EACH IP Flexible Reach Signaling network WITH CV = 100******

******If there are IP Flexible Reach Signaling networks with CV value 100, only configure the deny statement shown below*****

ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32

!

!

ip prefix-list CV90 description Quaternary Backup Routes with CV of 90

ip prefix-list CV90 seq 5 permit < Backup E IP Flexible Reach Signaling network >/29

ip prefix-list CV90 seq 10 permit < Backup F IP Flexible Reach Signaling network >/29

****** CONTINUE TO ADD SEQUENCE LINES FOR EACH IP Flexible Reach Signaling network WITH CV = 90******

******If there are NO IP Flexible Reach Signaling network with CV value 90, only configure the deny statement shown below*****

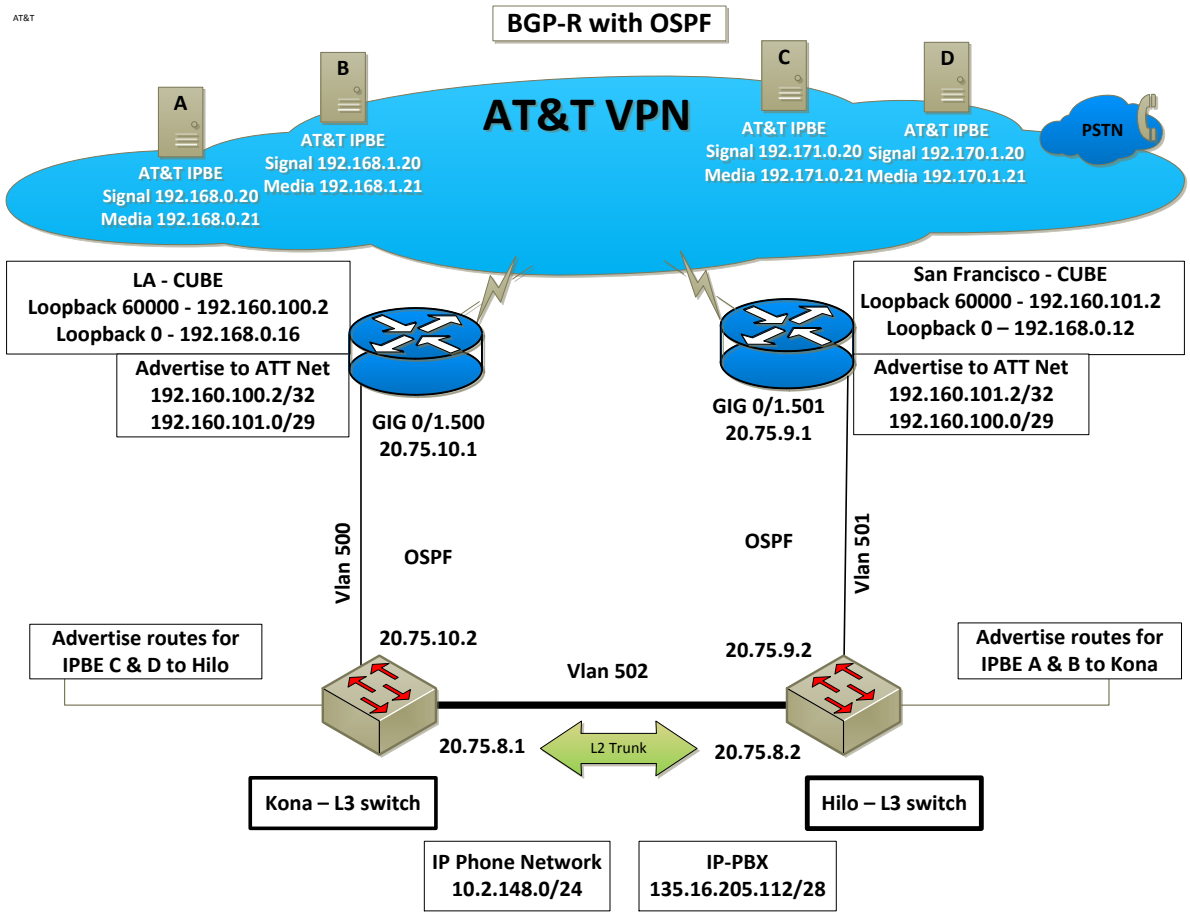
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32

```
!
!
ip prefix-list CV80 description Quinary Backup Routes with CV of 80
ip prefix-list CV80 seq 5 permit < Backup G IP Flexible Reach Signaling network >/29
ip prefix-list CV80 seq 10 permit < Backup H IP Flexible Reach Signaling network >/29
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH IP Flexible Reach Signaling network WITH CV = 80***
***If  there are NO IP Flexible Reach Signaling IP networks with CV value 80, only configure the deny statement shown below**
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
***ACL1 is used to capture AVPN routes to be redistributed into OSPF with Metric = 20 (OSPF E1 Routes) ***
access-list 1 permit <IP Border Element #1 assigned to this CUBE>
access-list 1 permit <IP Border Element #2 assigned to this CUBE>
access-list 1 permit <AVPN network 2>
****CONTINUE TO REPEAT FOR ALL ADDITIONAL IPBE ADDRESSES*
access-list 1 deny any
***ACL2 is used to capture AVPN routes to be redistributed into OSPF with Metric = 100 (OSPF E2 Routes***
access-list 2 permit <AVPN network 3>
access-list 2 permit <AVPN network 4>
****CONTINUE TO REPEAT FOR ALL ADDITIONAL IPBE ADDRESSES*
access-list 2 deny any
!
access-list 3 permit any
```

Called by "filter-list 1 in" (under router bgp)

4.1.2 Example Configurations for Integrated CUBE

The following information will be used to populate the sample configurations. Please refer to the diagram below:



Summary of IP Flexible Reach Signaling IP addresses:

CER/CUBE 1 = Los Angeles

- Primary for Los Angeles CUBE with CV of 120 = 192.160.100.2/32
- Backup for San Francisco CUBE with CV of 110= 192.160.101.0/29 (secondary route)

CER/CUBE 2 = San Francisco

- Primary for San Francisco CUBE with CV of 120 = 192.160.101.2 /32
- Backup for Los Angeles CUBE with CV value of 110 = 192.160.100.0 /29 (secondary route)

The following tables show the information that will need to be collected for BGP-R configurations:

CER Name	*Los Angeles*
Location Name	*Main Street*
CER LAN information	
Subinterface #	*Gi 0/1.500*
IP address & mask	*20.75.10.1 mask 255.255.255.0*
VLAN ID	*500*
OSPF/BGP Loopback IP address	*192.168.0.16*
IP PBX/IP Phone network & mask	*10.2.148.0 mask 255.255.255.0* *135.16.205.112 mask 255.255.255.240*
Primary CUBE with CV Value = 120	
Signaling IP address	*192.160.100.2/32*
Associated IP BE addresses	*192.171.0.20, 192.171.0.21, 192.170.1.20, 192.170.1.21*
Backup CUBE(s) with CV Value= 110	
Signaling IP address(es)	*192.160.101.0/29*
Associated IP BE addresses	*192.168.0.20, 192.168.0.21, 192.168.1.20, 192.168.1.21*
Backup CUBE(s) with CV Value = 100	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup CUBE(s) with CV Value = 90	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup CUBE(s) with CV Value = 80	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Does customer want AT&T to advertise default route?	*Yes*

CER Name	*San Francisco*
Location Name	*10th Ave*
CER LAN information	
Subinterface #	*Gi 0/1.501*
IP address & mask	*20.75.9.1 255.255.255.0*
VLAN ID	*501*
OSPF/BGP Loopback IP address	*192.168.0.12*
IP PBX/IP Phone network & mask	*Already being advertised out Los Angeles router*
Primary CUBE with CV Value = 120	
Signaling IP address	*192.160.101.2/32*
Associated IP BE addresses	*192.168.0.20, 192.168.0.21, 192.168.1.20, 192.168.1.21*
Backup CUBE(s) with CV Value = 110	
Signaling IP address(es)	*192.160.100.0/29*
Associated IP BE addresses	*192.171.0.20, 192.171.0.21, 192.170.1.20, 192.170.1.21*
Backup CUBE(s) with CV Value = 100	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup CUBE(s) with CV Value = 90	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup CUBE(s) with CV Value = 80	*N/A*
Signaling IP address(es)	
Associated IP BE addresses	
Does customer want AT&T to advertise default route?	*Yes*

Los Angeles Configuration:

```
3945E-Los-Angeles#sh run
Building configuration...


ip cef
!
interface Loopback0
 description Loopback OSPF/BGP Router ID
 ip address 192.168.0.16 255.255.255.255
!
!
interface Loopback60000
 description IP Flexible Reach Signaling IP address
 ip address 192.160.100.2 255.255.255.255
!
interface GigabitEthernet0/1
 description - LAN interface
 no ip address
 load-interval 30
 duplex full
 speed 1000
 media-type rj45
!
interface GigabitEthernet0/1.500
 description Trunk to Kona Layer 3 Switch
 encapsulation dot1Q 500
 ip address 20.75.10.1 255.255.255.0
!
!
router ospf 100
 router-id 192.168.0.16
 redistribute bgp 65000 subnets route-map bgp_to_ospf
 network 20.75.10.1 0.0.0.0 area 0       **LAN network**
 network 192.160.100.2 0.0.0.0 area 0    **Loopback 60000 IP Flexible Reach IP address**
 network 192.168.0.16 0.0.0.0 area 0  ** Loopback OSPF/BGP Router ID **
 default-information originate metric 20 metric-type 1
!
router bgp 65000
 bgp router-id 192.168.0.16
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 195.18.31.234 remote-as 13979
```

```
 neighbor 195.18.31.234 fall-over bfd
 !
 address-family ipv4
  network 20.75.10.0 mask 255.255.255.0        **LAN network**
  network 192.168.0.16 mask 255.255.255.255    ** Loopback OSPF/BGP Router ID **
  network 192.160.100.2 mask 255.255.255.255   **Loopback 60000 IP Flexible Reach IP
address**
  network 192.160.101.0 mask 255.255.255.248   **Backup Route for IP Flexible Reach IP
address on San Francisco**
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map ospf_to_bgp
  neighbor 195.18.31.234 activate
  neighbor 195.18.31.234 send-community both
  neighbor 195.18.31.234  advertisement-interval 3
  neighbor 195.18.31.234 soft-reconfiguration inbound
  neighbor 195.18.31.234 route-map AVPN_Routes_In in
  neighbor 195.18.31.234 route-map Customer_SBC_Networks out
  neighbor 195.18.31.234 filter-list 1 in
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
ip route 192.160.101.0 255.255.255.248 GigabitEthernet0/1.500
!
ip prefix-list CV120 description Primary Routes with CV120
ip prefix-list CV120 seq 5 permit 192.160.100.2/32   **Loopback 60000 IP Flexible Reach IP
address**
ip prefix-list CV120 seq 10 permit 192.168.0.16/32   ** Loopback OSPF/BGP Router ID **
ip prefix-list CV120 seq 15 permit 10.2.148.0/24     **IP Phone network**
ip prefix-list CV120 seq 20 permit 135.16.205.112/28 **IP PBX network**
ip prefix-list CV120 seq 25 permit 20.75.10.0/24     **LAN network**
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description Secondary Backup Routes with CV of 110
ip prefix-list CV110 seq 5 permit 192.160.101.0/29   **Backup Route for IP Flexible Reach IP
address on San Francisco**
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV100 description Tertiary Backup Routes with CV of 100
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description Quaternary Backup Routes with CV of 90
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
```

```
ip prefix-list CV80 description Quinary Backup Routes with CV of 80
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list OSPF_2_BGP description Valid OSPF routes to be sent to BGP
ip prefix-list OSPF_2_BGP seq 90 permit 135.16.205.112/28  **IP PBX network**
ip prefix-list OSPF_2_BGP seq 95 permit 10.2.148.0/24      **IP Phone network**
ip prefix-list OSPF_2_BGP seq 100 deny 0.0.0.0/0 le 32
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_SBC_Networks permit 40
 match ip address prefix-list CV90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map bgp_to_ospf permit 10
 match ip address 1
 set metric 20
 set metric-type type-1
!
route-map bgp_to_ospf permit 20
```

```
 match ip address 2
 set metric 100
 set metric-type type-2
!
route-map ospf_to_bgp permit 10
 match ip address prefix-list OSPF_2_BGP
!
!
access-list 1 permit 192.168.0.20   ** IP Border Element Signaling IP address #1**
access-list 1 permit 192.168.0.21   ** IP Border Element Media IP address #1**
access-list 1 permit 192.168.1.20   ** IP Border Element Signaling IP address #2**
access-list 1 permit 192.168.1.21   ** IP Border Element Media IP address #2**
access-list 1 permit 12.2.3.0 0.0.0.255   ** Data network from AVPN**
access-list 1 deny any
access-list 2 permit 25.66.1.0 0.0.0.255  ** Data network from AVPN**
access-list 2 deny any
access-list 3 permit any
```

San Francisco Configuration:

```
3945C-San-Francisco#

ip cef
!
interface Loopback0
 description Loopack OSPF/BGP router ID
 ip address 192.168.0.12 255.255.255.255
!
interface Loopback60000
 description IP Flexible Reach Signaling IP address
 ip address 192.160.101.2 255.255.255.255
!
interface GigabitEthernet0/1
 description - LAN interface
 no ip address
 load-interval 30
 duplex full
 speed 1000
 media-type rj45
!
interface GigabitEthernet0/1.501
 description Trunk to Hilo Layer 3 Switch
 encapsulation dot1Q 501
 ip address 20.75.9.1 255.255.255.0
!
```

```
!
router ospf 100
 router-id 192.168.0.12
 redistribute bgp 65000 subnets route-map bgp_to_ospf
 network 20.75.9.1 0.0.0.0 area 0      **LAN network**
 network 192.160.101.2 0.0.0.0 area 0  **Loopback 60000 IP Flexible Reach IP address**
 network 192.168.0.12 0.0.0.0 area 0   ** Loopback OSPF/BGP Router ID **
!
router bgp 65000
 bgp router-id 192.168.0.12
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 192.168.130.46 remote-as 13979
 neighbor 192.168.130.46 fall-over bfd
!
 address-family ipv4
  network 192.160.100.0 mask 255.255.255.248   **Backup Route for IP Flexible Reach IP
address on Los Angeles**
  network 192.160.101.2 mask 255.255.255.255   **Loopback 60000 IP Flexible Reach IP
address**
  network 20.75.9.0 mask 255.255.255.0         **LAN network**
  network 192.168.0.12 mask 255.255.255.255    ** Loopback OSPF/BGP Router ID **
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map ospf_to_bgp
  neighbor 192.168.130.46 activate
  neighbor 192.168.130.46 send-community both
  neighbor 192.168.130.46 advertisement-interval 3
  neighbor 192.168.130.46 soft-reconfiguration inbound
  neighbor 192.168.130.46 route-map AVPN_Routes_In in
  neighbor 192.168.130.46 route-map Customer_SBC_Networks out
  neighbor 192.168.130.46 filter-list 1 in
  exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
ip route 192.160.100.0 255.255.255.248 GigabitEthernet0/1.501
!
!
ip prefix-list CV120 description Primary Routes with CV120
ip prefix-list CV120 seq 5 permit 192.160.101.2/32    **Loopback 60000 IP Flexible Reach IP
address**
ip prefix-list CV120 seq 15 permit 192.168.0.12/32    ** Loopback OSPF/BGP Router ID **
ip prefix-list CV120 seq 25 permit 20.75.9.0/24       **LAN network**
```

```
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description Secondary Backup Routes with CV of 110
ip prefix-list CV110 seq 5 permit 192.160.100.0/29    **Backup Route for IP Flexible Reach
IP address on Los Angeles**
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV100 description Tertiary Backup Routes with CV of 100
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description Quaternary Backup Routes with CV of 90
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description Quinary Backup Routes with CV of 80
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list OSPF_2_BGP seq 100 deny 0.0.0.0/0 le 32
!
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_SBC_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_SBC_Networks permit 40
 match ip address prefix-list CV90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_SBC_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map bgp_to_ospf permit 10
```

```
 match ip address 1
 set metric 20
 set metric-type type-1
!
route-map bgp_to_ospf  permit 20
 match ip address 2
 set metric 100
 set metric-type type-2
!
route-map ospf_to_bgp permit 10
 match ip address prefix-list OSPF_2_BGP
!
!
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
!
access-list 1 permit 192.171.0.20   ** IP Border Element Signaling IP address #1**
access-list 1 permit 192.171.0.21   ** IP Border Element Media IP address #1**
access-list 1 permit 192.170.1.20   ** IP Border Element Signaling IP address #2**
access-list 1 permit 192.170.1.21   ** IP Border Element Media IP address #2**
access-list 1 permit 12.87.5.0 0.0.0.255   ** Data network from AVPN**
access-list 1 deny any
access-list 2 permit 25.65.9.0 0.0.0.255  ** Data network from AVPN**
access-list 2 deny any
access-list 3 permit any
!
```

4.1.3 Example Configuration for Cascaded OSPF Layer 3 Switch

The following sample configuration is provided to assist with configuring a cascaded OSPF Cisco Layer 3 Switch for use with BGP-R. This example matches up with the integrated CUBE configuration in this OSPF section. The red highlighted entries are variables that are specific to the customer environment.

The cascaded OSPF Layer 3 Switch example is designed to have one physical interface facing the CERs with integrated CUBE and one physical interface facing the IP PBX/IP Phones. There is a trunk between the two Layer 3 Switches.

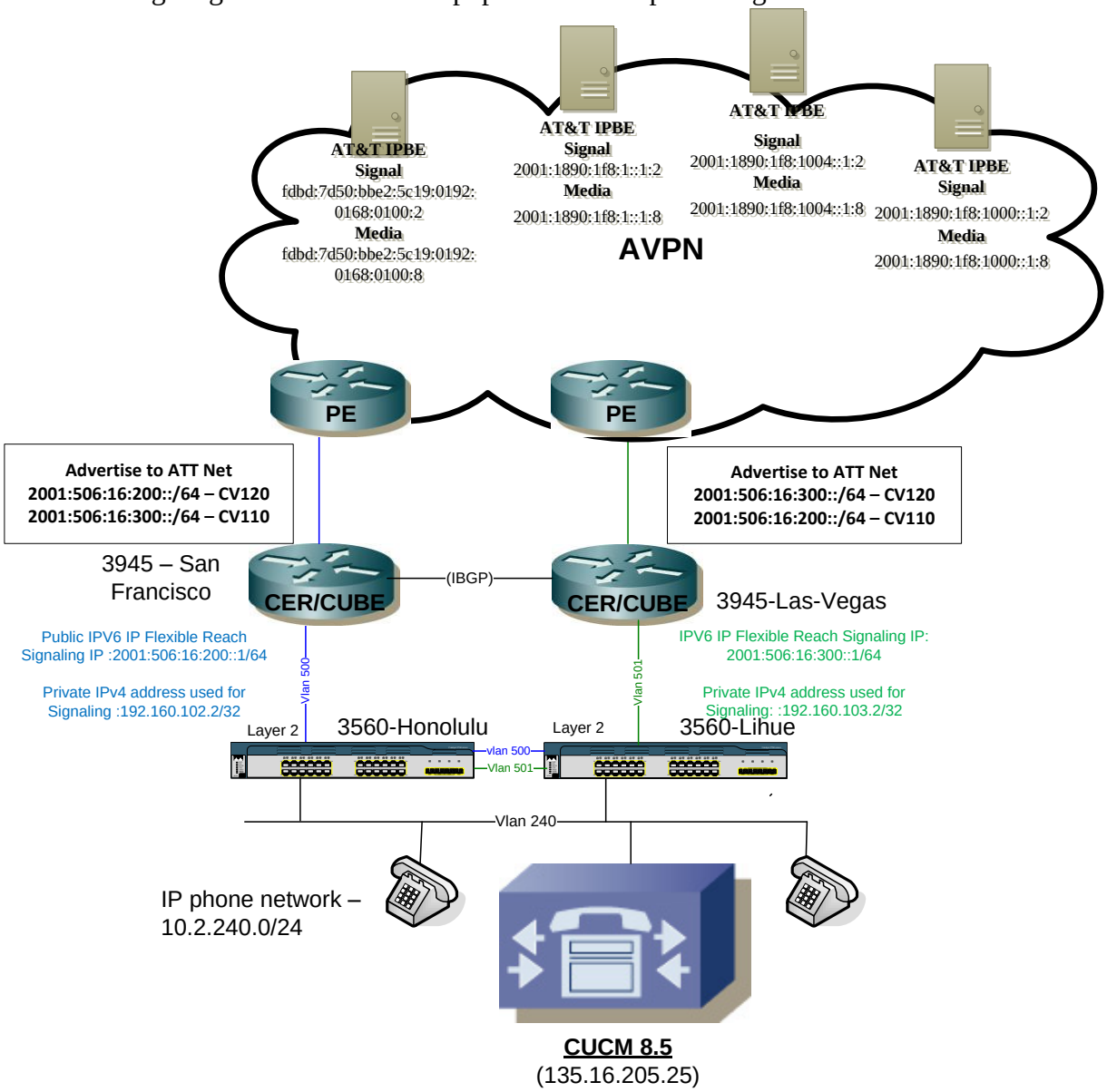
```
3750-Kona#sh run
Building configuration...

vlan 148
 name IP_PHONES
!
vlan 244
 name CUCM-VLAN
!
vlan 500
 name VLAN_to_Los_Angelese
!
vlan 502
 name HILO_KONA_TRUNK
!
interface FastEthernet1/0/41
 description - Link To 3945-San-Francisco
 switchport access vlan 500
 switchport mode access
!
interface FastEthernet1/0/47
 description - Trunk To 3550-Hilo
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 111,148,224,502
 switchport mode trunk
!
interface FastEthernet1/0/48
 description - Trunk To Union-Station
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 148,244
 switchport mode trunk
 load-interval 30
!
!
interface Vlan148
 description - Phones Vlan
 ip address 10.2.148.1 255.255.255.0
!
interface Vlan244
 description - Call Manager Vlan
 ip address 135.16.205.121 255.255.255.240
!
interface Vlan500
 description - VLAN to Los Angeles
 ip address 20.75.10.3 255.255.255.0
!
interface Vlan502
 description - VLAN between Hilo and Kona switches
 ip address 20.75.8.1 255.255.255.0
```

```
!
!
router ospf 100
 router-id 20.75.10.3
 log-adjacency-changes
 redistribute connected metric 20 metric-type 1 subnets
 redistribute static metric 20 metric-type 1 subnets
 network 10.2.148.0 0.0.0.255 area 0
 network 20.75.8.1 0.0.0.0 area 0
 network 20.75.10.3 0.0.0.0 area 0
 network 135.16.205.112 0.0.0.15 area 0
!
```

4.1.4 IPV6 Example Configurations

The following diagram will be used to populate the sample configurations.



3945 San Francisco

```
ip cef
ipv6 cef
!
!
interface Loopback0
 description BGP OSPF Loopback
 ip address 192.168.0.178 255.255.255.255
 ipv6 address 2001:506:16:100::178/128
 ipv6 enable
 ipv6 ospf 100 area 0
!
interface Loopback60000
 description CUBE Loopback
 ip address 192.160.102.2 255.255.255.255
 ipv6 address 2001:506:16:200::1/64
 ipv6 enable
 ipv6 ospf 100 area 0
!
!
!
interface GigabitEthernet0/0/2
 description - Trunk To 3560-Honolulu - Port gig0/1
 no ip address
 load-interval 30
 negotiation auto
 hold-queue 2048 in
 hold-queue 2048 out
!
interface GigabitEthernet0/0/2.500
 description Link to 3550-Honolulu - Vlan500
 encapsulation dot1Q 500
 ip address 192.168.50.101 255.255.255.252
 ip ospf cost 10
 ipv6 address 2002::500:101/126
 ipv6 ospf 100 area 0
 ipv6 ospf cost 10
 no cdp enable
!
!
interface Serial1/0/0
 description - T3 PPP WAN Link
 bandwidth 41992
 ip address 195.18.32.9 255.255.255.252
 encapsulation ppp
 ipv6 address 2001:506:15:102::1/64
 dsu bandwidth 44210
 scramble
 framing c-bit
 cablelength 10
 hold-queue 32768 out
!
!
router ospf 100
 router-id 192.168.0.178
 redistribute bgp 65000 subnets route-map IPV4_BGP_TO_OSPF
 network 192.160.102.2 0.0.0.0 area 0
 network 192.168.0.178 0.0.0.0 area 0
 network 192.168.50.101 0.0.0.0 area 0
```

```
 default-information originate metric 20 metric-type 1
 distribute-list route-map IPV4_LAN_To_WAN_Routes in
!
router bgp 65000
 bgp router-id 192.168.0.178
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 2001:506:15:102::2 remote-as 13979
 neighbor 195.18.32.10 remote-as 13979
 !
 address-family ipv4
  network 172.50.128.0 mask 255.255.128.0
  network 192.160.102.2 mask 255.255.255.255
  network 192.168.0.178 mask 255.255.255.255
  network 195.18.32.8 mask 255.255.255.252
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map
IPV4_OSPF_TO_BGP
  no neighbor 2001:506:15:102::2 activate
  neighbor 195.18.32.10 activate
  neighbor 195.18.32.10 send-community both
  neighbor 195.18.32.10 advertisement-interval 1
  neighbor 195.18.32.10 allowas-in
  neighbor 195.18.32.10 soft-reconfiguration inbound
  neighbor 195.18.32.10 route-map IPV4_AVPN_Routes_In in
  neighbor 195.18.32.10 route-map IPV4_Customer_Networks out
  neighbor 195.18.32.10 filter-list 1 in
 exit-address-family
 !
 address-family ipv6
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map
IPV6_OSPF_TO_BGP
  network 2001:506:15:102::/64
  network 2001:506:16:100::178/128
  network 2001:506:16:178::/64
  network 2001:506:16:200::/64
  network 2001:506:16:300::/64
  network 2002::500:100/126
  neighbor 2001:506:15:102::2 activate
  neighbor 2001:506:15:102::2 send-community both
  neighbor 2001:506:15:102::2 advertisement-interval 1
  neighbor 2001:506:15:102::2 allowas-in
  neighbor 2001:506:15:102::2 soft-reconfiguration inbound
  neighbor 2001:506:15:102::2 route-map IPV6_AVPN_Routes_In in
  neighbor 2001:506:15:102::2 route-map IPV6_Customer_Networks out
  neighbor 2001:506:15:102::2 filter-list 1 in
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
!
ip prefix-list IPV4-ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ip prefix-list IPV4-ALLOW-ANY seq 100 permit 0.0.0.0/0 le 32
!
ip prefix-list IPV4-BGP-TO-OSPF-TYPE-1 description - BGP ROUTES -> OSPF E1 ROUTES
ip prefix-list IPV4-BGP-TO-OSPF-TYPE-1 seq 5 permit 0.0.0.0/0
ip prefix-list IPV4-BGP-TO-OSPF-TYPE-1 seq 100 deny 0.0.0.0/0 le 32
!
```

```
ip prefix-list IPV4-BGP-TO-OSPF-TYPE-2 description - BGP ROUTES -> OSPF E2 ROUTES
ip prefix-list IPV4-BGP-TO-OSPF-TYPE-2 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-TO-WAN-Routes description - LAN Routes Allowed Into WAN
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 5 permit 10.2.240.0/24
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 10 permit 135.16.205.25/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 15 permit 192.168.0.150/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 20 permit 192.168.0.151/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 25 permit 192.160.103.2/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-OSPF-TO-BGP description - OSPF Routes Allowed In
ip prefix-list IPV4-OSPF-TO-BGP seq 5 permit 10.2.240.0/24
ip prefix-list IPV4-OSPF-TO-BGP seq 10 permit 135.16.205.25/32
ip prefix-list IPV4-OSPF-TO-BGP seq 15 permit 192.168.0.150/32
ip prefix-list IPV4-OSPF-TO-BGP seq 20 permit 192.168.0.151/32
ip prefix-list IPV4-OSPF-TO-BGP seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ip prefix-list IPV4-WAN-CV-Value-100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ip prefix-list IPV4-WAN-CV-Value-110 seq 10 permit 192.168.0.151/32
ip prefix-list IPV4-WAN-CV-Value-110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-120 description - CV 120 - Highest Priority
ip prefix-list IPV4-WAN-CV-Value-120 seq 5 permit 192.160.102.2/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 10 permit 192.168.0.178/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 15 permit 172.50.128.0/25
ip prefix-list IPV4-WAN-CV-Value-120 seq 20 permit 192.168.0.150/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ip prefix-list IPV4-WAN-CV-Value-80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ip prefix-list IPV4-WAN-CV-Value-90 seq 100 deny 0.0.0.0/0 le 32
!
ipv6 route 2001:506:16:300::/64 GigabitEthernet0/0/2.500
!
ipv6 router ospf 100
 router-id 192.168.0.178
 distribute-list prefix-list IPV6_LAN_To_WAN_Routes in
 default-information originate metric 20 metric-type 1
 redistribute connected
 redistribute bgp 65000 route-map IPV6_BGP_TO_OSPF
!
!
ipv6 prefix-list IPV6-ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list IPV6-ALLOW-ANY seq 100 permit ::/0 le 128
!
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-1 description - BGP ROUTES -> OSPF E1 ROUTES
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-1 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-2 description - BGP ROUTES -> OSPF E2 ROUTES
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-2 seq 5 permit 2001:1890:1f8:1004::/64
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-2 seq 10 permit 2001:1890:1f8:1000::/64
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-2 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes description - LAN Routes Allowed Into WAN
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 5 permit FDBD:7D50:BBE2:5C19::/64
```

```
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 10 permit 2001:1890:1f8:1::/64
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 15 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 20 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 25 permit 2001:506:16:300::/64
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-OSPF-TO-BGP description - OSPF Routes Allowed In
ipv6 prefix-list IPV6-OSPF-TO-BGP seq 5 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6-OSPF-TO-BGP seq 10 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-OSPF-TO-BGP seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 10 permit 2001:506:16:100::178/128
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 15 permit 2001:506:16:178::/64
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 20 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 5 permit 2001:506:16:300::/64
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 10 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-80 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6_OSPF-TO-BGP description - OSPF Routes Allowed In
ipv6 prefix-list IPV6_OSPF-TO-BGP seq 5 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6_OSPF-TO-BGP seq 10 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6_OSPF-TO-BGP seq 100 deny ::/0 le 128
!
route-map IPV4_AVPN_Routes_In permit 10
 match ip address prefix-list IPV4-ALLOW-ANY
 set weight 64000
!
route-map IPV6_AVPN_Routes_In permit 10
 match ipv6 address prefix-list IPV6-ALLOW-ANY
 set weight 64000
!
route-map IPV4_OSPF_TO_BGP permit 10
 match ip address prefix-list IPV4-OSPF-TO-BGP
!
route-map IPV4_BGP_TO_OSPF permit 10
 match ip address prefix-list IPv4-BGP-TO-OSPF-TYPE-1
 set metric 20
 set metric-type type-1
!
route-map IPV4_BGP_TO_OSPF permit 20
 match ip address prefix-list IPV4-BGP-TO-OSPF-TYPE-2
 set metric 100
 set metric-type type-2
!
route-map IPV6_OSPF_TO_BGP permit 10
 match ipv6 address prefix-list IPV6-OSPF-TO-BGP
!
```

```
route-map IPV6_BGP_TO_OSPF permit 10
 match ipv6 address prefix-list IPV6-BGP-TO-OSPF-TYPE-1
 set metric 20
 set metric-type type-1
!
route-map IPV6_BGP_TO_OSPF permit 20
 match ipv6 address prefix-list IPV6-BGP-TO-OSPF-TYPE-2
 set metric 100
 set metric-type type-2
!
route-map IPV6_Customer_Networks permit 10
 match ipv6 address prefix-list IPV6-WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map IPV6_Customer_Networks permit 20
 match ipv6 address prefix-list IPV6-WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map IPV6_Customer_Networks permit 30
 match ipv6 address prefix-list IPV6-WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map IPV6_Customer_Networks permit 40
 match ipv6 address prefix-list IPV6-WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map IPV6_Customer_Networks permit 50
 match ipv6 address prefix-list IPV6-WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map IPV4_LAN_To_WAN_Routes permit 10
 match ip address prefix-list IPV4-LAN-TO-WAN-Routes
!
route-map IPV4_Customer_Networks permit 10
 match ip address prefix-list IPV4-WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map IPV4_Customer_Networks permit 20
 match ip address prefix-list IPV4-WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map IPV4_Customer_Networks permit 30
 match ip address prefix-list IPV4-WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map IPV4_Customer_Networks permit 40
 match ip address prefix-list IPV4-WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map IPV4_Customer_Networks permit 50
 match ip address prefix-list IPV4-WAN-CV-Value-80
 set as-path prepend 64600
```

```
 set community 13979:80 additive
!
route-map IPV6_LAN_To_WAN_Routes permit 10
 match ipv6 address prefix-list IPV6-LAN-TO-WAN-Routes
```

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```
ip cef
ipv6 cef
!
!
!
interface Loopback0
 description BGP OSPF Loopback
 ip address 192.168.0.11 255.255.255.255
 ipv6 address 2001:506:16:100::11/128
 ipv6 enable
 ipv6 ospf 100 area 0
!
interface Loopback60000
 description CUBE Loopback
 ip address 192.160.103.2 255.255.255.255
 ipv6 address 2001:506:16:300::1/64
 ipv6 enable
 ipv6 ospf 100 area 0
!
!
interface GigabitEthernet0/0
 description - WAN Link no ip address
 load-interval 30
 duplex full
 speed 1000

!
interface GigabitEthernet0/0.2815
 encapsulation dot1Q 2815
 ip address 192.168.130.49 255.255.255.252
 ip virtual-reassembly in
 ipv6 address 2001:506:15:34::2/64
 bfd interval 999 min_rx 999 multiplier 3
 no bfd echo
!
!
interface GigabitEthernet0/2
 no ip address
 load-interval 30
 duplex full
 speed 100
 media-type rj45
!
interface GigabitEthernet0/2.501
 description Link to 3550-Honolulu - Vlan 501
 encapsulation dot1Q 501
 ip address 192.168.51.101 255.255.255.252
 ip ospf cost 10
 ipv6 address 2002::501:101/126
 ipv6 ospf 100 area 0
 ipv6 ospf cost 10
```

```
!
!
router ospf 100
 router-id 192.168.0.11
 redistribute bgp 65000 subnets route-map IPV4_BGP_TO_OSPF
 network 192.160.103.2 0.0.0.0 area 0
 network 192.168.0.11 0.0.0.0 area 0
 network 192.168.51.101 0.0.0.0 area 0
 default-information originate metric 20 metric-type 1
 distribute-list route-map IPV4_LAN_To_WAN_Routes in
!
router bgp 65000
 bgp router-id 192.168.0.11
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 2001:506:15:34::1 remote-as 13979
 neighbor 2001:506:15:34::1 fall-over bfd
 neighbor 192.168.130.50 remote-as 13979
 !
 address-family ipv4
  network 172.23.64.0 mask 255.255.192.0
  network 192.160.103.2 mask 255.255.255.255
  network 192.168.0.11 mask 255.255.255.255
  network 192.168.130.48 mask 255.255.255.252
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map
IPV4_OSPF_TO_BGP
  no neighbor 2001:506:15:34::1 activate
  neighbor 192.168.130.50 activate
  neighbor 192.168.130.50 send-community both
  neighbor 192.168.130.50 advertisement-interval 1
  neighbor 192.168.130.50 allowas-in
  neighbor 192.168.130.50 soft-reconfiguration inbound
  neighbor 192.168.130.50 route-map IPV4_AVPN_Routes_In in
  neighbor 192.168.130.50 route-map IPV4_Customer_Networks out
  neighbor 192.168.130.50 filter-list 1 in
 exit-address-family
 !
 address-family ipv6
  redistribute ospf 100 metric 20 match internal external 1 external 2 route-map
IPV6_OSPF_TO_BGP
  network 2001:506:15:34::/64
  network 2001:506:16:11::/64
  network 2001:506:16:100::11/128
  network 2001:506:16:200::/64
  network 2001:506:16:300::/64
  network 2002::501:100/126
  neighbor 2001:506:15:34::1 activate
  neighbor 2001:506:15:34::1 send-community both
  neighbor 2001:506:15:34::1 advertisement-interval 1
  neighbor 2001:506:15:34::1 allowas-in
  neighbor 2001:506:15:34::1 soft-reconfiguration inbound
  neighbor 2001:506:15:34::1 route-map IPV6_AVPN_Routes_In in
  neighbor 2001:506:15:34::1 route-map IPV6_Customer_Networks out
  neighbor 2001:506:15:34::1 filter-list 1 in
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
```

```
!
ip prefix-list IPV4-ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ip prefix-list IPV4-ALLOW-ANY seq 100 permit 0.0.0.0/0 le 32
!
ip prefix-list IPV4-BGP-TO-OSPF-TYPE-1 description - BGP ROUTES -> OSPF E1 ROUTES
ip prefix-list IPV4-BGP-TO-OSPF-TYPE-1 seq 5 permit 0.0.0.0/0
ip prefix-list IPV4-BGP-TO-OSPF-TYPE-1 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-BGP-TO-OSPF-TYPE-2 description - BGP ROUTES -> OSPF E2 ROUTES
ip prefix-list IPV4-BGP-TO-OSPF-TYPE-2 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-TO-WAN-Routes description - LAN Routes Allowed Into WAN
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 5 permit 10.2.240.0/24
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 10 permit 135.16.205.25/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 15 permit 192.168.0.150/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 20 permit 192.168.0.151/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 25 permit 192.160.102.2/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-OSPF-TO-BGP description - OSPF Routes Allowed In
ip prefix-list IPV4-OSPF-TO-BGP seq 5 permit 10.2.240.0/24
ip prefix-list IPV4-OSPF-TO-BGP seq 10 permit 135.16.205.25/32
ip prefix-list IPV4-OSPF-TO-BGP seq 15 permit 192.168.0.150/32
ip prefix-list IPV4-OSPF-TO-BGP seq 20 permit 192.168.0.151/32
ip prefix-list IPV4-OSPF-TO-BGP seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list IPV4-WAN-CV-Value-120 description - CV 120 - Highest Priority
ip prefix-list IPV4-WAN-CV-Value-120 seq 5 permit 192.160.103.2/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 10 permit 192.168.0.11/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 15 permit 172.23.64.0/18
ip prefix-list IPV4-WAN-CV-Value-120 seq 20 permit 192.168.0.151/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ip prefix-list IPV4-WAN-CV-Value-110 seq 10 permit 192.168.0.150/32
ip prefix-list IPV4-WAN-CV-Value-110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ip prefix-list IPV4-WAN-CV-Value-100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ip prefix-list IPV4-WAN-CV-Value-80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ip prefix-list IPV4-WAN-CV-Value-90 seq 100 deny 0.0.0.0/0 le 32
!
ipv6 route 2001:506:16:200::/64 GigabitEthernet0/2.501
!
ipv6 router ospf 100
 router-id 192.168.0.11
 distribute-list prefix-list IPV6_LAN_To_WAN_Routes in
 default-information originate metric 20 metric-type 1
 redistribute bgp 65000 route-map IPV6_BGP_TO_OSPF
!
!
!
ipv6 prefix-list IPV6-ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list IPV6-ALLOW-ANY seq 100 permit ::/0 le 128
!
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-1 description - BGP ROUTES -> OSPF E1 ROUTES
```

```
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-1 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-2 description - BGP ROUTES -> OSPF E2 ROUTES
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-2 seq 5 permit FDBD:7D50:BBE2:5C19::/64
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-2 seq 10 permit 2001:1890:1f8:1::/64
ipv6 prefix-list IPV6-BGP-TO-OSPF-TYPE-2 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes description - LAN Routes Allowed Into WAN
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 5 permit 2001:1890:1f8:1004::/64
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 10 permit 2001:1890:1f8:1000::/64
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 15 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 20 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 25 permit 2001:506:16:200::/64
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-OSPF-TO-BGP description - OSPF Routes Allowed In
ipv6 prefix-list IPV6-OSPF-TO-BGP seq 5 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6-OSPF-TO-BGP seq 10 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-OSPF-TO-BGP seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 5 permit 2001:506:16:300::/64
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 10 permit 2001:506:16:100::11/128
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 15 permit 2001:506:16:11::/64
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 20 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 10 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-80 seq 100 deny ::/0 le 128
!
route-map IPV4_AVPN_Routes_In permit 10
 match ip address prefix-list IPV4-ALLOW-ANY
 set weight 64000
!
route-map IPV6_AVPN_Routes_In permit 10
 match ipv6 address prefix-list IPV6-ALLOW-ANY
 set weight 64000
!
route-map IPV4_OSPF_TO_BGP permit 10
 match ip address prefix-list IPV4-OSPF-TO-BGP
!
route-map IPV4_BGP_TO_OSPF permit 10
 match ip address prefix-list IPV4-BGP-TO-OSPF-TYPE-1
 set metric 20
 set metric-type type-1
!
route-map IPV4_BGP_TO_OSPF permit 20
 match ip address prefix-list IPV4-BGP-TO-OSPF-TYPE-2
 set metric 100
 set metric-type type-2
```

```
!
route-map IPV6_OSPF_TO_BGP permit 10
 match ipv6 address prefix-list IPV6-OSPF-TO-BGP
!
route-map IPV6_BGP_TO_OSPF permit 10
 match ipv6 address prefix-list IPV6-BGP-TO-OSPF-TYPE-1
 set metric 20
 set metric-type type-1
!
route-map IPV6_BGP_TO_OSPF permit 20
 match ipv6 address prefix-list IPV6-BGP-TO-OSPF-TYPE-2
 set metric 100
 set metric-type type-2
!
route-map IPV6_Customer_Networks permit 10
 match ipv6 address prefix-list IPV6-WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map IPV6_Customer_Networks permit 20
 match ipv6 address prefix-list IPV6-WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map IPV6_Customer_Networks permit 30
 match ipv6 address prefix-list IPV6-WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map IPV6_Customer_Networks permit 40
 match ipv6 address prefix-list IPV6-WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map IPV6_Customer_Networks permit 50
 match ipv6 address prefix-list IPV6-WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map IPV4_LAN_To_WAN_Routes permit 10
 match ip address prefix-list IPV4-LAN-TO-WAN-Routes
!
route-map IPV4_Customer_Networks permit 10
 match ip address prefix-list IPV4-WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map IPV4_Customer_Networks permit 20
 match ip address prefix-list IPV4-WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map IPV4_Customer_Networks permit 30
 match ip address prefix-list IPV4-WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map IPV4_Customer_Networks permit 40
 match ip address prefix-list IPV4-WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
```

```
!
route-map IPV4_Customer_Networks permit 50
 match ip address prefix-list IPV4-WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
```

Cisco 3560 Honolulu (Cascaded Layer 3 Switch)

```
vlan 240
 name CUCM-9-10-PHONES
!
vlan 500
 name BGP-R-IPV6-CER1
!
vlan 501
 name BGP-R-IPV6-CER2
!
vlan 502
 name BGP-R-IPV6-CROSS-LINK
!
!
!
!
interface Loopback0
 ip address 192.168.0.150 255.255.255.255
 ipv6 address 2001:506:16:100::150/128
 ipv6 enable
 ipv6 ospf 100 area 0
!
!
interface FastEthernet0/2
 description - Trunk To 3945 San Francisco (EBGP #1 Router)
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 500
 switchport mode trunk
 spanning-tree portfast trunk
!
!
interface FastEthernet0/23
 description - Trunk To 3560-Lihue
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 502,503
 switchport mode trunk
!
interface FastEthernet0/24
 description - Trunk To Union-Station
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 240,4001
 switchport mode trunk
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 no ip address
 shutdown
!
```

```
interface Vlan240
 description - CUCM8.5 - Phones Vlan
 ip address 10.2.240.248 255.255.255.0
 ip ospf cost 65535
 ip ospf priority 0
!
interface Vlan500
 description - BGP Link To CER1
 ip address 192.168.50.102 255.255.255.252
 ip ospf cost 10
 ip ospf priority 0
 ipv6 address 2002::500:102/126
 ipv6 enable
 ipv6 ospf cost 10
 ipv6 ospf priority 0
 ipv6 ospf 100 area 0
!
interface Vlan502
 description - OSPF Link To Customer L2/L3 device
 ip address 192.168.52.101 255.255.255.252
 ip ospf cost 100
 ipv6 address 2002::502:101/126
 ipv6 enable
 ipv6 ospf cost 100
 ipv6 ospf 100 area 0
!
!
router ospf 100
 router-id 192.168.0.150
 redistribute static metric 20 metric-type 1 subnets route-map
IPV4_OSPF_Routes_Static
 network 10.2.240.0 0.0.0.255 area 0
 network 192.168.0.150 0.0.0.0 area 0
 network 192.168.50.102 0.0.0.0 area 0
 network 192.168.52.101 0.0.0.0 area 0
 network 192.168.53.103 0.0.0.0 area 0
 distribute-list route-map IPV4_WAN_Routes in
!
!
ip route 135.16.205.25 255.255.255.255 10.2.240.250
!
!
ip prefix-list IPV4-OSPF-Routes-Static description - OSPF Static Routes
ip prefix-list IPV4-OSPF-Routes-Static seq 5 permit 135.16.205.25/32
ip prefix-list IPV4-OSPF-Routes-Static seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-Routes description - IPv4 Incoming OSPF Routes
ip prefix-list IPV4-WAN-Routes seq 5 permit 192.160.102.2/32
ip prefix-list IPV4-WAN-Routes seq 10 permit 192.160.103.2/32
ip prefix-list IPV4-WAN-Routes seq 15 permit 192.168.0.151/32
ip prefix-list IPV4-WAN-Routes seq 50 permit 0.0.0.0/0
ip prefix-list IPV4-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
ipv6 router ospf 100
 router-id 192.168.0.150
 distribute-list prefix-list IPV6-WAN-Routes in
!
!
!
ipv6 prefix-list IPV6-WAN-Routes description - IPv6 Incoming WAN Routes
ipv6 prefix-list IPV6-WAN-Routes seq 5 permit 2001:506:16:200::1/128
```

```
ipv6 prefix-list IPV6-WAN-Routes seq 10 permit 2001:506:16:300::1/128
ipv6 prefix-list IPV6-WAN-Routes seq 15 permit FDBD:7D50:BBE2:5C19::/64
ipv6 prefix-list IPV6-WAN-Routes seq 20 permit 2001:1890:1f8:1::/64
ipv6 prefix-list IPV6-WAN-Routes seq 25 permit 2001:1890:1f8:1004::/64
ipv6 prefix-list IPV6-WAN-Routes seq 30 permit 2001:1890:1f8:1000::/64
ipv6 prefix-list IPV6-WAN-Routes seq 35 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-WAN-Routes seq 40 permit ::/0
ipv6 prefix-list IPV6-WAN-Routes seq 100 deny ::/0 le 128
route-map IPV4_WAN_Routes permit 10
 match ip address prefix-list IPV4-WAN-Routes
!
route-map IPV4_OSPF_Routes_Static permit 10
 match ip address prefix-list IPV4-OSPF-Routes-Static
```

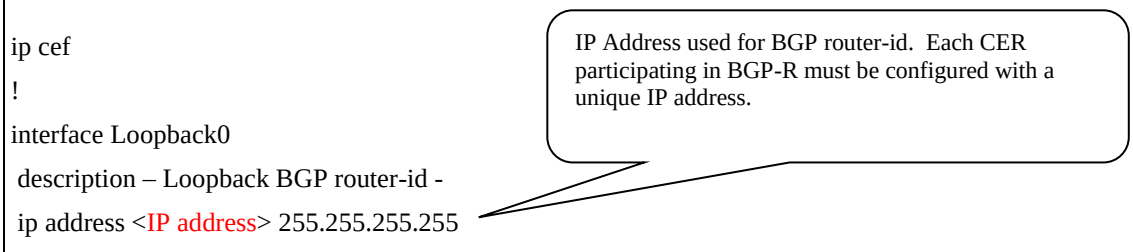
4.2 *Router Configurations with EBGP*

This section provides templates and examples to configure the CERs to work with BGP-R with EBGP on the LAN. An example will also be provided to configure EBGP on a cascaded layer 3 switch.

4.2.1 CER Configuration (BGP-R and EBGP) Template

The configurations provided in this section are in addition to the base CER configuration (see section 1.3 for links to the CER CCGs).

EBGP Template




```
ip cef
!
interface Loopback0
 description – Loopback BGP router-id -
 ip address <IP address> 255.255.255.255
!
interface Loopback60000
 description IP Flexible Reach Signaling IP address
 ip address <IP Address> 255.255.255.255
!
interface GigabitEthernet <interface number>
 no ip address
 !
interface GigabitEthernet <sub-interface number>
```

```
 description - Link to Layer 2/3 Device LAN
 encapsulation dot1Q <VLAN ID>
 ip address <IP Address>  <subnet mask>
!
Interface GigabitEthernet <interface connecting to the Voice Quality Monitor>
ip address <LAN IP address determined by VQM model> <mask>
!
router bgp <AS number>
 bgp router-id <Loopback 0 IP address for BGP router-id>
 timers bgp 3 9
 neighbor <AT&T PER IP Address> remote-as <remote AS number>
 neighbor <EBGP Neighbor IP Address> remote-as <EBP AS number>
 !
 address-family ipv4
  network < Loopback 0 IP Address for BGP router-id> mask 255.255.255.255
  network < Loopback 60000 IP Flexible Reach Signaling IP address>  255.255.255.255
  network < IP Flexible Reach Signaling network Backup #1>  255.255.255.248
  network < IP Flexible Reach Signaling network Backup #2>  255.255.255.248
  network <VQM network> mask <subnet mask>
*******Continue to add IP Flexible Reach Backup Networks as necessary******
  network < Data network #1 directly connected to CER > mask <subnet mask>
  network < Data network #2 directly connected to CER > mask <subnet mask>
  ***** Add multiple network statements for data networks *****
  neighbor <AT&T PER IP Address> activate
  neighbor <AT&T PER IP Address> send-community both
  neighbor <AT&T PER IP Address>  advertisement-interval 3
  neighbor <AT&T PER IP Address> soft-reconfiguration inbound
  neighbor <AT&T PER IP Address> route-map AVPN_Routes_In in
  neighbor <AT&T PER IP Address> route-map Customer_SBC_Networks out
  neighbor <AT&T PER IP Address> filter-list 1 in
  neighbor <EBGP Neighbor IP Address> activate
  neighbor <EBGP Neighbor IP Address> send-community both
  neighbor <EBGP Neighbor IP Address> advertisement-interval 3
  neighbor <EBGP Neighbor IP Address> soft-reconfiguration inbound
  neighbor <EBGP Neighbor IP Address> route-map EBGP_In in
  neighbor <EBGP Neighbor IP Address> route-map EBGP_Out out
  neighbor < EBGP Neighbor IP Address > filter-list 1 in
  no auto-summary
```

The EBGP Neighbor is located in the customer's network.

Add network statement(s) for backup IP Flexible Reach Signaling IP

"Network" statements are needed for additional local hosts or networks that need to be redistributed with BGP. NOTE: There may already be existing network statements in the BGP configuration. All networks statements will now need to be added into the "ip prefix-list SBC" portion of the configuration (see farther down in template).

```
 no synchronization
 exit-address-family
!
ip route <IP Flexible Reach Signaling network Backup #1> 255.255.255.248 GigabitEthernet<LAN subinterface>
ip route <IP Flexible Reach Signaling network Backup #2> 255.255.255.248 GigabitEthernet<LAN subinterface>
ip route < IP Border Element #1 Signaling IP address assigned to this CUBE > 255.255.255.255 <EBGP Neighbor IP address> 250
ip route < IP Border Element #1 Media IP address assigned to this CUBE > 255.255.255.255 <EBGP Neighbor IP address> 250
ip route < IP Border Element #2 Signaling IP address assigned to this CUBE > 255.255.255.255 <EBGP Neighbor IP address> 250
 ip route < IP Border Element #2 Media IP address assigned to this CUBE > 255.255.255.255 <EBGP Neighbor IP address> 250
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map EBGP_In permit 10
 match ip address prefix-list EBGP-In
!
route-map EBGP_Out permit 10
 match ip address prefix-list EBGP-Out-CV120
 set as-path prepend 64600
 set community <EBGP AS Number>:120 additive
!
route-map EBGP_Out permit 20
 match ip address prefix-list EBGP-Out-CV110
 set as-path prepend 64600
 set community <EBGP AS Number>:110 additive
!
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community <PER AS number>:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
```

**Required to adverstise the backup /29 network into BGP table **

These static entries set the route to the AT&T IP Border Elements (via the customer's LAN) as a lower priority. Higher priority is via directly connected AVPN network.

```
 set as-path prepend 64600
 set community <PER AS number>:110 additive
!
!
!
ip prefix-list CV120 description Primary Routes with CV120
ip prefix-list CV120 seq 5 permit < Loopback 60000 IP Flexible Reach Signaling IP address >/32
ip prefix-list CV120 seq 10 permit < Loopback 0 IP Address for BGP router-id >/32
ip prefix list CV120 seq 15 permit <IP PBX and/or IP Phone network>/<Prefix Size>   **Optional**
ip prefix list CV120 seq 20 permit <VQM Network>/<Prefix Size>
ip prefix-list CV120 seq 25 permit < Data network #1 directly connected to CER>/<Prefix Size>
ip prefix-list CV120 seq 30 permit < Data network #2 directly connected to CER >/<Prefix Size>
ip prefix-list CV120 seq 35 permit < Data network X advertised via EBGP >/<Prefix Size>
ip prefix-list CV120 seq 40 permit < Data network Y advertised via EBGP >/<Prefix Size>
ip prefix-list CV120 seq 45 permit < Data network Z advertised via EBGP >/<Prefix Size>
***NOTE - Insert additional prefix-list entries for each network statement***
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list CV110 description  Secondary Backup Routes with CV of 110
ip prefix-list CV110 seq 5 permit < Backup IP Flexible Reach Signaling network >/29
ip prefix-list CV110 seq 10 permit < Backup IP Flexible Reach Signaling network >/29
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH IP Flexible Reach Signaling IP address with CV = 110***
***If  there are NO IP Flexible Reach Signaling IP addresses with CV value 110, only configure the deny statement shown below**
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list CV100 description  Tertiary Backup Routes with CV of 100
ip prefix-list CV100 seq 5 permit < Backup IP Flexible Reach Signaling network >/29
ip prefix-list CV100 seq 10 permit < Backup IP Flexible Reach Signaling network >/29
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH IP Flexible Reach Signaling IP address with CV = 100***
***If  there are NO IP Flexible Reach Signaling IP addresseses with CV value 100, only configure the deny statement shown below**
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
!
```

Customer must configure network and prefix size for all the data networks to be redistributed into AT&T VPN service.

ip prefix-list CV90 description Quaternary Backup Routes with CV of 90

ip prefix-list CV90 seq 5 permit < Backup IP Flexible Reach Signaling network >/29

ip prefix-list CV90 seq 10 permit < Backup IP Flexible Reach Signaling network >/29

****** CONTINUE TO ADD SEQUENCE LINE FOR EACH IP Flexible Reach Signaling IP addresses with CV = 90******

******If there are NO IP Flexible Reach Signaling IP addresses with CV value 90, only configure the deny statement shown below***

ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32

!

!

ip prefix-list CV80 description Quinary Backup Routes with CV of 80

ip prefix-list CV80 seq 5 permit < Backup IP Flexible Reach Signaling network >/29

ip prefix-list CV80 seq 10 permit < Backup IP Flexible Reach Signaling network >/29

****** CONTINUE TO ADD SEQUENCE LINE FOR EACH IP Flexible Reach Signaling IP address with CV = 80******

******If there are NO IP Flexible Reach Signaling IP addresses with CV value 80, only configure the deny statement shown below***

ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32

!

!

ip prefix-list EBGP-Out-CV120 description Prefix list to capture primary routes to AVPN associated with this CER and redistribute via EBGP

ip prefix-list EBGP-Out-CV120 seq 5 permit < Loopback 60000 IP Flexible Reach Signaling IP address >/32

ip prefix-list EBGP-Out-CV120 seq 10 permit < Loopback 0 IP Address for BGP router-id >/32

ip prefix-list EBGP-Out-CV120 seq 15 permit <AT&T IP Border Element #1 Signaling IP assigned to **other** CUBE>/32

ip prefix-list EBGP-Out-CV120 seq 20 permit <AT&T IP Border Element #1 Media IP assigned to **other** CUBE>/32

ip prefix-list EBGP-Out-CV120 seq 25 permit <AT&T IP Border Element #2 Signaling IP assigned to **other** CUBE>/32

ip prefix-list EBGP-Out-CV120 seq 30 permit <AT&T IP Border Element #2 Media IP assigned to **other** CUBE>/32

ip prefix-list EBGP-Out-CV120 seq 35 permit < AVPN Route 1 >/<prefix size>

ip prefix-list EBGP-Out-CV120 seq 40 permit < AVPN Route 2 >/<prefix size>

****** CONTINUE TO ADD SEQUENCE LINE FOR EACH ROUTE TO ADD TO PREFIX LIST******

ip prefix-list EBGP-Out-CV120 seq 95 permit 0.0.0.0/0 ** optional- allows all routes to be mapped to this CER**

ip prefix-list EBGP-Out-CV120 seq 100 deny 0.0.0.0/0 le 32

!

!

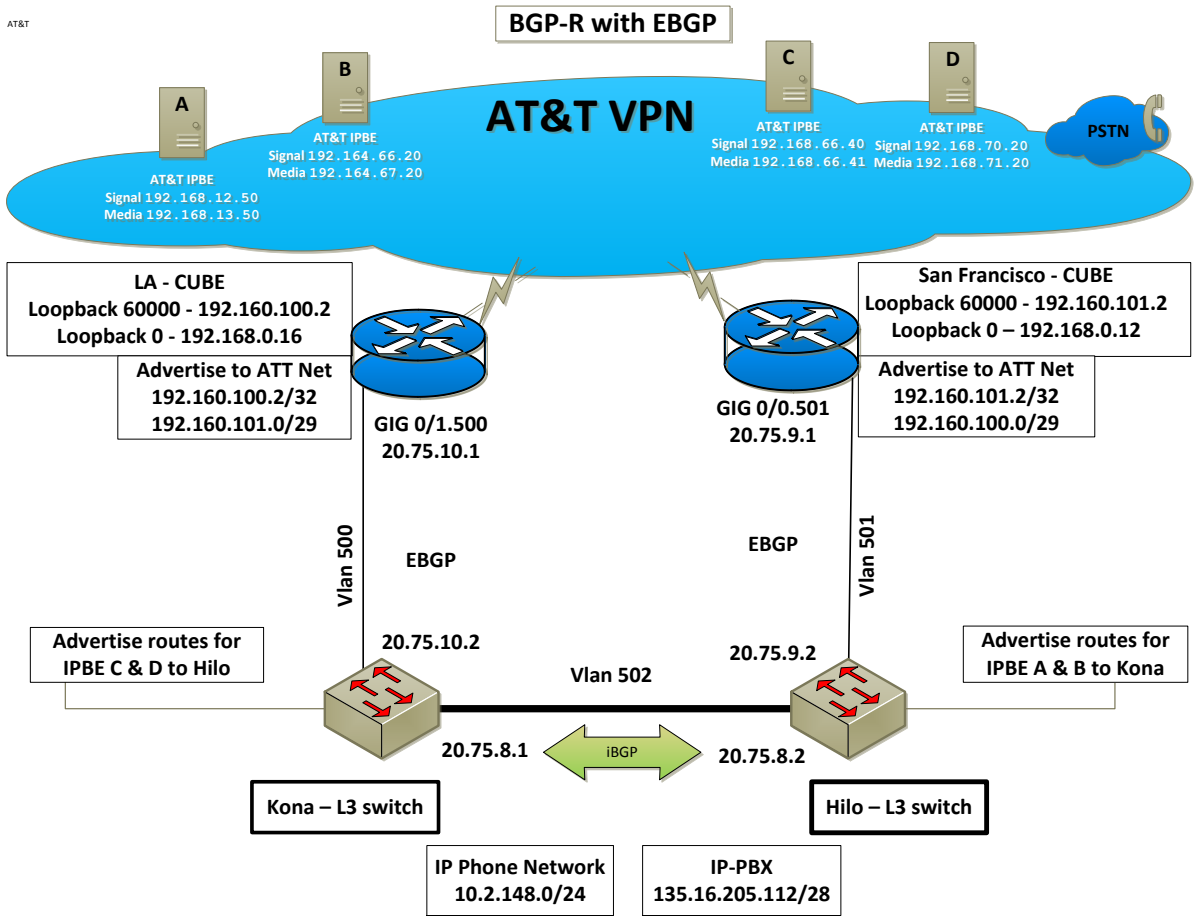
```
ip prefix-list EBGP-Out-CV110 description Prefix list to capture secondary routes to AVPN associated with this CER and redistribute via EBGP
ip prefix-list EBGP-Out-CV110 seq 5 permit <AVPN Route 3>/<prefix size>
ip prefix-list EBGP-Out-CV110 seq 10 permit <AVPN Route  4>/<prefix size>
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH ROUTE TO ADD TO PREFIX LIST***
***If  there are NO Routes to add to the prefix list, only configure the deny statement shown below**
ip prefix-list EBGP-Out-CV110 seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list EBGP-In description - Valid EBGP Routes to be redistributed in
ip prefix-list EBGP-In seq 5 permit <IP PBX and/or IP Phone network>/<Prefix Size>  **Optional**
ip prefix-list EBGP-In seq 15 permit <EBGP Neighbor Loopback Interface>/32
ip prefix-list EBGP-In seq 20 permit <AT&T IP Border Element #1 Signaling IP assigned to this CUBE>/32
ip prefix-list EBGP-In seq 25 permit <AT&T IP Border Element #1 Media IP assigned to this CUBE>/32
ip prefix-list EBGP-In seq 30 permit <AT&T IP Border Element #2 Signaling IP assigned to this CUBE>/32
ip prefix-list EBGP-In seq 35 permit <AT&T IP Border Element #2 Media IP assigned to this CUBE>/32
ip prefix-list EBGP-In seq 40 permit < Data network X advertised via EBGP >/<Prefix Size>
ip prefix-list EBGP-In seq 45 permit < Data network Y advertised via EBGP >/<Prefix Size>
ip prefix-list EBGP-In  seq 50 permit < Data network Z advertised via EBGP >/<Prefix Size>
*** CONTINUE TO ADD SEQUENCE LINE FOR EACH LAN ROUTE TO ADD TO PREFIX LIST***
ip prefix-list EBGP-In seq 100 deny 0.0.0.0/0 le 32
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
access-list 3 permit any
```

Customer must configure network and prefix size for all the data networks to be redistributed from EBGP into AT&T VPN service.

Called by “filter-list 1 in” (under router bgp)

4.2.2 Example Configurations for Integrated CUBE

The following information will be used to populate the sample configurations. Please refer to the diagram below:



Summary of IP Flexible Reach Signaling IP addresses:

CER/CUBE 1 = Los Angeles

- Primary for Los Angeles CUBE with CV of 120 = 192.160.100.2/32
- Backup for San Francisco CUBE with CV of 110= 192.160.101.0/29 (secondary route)

CER/CUBE 2 = San Francisco

- Primary for San Francisco CUBE with CV of 120 = 192.160.101.2 /32
- Backup for Los Angeles CUBE with CV value of 110 = 192.160.100.0 /29 (secondary route)

The following tables show the information that will need to be collected for BGP-R configurations:

CER Name	*Los Angeles*
Location Name	*Main Street*
CER LAN information	
Subinterface #	*Gi 0/2.500*
IP address & mask	*20.75.10.1 mask 255.255.255.0*
VLAN ID	*500*
BGP Loopback IP address	*192.168.0.16*
IP PBX/IP Phone network & mask	*10.2.148.0 mask 255.255.255.0* *135.16.205.112 mask 255.255.255.240*
Primary CUBE with CV Value = 120	
Signaling IP address	*192.160.100.2/32*
Associated IP BE addresses	*192.168.12.50, 192.168.13.50, 192.164.66.20, 192.164.67.20*
Backup CUBE(s) with CV Value= 110	
Signaling IP address(es)	*192.160.101.0/29*
Associated IP BE addresses	*192.168.66.41, 192.168.66.41 , 192.168.70.20, 192.168.71.20*
Backup CUBE(s) with CV Value = 100	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup CUBE(s) with CV Value = 90	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup CUBE(s) with CV Value = 80	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Does customer want AT&T to advertise default route?	*Yes*

CER Name	*San Francisco*
Location Name	*10th Street*
CER LAN information (facing SBC)	
Subinterface #	*Gi 0/0.501*
IP address & mask	*20.75.9.1 mask 255.255.255.0*
VLAN ID	*500*
BGP Loopback IP address	*192.168.0.12*
IP PBX/IP Phone network & mask	*Already being advertised out Los Angeles router*
Primary SBC with CV Value = 120	
Signaling IP address	*192.160.101.2/29*
Associated IP BE addresses	*192.168.66.41, 192.168.66.41 , 192.168.70.20, 192.168.71.20*
Backup SBC(s) with CV Value = 110	
Signaling IP address(es)	*192.160.100.0/29*
Associated IP BE addresses	*192.168.12.50, 192.168.13.50, 192.164.66.20, 192.164.67.20*
Backup SBC(s) with CV Value = 100	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 90	
Signaling IP address(es)	*N/A*
Associated IP BE addresses	
Backup SBC(s) with CV Value = 80	*N/A*
Signaling IP address(es)	
Associated IP BE addresses	
Does customer want AT&T to advertise default route?	*Yes*

Los Angeles:

```
3945E-Los-Angeles#show runn
ip cef
!
interface Loopback0
 description Loopack OSPF/BGP router ID
 ip address 192.168.0.16 255.255.255.255
!
!
interface Loopback60000
 description IP Flexible Reach Signaling IP address
 ip address 192.160.100.2 255.255.255.255
!
!
interface GigabitEthernet0/2
 description - LAN interface
 no ip address
 load-interval 30
 duplex full
 speed 1000
 media-type rj45
!
interface GigabitEthernet0/2.500
 description Trunk to Kona Layer 3 Switch
 encapsulation dot1Q 500
 ip address 20.75.10.1 255.255.255.0
!
router bgp 65000
 bgp router-id 192.168.0.16
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 20.75.10.2 remote-as 65100      **Neighbor to EBGP Layer 3
Switch**
 neighbor 195.18.31.234 fall-over bfd     **Neighbor to AT&T PER**
 neighbor 195.18.31.234 remote-as 13979
 !
 address-family ipv4
  network 20.75.10.0 mask 255.255.255.0            **LAN network**
  network 192.160.100.2 mask 255.255.255.255       **Loopback 60000 IP
Flexible Reach IP address**
  network 192.160.101.0 mask 255.255.255.248       **Backup Route for IP
Flexible Reach IP network San Francisco**
  network 192.168.0.16 mask 255.255.255.255        ** Loopback OSPF/BGP
Router ID **
  network 10.10.54.0 mask 255.255.255.255       **Data network **
  neighbor 195.18.31.234 activate
  neighbor 195.18.31.234 send-community both
  neighbor 195.18.31.234  advertisement-interval 3
  neighbor 195.18.31.234 soft-reconfiguration inbound
  neighbor 195.18.31.234 route-map AVPN_Routes_In in
  neighbor 195.18.31.234 route-map Customer_SBC_Networks out
  neighbor 195.18.31.234 filter-list 1 in
  neighbor 20.75.10.2 activate
  neighbor 20.75.10.2 send-community both
  neighbor 20.75.10.2 advertisement-interval 3
```

```
  neighbor 20.75.10.2 soft-reconfiguration inbound
  neighbor 20.75.10.2 route-map EBGP_In in
  neighbor 20.75.10.2 route-map EBGP_Out out
  neighbor 20.75.10.2 filter-list 1 in
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
ip route 192.160.101.0 255.255.255.248 GigabitEthernet0/2 **Required to
advertise the backup /29 network into BGP table **
ip route 192.168.66.40 255.255.255.255 20.75.10.2 250  **Required to
prioritize routing to AT&T IP Border Elements IP addresses - AT&T IP Border
Element #1 Signaling **
ip route 192.168.66.41 255.255.255.255 20.75.10.2 250   **AT&T IP Border
Element #1 Media**
ip route 192.168.70.20 255.255.255.255 20.75.10.2 250   **AT&T IP Border
Element #2 Signaling**
ip route 192.168.71.20 255.255.255.255 20.75.10.2 250  **AT&T IP Border
Element #2 Media**
!
ip prefix-list CV120 description Primary Routes with CV120
ip prefix-list CV120 seq 5 permit 192.160.100.2/32    **Loopback 60000 IP
Flexible Reach IP address**
ip prefix-list CV120 seq 10 permit 192.168.0.16/32    ** Loopback OSPF/BGP
Router ID **
ip prefix-list CV120 seq 15 permit 10.2.148.0/24       **IP Phone network**
ip prefix-list CV120 seq 20 permit 135.16.205.112/2    **IP PBX network**
ip prefix-list CV120 seq 25 permit 10.10.54.0/24         **Data network
directly connected to CER**
ip prefix-list CV120 seq 30 permit 23.55.11.0/24       **Data network
advertised via EBGP**
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description Secondary Routes with CV110
ip prefix-list CV110 seq 5 permit 192.160.101.0/29    **Backup Route for IP
Flexible Reach IP address on San Francisco**
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV100 description Tertiary Routes with CV100
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description Quaternary Routes with CV90
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description Quinary Routes with CV80
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-In description Valid EBGP Routes to be redistributed in
ip prefix-list EBGP-In seq 5 permit 10.2.148.0/24           **IP Phone
network**
ip prefix-list EBGP-In seq 10 permit 135.16.205.112/28      **IP PBX
network**
```

```
ip prefix-list EBGP-In seq 15 permit 192.168.66.40/32 **AT&T IP Border
Element #1 Signaling IP – San Fran**
ip prefix-list EBGP-In seq 20 permit 192.168.66.41/32 **AT&T IP Border
Element #1 Media IP – San Fran**
ip prefix-list EBGP-In seq 25 permit 192.168.70.20/32 **AT&T IP Border
Element #2 Signaling IP – San Fran**
ip prefix-list EBGP-In seq 30 permit 192.168.71.20/32 **AT&T IP Border
Element #2 Media IP – San Fran**
ip prefix-list EBGP-In seq 35 permit 192.168.0.12/32     **EBGP Neighbor
Loopback Interface**
ip prefix-list EBGP-In seq 40 permit 23.55.11.0/24        **Data network
advertised via EBGP**
ip prefix-list EBGP-In seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list EBGP-Out-CV120 description Prefix list to capture primary
AVPN routes associated with this router to redistribute via EBGP
ip prefix-list EBGP-Out-CV120 seq 5 permit 192.168.12.50/32    **AT&T IP
Border Element #1 Signaling IP – Los Angeles**
ip prefix-list EBGP-Out-CV120 seq 10 permit 192.168.13.50/32  **AT&T IP
Border Element #1 Media IP – Los Angeles **
ip prefix-list EBGP-Out-CV120 seq 15 permit 192.168.66.20/32  **AT&T IP
Border Element #2 Signaling IP – Los Angeles**
ip prefix-list EBGP-Out-CV120 seq 20 permit 192.168.67.20/32   **AT&T IP
Border Element #2 Media IP – Los Angeles **
ip prefix-list EBGP-Out-CV120 seq 25 permit 192.160.100.2/32   ** Loopback
60000 IP Flexible Reach Signaling IP address**
ip prefix-list EBGP-Out-CV120 seq 30 permit 192.168.0.16/32    ** Loopback
OSPF/BGP Router ID **
ip prefix-list EBGP-Out-CV120 seq 35 permit 177.34.2.0/24    ** AVPN route
**
ip prefix-list EBGP-Out-CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV110 description Prefix list to capture backup AVPN
routes associated with this router and redistribute via BGP
ip prefix-list EBGP-Out-CV110 seq 100 deny 0.0.0.0/0 le 32
!
route-map EBGP_Out permit 10
 match ip address prefix-list EBGP-Out-CV120
 set as-path prepend 64600
 set community 65100:120 additive
!
route-map EBGP_Out permit 20
 match ip address prefix-list EBGP-Out-CV110
 set as-path prepend 64600
 set community 65100:110 additive
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
```

```
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map EBGP_In permit 10
 match ip address prefix-list EBGP-In
!
!
access-list 3 permit any
```

San Francisco:

```
3945C-San-Francisco#show runn
ip cef
!
interface Loopback0
 description Loopack OSPF/BGP router ID
 ip address 192.168.0.12 255.255.255.255
!
interface Loopback60000
 description IP Flexible Reach Signaling IP address
 ip address 192.160.101.2 255.255.255.255
!
interface GigabitEthernet0/0
description - LAN interface
 no ip address
 load-interval 30
 duplex full
 speed 1000
 media-type rj45
!
interface GigabitEthernet0/0.501
 description Trunk to Hilo Layer 3 Switch
 encapsulation dot1Q 501
 ip address 20.75.9.1 255.255.255.0
!
!
router bgp 65000
 bgp router-id 192.168.0.12
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 20.75.9.2 remote-as 65100       **Neighbor to EBGP Layer 3
Switch**
 neighbor 192.168.130.46 remote-as 13979  **Neighbor to AT&T PER**
 neighbor 192.168.130.46 fall-over bfd
 !
 address-family ipv4
  network 20.75.9.0 mask 255.255.255.0                **LAN network**
  network 192.160.100.0 mask 255.255.255.248     **Backup Route for IP
Flexible Reach IP network Los Angeles**
  network 192.160.101.2 mask 255.255.255.255          **Loopback 60000 IP
Flexible Reach IP address**
  network 192.168.0.12 mask 255.255.255.255           ** Loopback OSPF/BGP
```

```
Router ID **
  neighbor 192.168.130.46 activate
  neighbor 192.168.130.46 send-community both
  neighbor 195.168.130.46  advertisement-interval 3
  neighbor 192.168.130.46 soft-reconfiguration inbound
  neighbor 192.168.130.46 route-map AVPN_Routes_In in
  neighbor 192.168.130.46 route-map Customer_SBC_Networks out
  neighbor 192.168.130.46 filter-list 1 in
  neighbor 20.75.9.2 activate
  neighbor 20.75.9.2 send-community both
  neighbor 20.75.9.2 advertisement-interval 3
  neighbor 20.75.9.2 soft-reconfiguration inbound
  neighbor 20.75.9.2 route-map EBGP_In in
  neighbor 20.75.9.2 route-map EBGP_Out out
  neighbor 20.75.9.2 filter-list 1 in
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
ip route 192.160.100.0 255.255.255.248 GigabitEthernet0/0   **Required to
advertise the backup /29 network into BGP table **
ip route 192.168.12.50 255.255.255.255 20.75.9.2 250  **Required to
prioritize routing to AT&T IP Border Elements IP addresses – AT&T IP Border
Element #1 Signaling **
ip route 192.168.13.50 255.255.255.255 20.75.9.2 250  **AT&T IP Border
Element #1 Media**
ip route 192.164.66.20 255.255.255.255 20.75.9.2 250  **AT&T IP Border
Element #2 Signaling**
ip route 192.164.67.20 255.255.255.255 20.75.9.2 250  **AT&T IP Border
Element #2 Media**
!
ip prefix-list CV120 description Primary Routes with CV120
ip prefix-list CV120 seq 5 permit 192.160.101.2/32     **Loopback 60000 IP
Flexible Reach IP address**
ip prefix-list CV120 seq 10 permit 192.168.0.12/32    ** Loopback OSPF/BGP
Router ID **
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32

!
ip prefix-list CV110 description Secondary Routes with CV110
ip prefix-list CV110 seq 5 permit 192.160.100.0/29   **Backup Route for IP
Flexible Reach IP address on Los Angeles **
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list CV100 description Tertiary Routes with CV100
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description Quaternary Routes with CV90
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description Quinary Routes with CV80
```

```
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-In description - Valid EBGP Routes to be redistributed
in
ip prefix-list EBGP-In seq 10 permit 192.168.12.50/32 **AT&T IP Border
Element #1 Signaling - Los Angeles **
ip prefix-list EBGP-In seq 15 permit 192.168.13.50/32 **AT&T IP Border
Element #1 Media - Los Angeles **
ip prefix-list EBGP-In seq 20 permit 192.164.66.20/32 **AT&T IP Border
Element #2 Signaling - Los Angeles **
ip prefix-list EBGP-In seq 25 permit 192.164.67.20/32 **AT&T IP Border
Element #2 Media - Los Angeles **
ip prefix-list EBGP-In seq 30 permit 192.168.0.16/32        **EBGP Neighbor
Loopback Interface - Los Angeles **
ip prefix-list EBGP-In seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV120 description Prefix list to capture primary
AVPN routes associated with this CER and redistribute via BGP
ip prefix-list EBGP-Out-CV120 seq 10 permit 192.168.66.40/32      **AT&T IP
Border Element #1 Signaling - San Fran**
ip prefix-list EBGP-Out-CV120 seq 15 permit 192.168.66.41/32      **AT&T IP
Border Element #1 Media - San Fran**
ip prefix-list EBGP-Out-CV120 seq 20 permit 192.164.70.20/32      **AT&T IP
Border Element #2 Signaling - San Fran**
ip prefix-list EBGP-Out-CV120 seq 25 permit 192.164.71.20/32      **AT&T IP
Border Element #2 Media - San Fran**
ip prefix-list EBGP-Out-CV120 seq 30 permit 192.160.101.2/32   ** Loopback
OSPF/BGP Router ID **
ip prefix-list EBGP-Out-CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list EBGP-Out-CV110 description Prefix list to capture secondary
AVPN routes associated with this CER and redistribute voa BGP
ip prefix-list EBGP-Out-CV110 seq 5 permit 177.34.2.0/24    **AVPN route**
ip prefix-list EBGP-Out-CV110 seq 100 deny 0.0.0.0/0 le 32
!
route-map EBGP_Out permit 10
 match ip address prefix-list EBGP-Out-CV120
 set as-path prepend 64600
 set community 13979:120 64100:120 additive
!
route-map EBGP_Out permit 20
 match ip address prefix-list EBGP-Out-CV110
 set as-path prepend 64600
 set community 13979:110 65100:110 additive
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 65100:120 additive
!
route-map Customer_SBC_Networks permit 20
```

```
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 65100:110 additive
!
!
route-map EBGP_In permit 10
 match ip address prefix-list EBGP-In
!
route-map AVPN_Routes_In_Backup permit 20
 match ip address 3
 set weight 60000
!
!
access-list 3 permit any
```

4.2.3 Example Configuration for Cascaded EBGP Layer 3 Switch

The following sample configuration is provided to assist with configuring a cascaded EBGP Cisco Layer 3 Switch for use with BGP-R. This example matches up with the integrated CUBE configuration in this EBGP section. The red highlighted entries are variables that are specific to the customer's environment.

The cascaded EBGP Layer 3 Switch example is designed to have one physical interface facing each of the CERs with integrated CUBE and one physical interface facing the IP PBX/IP Phones. There is an iBGP link between the two Layer 3 Switches.

```
3750-Kona#show runn
!
vlan 148
 name IP-PHONES_VLAN
!
vlan 244
 name CUCM-VLAN
!
vlan 500
 name LosAngeles_VLAN
!
vlan 502
 name TRUNK_BTWN_SWITCHES
!
!
interface Loopback0
 ip address 192.168.0.152 255.255.255.255
!
interface FastEthernet1/0/42
 description - Link To 3945E-Los-Angeles
 switchport access vlan 500
 switchport mode access
!
```

```
!
interface FastEthernet1/0/47
 description - Trunk To 3550-Hilo Switch
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 148,244,502
 switchport mode trunk
!
interface FastEthernet1/0/48
 description - Trunk To Union-Station
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 148,244
 switchport mode trunk
 load-interval 30
!
!
interface Vlan148
 description - Phones Vlan
 ip address 10.2.148.1 255.255.255.0
!
interface Vlan244
 description - CUCM Vlan
 ip address 135.16.205.121 255.255.255.240
!
interface Vlan500
 ip address 20.75.10.2 255.255.255.0
!
interface Vlan502
 ip address 20.75.8.1 255.255.255.0
!
router bgp 65100
 bgp router-id 192.168.0.152
 bgp log-neighbor-changes
 neighbor 20.75.8.2 remote-as 65100    **Neighbor to Switch**
 neighbor 20.75.10.1 remote-as 65000   **Neighbor to Los Angeles**
 !
 address-family ipv4
  redistribute connected
  neighbor 20.75.8.2 activate
  neighbor 20.75.8.2 next-hop-self
  neighbor 20.75.8.2 route-map IBGP_Routes_In in
  neighbor 20.75.10.1 activate
  neighbor 20.75.10.1 send-community
  neighbor 20.75.10.1 route-map Incoming_WAN_Routes in
  neighbor 20.75.10.1 route-map LAN_To_WAN_Routes out
  no auto-summary
  no synchronization
 exit-address-family
!
!
!
```

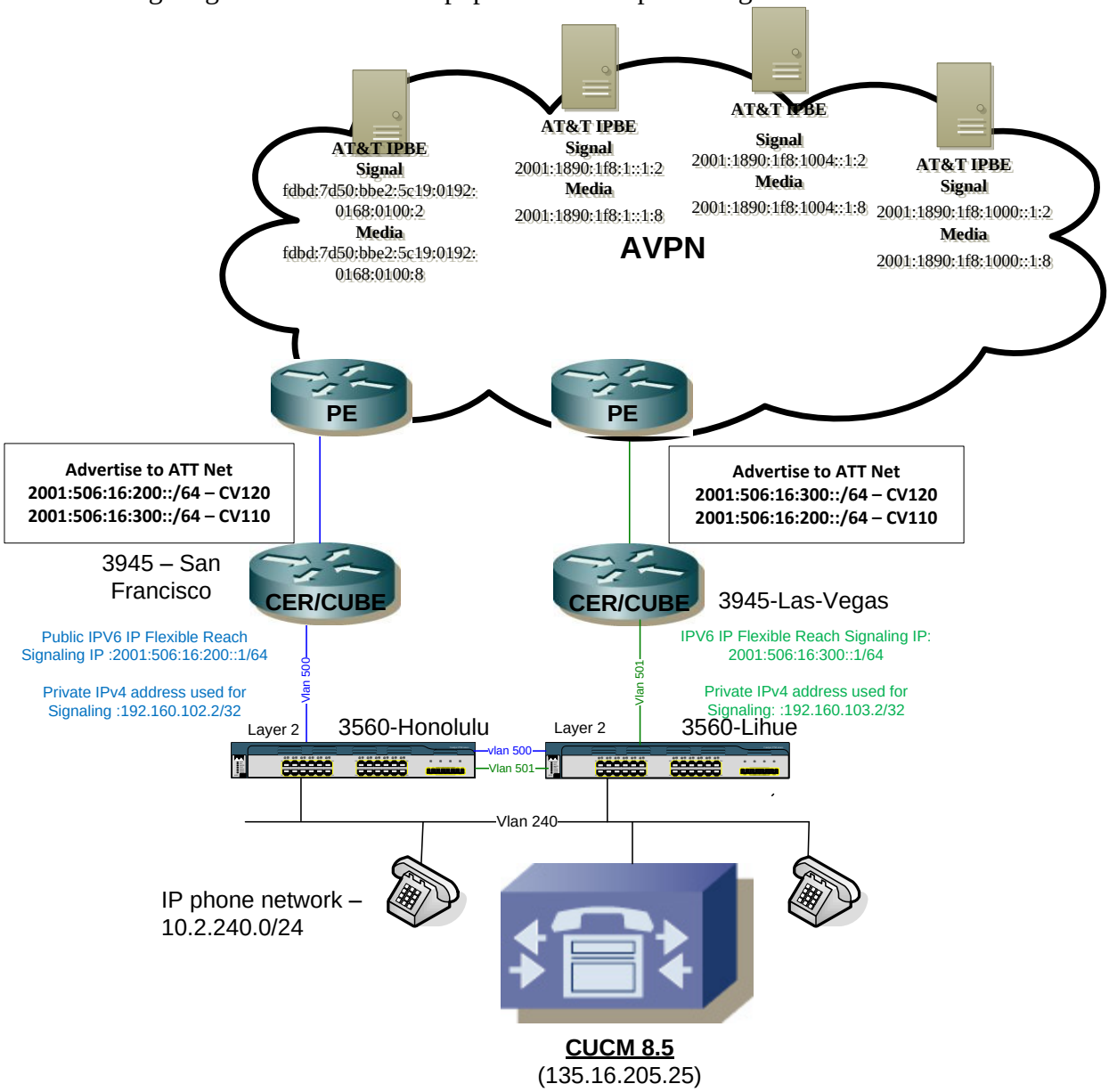
```
ip prefix-list IBGP-Routes-In description IBGP In Routes
ip prefix-list IBGP-Routes-In seq 5 permit 192.160.101.2/32  **San
Francisco CUBE IP Flexible Reach IP address**
ip prefix-list IBGP-Routes-In seq 10 permit 192.168.12.50/32 **AT&T
IP Border Element #1 Signaling - Los Angeles**
ip prefix-list IBGP-Routes-In seq 15 permit 192.168.13.50/32 **AT&T
IP Border Element #1 Media - Los Angeles **
ip prefix-list IBGP-Routes-In seq 20 permit 192.164.66.20/32 **AT&T
IP Border Element #2 Signaling - Los Angeles **
ip prefix-list IBGP-Routes-In seq 25 permit 192.164.67.20/32
     **AT&T IP Border Element #2 Media - Los Angeles **

ip prefix-list IBGP-Routes-In seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list Incoming-WAN-Routes description Incoming WAN Routes
ip prefix-list Incoming-WAN-Routes seq 5 permit 192.160.100.2/32 ****
Los Angeles Loopback 60000 IP Flexible Reach Signaling IP address**
ip prefix-list Incoming-WAN-Routes seq 10 permit 192.168.66.40/32
**AT&T IP Border Element #1 Signaling IP - San Francisco**
ip prefix-list Incoming-WAN-Routes seq 15 permit 192.168.66.41/32
**AT&T IP Border Element #1 Media IP - San Francisco**
ip prefix-list Incoming-WAN-Routes seq 20 permit 192.168.70.20/32
**AT&T IP Border Element #2 Signaling IP - San Francisco**
ip prefix-list Incoming-WAN-Routes seq 25 permit 192.168.71.20/32
**AT&T IP Border Element #2 Media IP - San Francisco**
ip prefix-list Incoming-WAN-Routes seq 30 permit 192.168.0.16/32
** Loopback OSPF/BGP Router ID **
ip prefix-list Incoming-WAN-Routes seq 35 permit 177.34.2.0/24    **
AVPN route **
ip prefix-list Incoming-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list LAN-To-WAN-Routes description - Valid  Routes to be
sent to WAN CER
ip prefix-list LAN-To-WAN-Routes seq 5 permit 190.160.101.2/32 **San
Francisco CUBE IP Flexible Reach IP address**
ip prefix-list LAN-To-WAN-Routes seq 10 permit 192.168.12.50/32
**AT&T IP Border Element #1 Signaling - Los Angeles**
ip prefix-list LAN-To-WAN-Routes seq 15 permit 192.168.13.50/32
**AT&T IP Border Element #1 Media - Los Angeles **
ip prefix-list LAN-To-WAN-Routes seq 20 permit 192.168.13.50/32
**AT&T IP Border Element #1 Media - Los Angeles **
ip prefix-list LAN-To-WAN-Routes seq 25 permit 192.164.67.20/32
     **AT&T IP Border Element #2 Media - Los Angeles **
ip prefix-list LAN-To-WAN-Routes seq 30 permit 10.2.148.0/24  ** IP
phone network **
ip prefix-list LAN-To-WAN-Routes seq 35 permit 135.16.205.112/28
**CUCM network **
ip prefix-list LAN-To-WAN-Routes seq 40 permit 192.168.0.152/32
**Loopback interface for Hilo
ip prefix-list LAN-To-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
```

```
!
route-map IBGP_Routes_In permit 10
 match ip address prefix-list IBGP-Routes-In
!
route-map Incoming_WAN_Routes permit 10
 match ip address prefix-list Incoming-WAN-Routes
 match community 10
 set local-preference 120
!
route-map Incoming_WAN_Routes permit 20
 match ip address prefix-list Incoming-WAN-Routes
 match community 20
 set local-preference 110
!
route-map LAN_To_WAN_Routes permit 10
 match ip address prefix-list LAN-To-WAN-Routes
!
!
!
```

4.2.1 IPV6 Example Configurations

The following diagram will be used to populate the sample configurations.



3945 San Francisco

```
ip cef
ipv6 cef
!
!
!
interface Loopback0
```

```
 description BGP Loopback
 ip address 192.168.0.178 255.255.255.255
 ipv6 address 2001:506:16:100::178/128
!
interface Loopback60000
 description CUBE Loopback
 ip address 192.160.102.2 255.255.255.255
 ipv6 address 2001:506:16:200::1/64
!
!
interface GigabitEthernet0/0/0
 description WAN Link
 mtu 1514
 no ip address
 load-interval 30
 negotiation auto
!
interface GigabitEthernet0/0/0.2708
 encapsulation dot1Q 2708
 ip address 195.18.34.133 255.255.255.252
 ipv6 address 2001:506:15:278::1/64
 bfd interval 999 min_rx 999 multiplier 3
 no bfd echo
!
!
interface GigabitEthernet0/0/2
 description - Trunk To 3560-Honolulu - Port gig0/1
 no ip address
 load-interval 30
 negotiation auto
 hold-queue 2048 in
 hold-queue 2048 out
!
interface GigabitEthernet0/0/2.500
 description Link to 3550-Honolulu - Vlan500
 encapsulation dot1Q 500
 ip address 192.168.50.101 255.255.255.252
 ipv6 address 2002::500:101/126
 ipv6 address 2002::500:100:101/126
 no cdp enable
!
interface GigabitEthernet0/0/3
 no ip address
 shutdown
 negotiation auto
!
!
router bgp 65000
 bgp router-id 192.168.0.178
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 2001:506:15:278::2 remote-as 13979
 neighbor 2001:506:15:278::2 fall-over bfd
 neighbor 2002::500:102 remote-as 65527
 neighbor 192.168.50.102 remote-as 65527
 neighbor 195.18.34.134 remote-as 13979
 !
 address-family ipv4
  network 172.50.128.0 mask 255.255.128.0
  network 192.160.102.2 mask 255.255.255.255
  network 192.168.0.178 mask 255.255.255.255
```

```
  network 195.18.32.8 mask 255.255.255.252
  neighbor 192.168.50.102 activate
  neighbor 192.168.50.102 send-community both
  neighbor 192.168.50.102 soft-reconfiguration inbound
  neighbor 192.168.50.102 route-map IPV4_LAN_To_WAN_Routes in
  neighbor 192.168.50.102 route-map IPV4_WAN_To_LAN_Routes out
  neighbor 195.18.34.134 activate
  neighbor 195.18.34.134 send-community both
  neighbor 195.18.34.134 advertisement-interval 1
  neighbor 195.18.34.134 allowas-in
  neighbor 195.18.34.134 soft-reconfiguration inbound
  neighbor 195.18.34.134 route-map IPV4_AVPN_Routes_In in
  neighbor 195.18.34.134 route-map IPV4_Customer_Networks out
  neighbor 195.18.34.134 filter-list 1 in
 exit-address-family
 !
 address-family ipv6
  network 2001:506:15:102::/64
  network 2001:506:16:100::178/128
  network 2001:506:16:178::/64
  network 2001:506:16:200::/64
  network 2001:506:16:300::/64
  network 2002::500:100/126
  neighbor 2001:506:15:278::2 activate
  neighbor 2001:506:15:278::2 send-community both
  neighbor 2001:506:15:278::2 advertisement-interval 1
  neighbor 2001:506:15:278::2 allowas-in
  neighbor 2001:506:15:278::2 soft-reconfiguration inbound
  neighbor 2001:506:15:278::2 route-map IPV6_AVPN_Routes_In in
  neighbor 2001:506:15:278::2 route-map IPV6_Customer_Networks out
  neighbor 2001:506:15:278::2 filter-list 1 in
  neighbor 2002::500:102 activate
  neighbor 2002::500:102 send-community both
  neighbor 2002::500:102 soft-reconfiguration inbound
  neighbor 2002::500:102 route-map IPV6_LAN_To_WAN_Routes in
  neighbor 2002::500:102 route-map IPV6_WAN_To_LAN_Routes out
 exit-address-family
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
!
!
!
ip prefix-list IPV4-LAN-CV-Value-120 description - CV 120 - Highest Priority
ip prefix-list IPV4-LAN-CV-Value-120 seq 5 permit 192.160.102.2/32
ip prefix-list IPV4-LAN-CV-Value-120 seq 10 permit 0.0.0.0/0
ip prefix-list IPV4-LAN-CV-Value-120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ip prefix-list IPV4-LAN-CV-Value-110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ip prefix-list IPV4-LAN-CV-Value-100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ip prefix-list IPV4-LAN-CV-Value-90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-CV-Value-80 description - CV 80 - 5th Highest Priority
```

```
ip prefix-list IPV4-LAN-CV-Value-80 seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list IPV4-LAN-TO-WAN-Routes description - LAN Routes Allowed Into WAN
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 5 permit 10.2.240.0/24
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 10 permit 135.16.205.25/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 15 permit 192.168.0.150/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 20 permit 192.168.0.151/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-120 description - CV 120 - Highest Priority
ip prefix-list IPV4-WAN-CV-Value-120 seq 5 permit 192.160.102.2/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 10 permit 192.168.0.178/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 15 permit 172.50.128.0/25
ip prefix-list IPV4-WAN-CV-Value-120 seq 20 permit 192.168.0.150/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ip prefix-list IPV4-WAN-CV-Value-110 seq 10 permit 192.168.0.151/32
ip prefix-list IPV4-WAN-CV-Value-110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ip prefix-list IPV4-WAN-CV-Value-100 seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list IPV4-WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ip prefix-list IPV4-WAN-CV-Value-90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ip prefix-list IPV4-WAN-CV-Value-80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4_ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ip prefix-list IPV4_ALLOW-ANY seq 100 permit 0.0.0.0/0 le 32
!
ipv6 route 2001:506:16:300::/64 2002::500:102 250
ipv6 route fdbc:7d50:bbe2:5c19::/64 2002::500:102 250
ipv6 route 2001:1890:01F8:1000::/64 2002::500:102 250
!
!
ipv6 prefix-list IPV6-LAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list IPV6-LAN-CV-Value-120 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list IPV6-LAN-CV-Value-120 seq 10 permit ::/0
ipv6 prefix-list IPV6-LAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-LAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list IPV6-LAN-CV-Value-110 seq 5 permit 2001:1890:1f8:1004::/64
ipv6 prefix-list IPV6-LAN-CV-Value-110 seq 5 permit 2001:1890:1f8:1000::/64
ipv6 prefix-list IPV6-LAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-LAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list IPV6-LAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-LAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list IPV6-LAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-LAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list IPV6-LAN-CV-Value-80 seq 100 deny ::/0 le 128

!
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes description - LAN Routes Allowed Into WAN
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 10 permit 2001:506:16:100::150/128
```

```
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 15 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 10 permit 2001:506:16:100::178/128
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 15 permit 2001:506:16:178::/64
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 20 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 5 permit 2001:506:16:300::/64
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 10 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-80 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6_ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list IPV6_ALLOW-ANY seq 100 permit ::/0 le 128
!
route-map IPV4_AVPN_Routes_In permit 10
 match ip address prefix-list IPV4_ALLOW-ANY
 set weight 64000
!
route-map IPV6_AVPN_Routes_In permit 10
 match ipv6 address prefix-list IPV6_ALLOW-ANY
 set weight 64000
!
route-map IPV6_Customer_Networks permit 10
 match ipv6 address prefix-list IPV6-WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map IPV6_Customer_Networks permit 20
 match ipv6 address prefix-list IPV6-WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map IPV6_Customer_Networks permit 30
 match ipv6 address prefix-list IPV6-WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map IPV6_Customer_Networks permit 40
 match ipv6 address prefix-list IPV6-WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map IPV6_Customer_Networks permit 50
 match ipv6 address prefix-list IPV6-WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map IPV4_WAN_To_LAN_Routes permit 10
```

```
 match ip address prefix-list IPV4-LAN-CV-Value-120
 set metric 100
 set community 13979:120 additive
!
route-map IPV4_WAN_To_LAN_Routes permit 20
 match ip address prefix-list IPV4-LAN-CV-Value-110
 set metric 110
 set community 13979:110 additive
!
route-map IPV4_WAN_To_LAN_Routes permit 30
 match ip address prefix-list IPV4-LAN-CV-Value-100
 set metric 120
 set community 13979:100 additive
!
route-map IPV4_WAN_To_LAN_Routes permit 40
 match ip address prefix-list IPV4-LAN-CV-Value-90
 set metric 130
 set community 13979:90 additive
!
route-map IPV4_WAN_To_LAN_Routes permit 50
 match ip address prefix-list IPV4-LAN-CV-Value-80
 set metric 140
 set community 13979:80 additive
!
route-map IPV4_LAN_To_WAN_Routes permit 10
 match ip address prefix-list IPV4-LAN-TO-WAN-Routes
!
route-map IPV4_Customer_Networks permit 10
 match ip address prefix-list IPV4-WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map IPV4_Customer_Networks permit 20
 match ip address prefix-list IPV4-WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map IPV4_Customer_Networks permit 30
 match ip address prefix-list IPV4-WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map IPV4_Customer_Networks permit 40
 match ip address prefix-list IPV4-WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map IPV4_Customer_Networks permit 50
 match ip address prefix-list IPV4-WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map IPV6_WAN_To_LAN_Routes permit 10
 match ipv6 address prefix-list IPV6-LAN-CV-Value-120
 set metric 100
 set community 13979:120 additive
!
route-map IPV6_WAN_To_LAN_Routes permit 20
 match ipv6 address prefix-list IPV6-LAN-CV-Value-110
 set metric 110
 set community 13979:110 additive
```

```
!
route-map IPV6_WAN_To_LAN_Routes permit 30
 match ipv6 address prefix-list IPV6-LAN-CV-Value-100
 set metric 120
 set community 13979:100 additive
!
route-map IPV6_WAN_To_LAN_Routes permit 40
 match ipv6 address prefix-list IPV6-LAN-CV-Value-90
 set metric 130
 set community 13979:90 additive
!
route-map IPV6_WAN_To_LAN_Routes permit 50
 match ipv6 address prefix-list IPV6-LAN-CV-Value-80
 set metric 140
 set community 13979:80 additive
!
route-map IPV6_LAN_To_WAN_Routes permit 10
 match ipv6 address prefix-list IPV6-LAN-TO-WAN-Routes
!
```

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Note – This configuration provides an example of how to prioritize router to the customer LAN via metrics.

```
ip cef
ipv6 cef
!
!
!
!
interface Loopback0
 description - BGP Loopback
 ip address 192.168.0.11 255.255.255.255
 ipv6 address 2001:506:16:100::11/128
!
interface Loopback60000
 description CUBE Loopback
 ip address 192.160.103.2 255.255.255.255
 ipv6 address 2001:506:16:300::1/64
!
!
interface GigabitEthernet0/0
 description - WAN Link
 no ip address
 load-interval 30
 duplex full
 speed 1000
!
interface GigabitEthernet0/0.2815
 description - PVC To SFCHXRPE4 - Gig0/10/0/4.2815
 encapsulation dot1Q 2815
 ip address 192.168.130.49 255.255.255.252
 ip virtual-reassembly in
 ipv6 address 2001:506:15:34::2/64
 bfd interval 999 min_rx 999 multiplier 3
 no bfd echo
```

```
!
!
interface GigabitEthernet0/2
 no ip address
 load-interval 30
 duplex full
 speed 100
 media-type rj45
!
interface GigabitEthernet0/2.501
 description Link to 3550-Honolulu - Vlan 501
 encapsulation dot1Q 501
 ip address 192.168.51.101 255.255.255.252
 ipv6 address 2002::501:101/126
!
!
router bgp 65000
 bgp router-id 192.168.0.11
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 2001:506:15:34::1 remote-as 13979
 neighbor 2001:506:15:34::1 fall-over bfd
 neighbor 2002::501:102 remote-as 65527
 neighbor 192.168.51.102 remote-as 65527
 neighbor 192.168.130.50 remote-as 13979
 !
 address-family ipv4
  network 172.23.64.0 mask 255.255.192.0
  network 192.160.103.2 mask 255.255.255.255
  network 192.168.0.11 mask 255.255.255.255
  network 192.168.130.48 mask 255.255.255.252
  no neighbor 2001:506:15:34::1 activate
  no neighbor 2002::501:102 activate
  neighbor 192.168.51.102 activate
  neighbor 192.168.51.102 send-community both
  neighbor 192.168.51.102 soft-reconfiguration inbound
  neighbor 192.168.51.102 route-map IPV4_LAN_To_WAN_Routes in
  neighbor 192.168.51.102 route-map IPV4_WAN_To_LAN_Routes out
  neighbor 192.168.130.50 activate
  neighbor 192.168.130.50 send-community both
  neighbor 192.168.130.50 advertisement-interval 1
  neighbor 192.168.130.50 allowas-in
  neighbor 192.168.130.50 soft-reconfiguration inbound
  neighbor 192.168.130.50 route-map IPV4_AVPN_Routes_In in
  neighbor 192.168.130.50 route-map IPV4_Customer_Networks out
  neighbor 192.168.130.50 filter-list 1 in
 exit-address-family
 !
 address-family ipv6
  network 2001:506:15:34::/64
  network 2001:506:16:11::/64
  network 2001:506:16:100::11/128
  network 2001:506:16:200::/64
  network 2001:506:16:300::/64
  network 2002::501:100/126
  neighbor 2001:506:15:34::1 activate
  neighbor 2001:506:15:34::1 send-community both
  neighbor 2001:506:15:34::1 advertisement-interval 1
  neighbor 2001:506:15:34::1 allowas-in
  neighbor 2001:506:15:34::1 soft-reconfiguration inbound
  neighbor 2001:506:15:34::1 route-map IPV6_AVPN_Routes_In in
```

```
  neighbor 2001:506:15:34::1 route-map IPV6_Customer_Networks out
  neighbor 2001:506:15:34::1 filter-list 1 in
  neighbor 2002::501:102 activate
  neighbor 2002::501:102 send-community both
  neighbor 2002::501:102 soft-reconfiguration inbound
  neighbor 2002::501:102 route-map IPV6_LAN_To_WAN_Routes in
  neighbor 2002::501:102 route-map IPV6_WAN_To_LAN_Routes out
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
ip prefix-list IPV4-LAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ip prefix-list IPV4-LAN-CV-Value-100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ip prefix-list IPV4-LAN-CV-Value-110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-CV-Value-120 description - CV 120 - Highest Priority
ip prefix-list IPV4-LAN-CV-Value-120 seq 5 permit 192.160.103.2/32
ip prefix-list IPV4-LAN-CV-Value-120 seq 10 permit 0.0.0.0/0
ip prefix-list IPV4-LAN-CV-Value-120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ip prefix-list IPV4-LAN-CV-Value-80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ip prefix-list IPV4-LAN-CV-Value-90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-LAN-TO-WAN-Routes description - LAN Routes Allowed Into WAN
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 5 permit 10.2.240.0/24
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 10 permit 135.16.205.25/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 15 permit 192.168.0.150/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 20 permit 192.168.0.151/32
ip prefix-list IPV4-LAN-TO-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
!
!
ip prefix-list IPV4-WAN-CV-Value-120 description - CV 120 - Highest Priority
ip prefix-list IPV4-WAN-CV-Value-120 seq 5 permit 192.160.103.2/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 10 permit 192.168.0.11/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 15 permit 172.23.64.0/18
ip prefix-list IPV4-WAN-CV-Value-120 seq 20 permit 192.168.0.151/32
ip prefix-list IPV4-WAN-CV-Value-120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ip prefix-list IPV4-WAN-CV-Value-110 seq 10 permit 192.168.0.150/32
ip prefix-list IPV4-WAN-CV-Value-110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ip prefix-list IPV4-WAN-CV-Value-100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ip prefix-list IPV4-WAN-CV-Value-90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ip prefix-list IPV4-WAN-CV-Value-80 seq 100 deny 0.0.0.0/0 le 32
!
```

```
!
ip prefix-list IPV4_ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ip prefix-list IPV4_ALLOW-ANY seq 100 permit 0.0.0.0/0 le 32
!
ipv6 route 2001:1890:1f8:1004::/64 2002::501:102 250
ipv6 route 2001:1890:1f8:1000::/64 2002::501:102 250
ipv6 route 2001:506:16:200::/64 2002::501:102 250
!
!
!
ipv6 prefix-list IPV6-LAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list IPV6-LAN-CV-Value-120 seq 10 permit 2001:506:16:300::/64
ipv6 prefix-list IPV6-LAN-CV-Value-120 seq 15 permit ::/0
ipv6 prefix-list IPV6-LAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-LAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list IPV6-LAN-CV-Value-110 seq 5 permit fdbc:7d50:bbe2:5c19::/64
ipv6 prefix-list IPV6-LAN-CV-Value-110 seq 10 permit 2001:1890:01F8:1000::/64
ipv6 prefix-list IPV6-LAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-LAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list IPV6-LAN-CV-Value-100 seq 100 deny ::/0 le 128
!
!
ipv6 prefix-list IPV6-LAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list IPV6-LAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-LAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list IPV6-LAN-CV-Value-80 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes description - LAN Routes Allowed Into WAN
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 10 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 15 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-LAN-TO-WAN-Routes seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 10 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6-WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 5 permit 2001:506:16:300::/64
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 10 permit 2001:506:16:100::11/128
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 15 permit 2001:506:16:11::/64
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 20 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-80 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list IPV6-WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6_ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list IPV6_ALLOW-ANY seq 100 permit ::/0 le 128
!
route-map IPV4_AVPN_Routes_In permit 10
 match ip address prefix-list IPV4_ALLOW-ANY
```

```
 set weight 64000
!
route-map IPV6_AVPN_Routes_In permit 10
 match ipv6 address prefix-list IPV6_ALLOW-ANY
 set weight 64000
!
route-map IPV6_Customer_Networks permit 10
 match ipv6 address prefix-list IPV6-WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map IPV6_Customer_Networks permit 20
 match ipv6 address prefix-list IPV6-WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map IPV6_Customer_Networks permit 30
 match ipv6 address prefix-list IPV6-WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map IPV6_Customer_Networks permit 40
 match ipv6 address prefix-list IPV6-WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map IPV6_Customer_Networks permit 50
 match ipv6 address prefix-list IPV6-WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map IPV4_WAN_To_LAN_Routes permit 10
 match ip address prefix-list IPV4-LAN-CV-Value-120
 set metric 100
 set community 13979:120 additive
!
route-map IPV4_WAN_To_LAN_Routes permit 20
 match ip address prefix-list IPV4-LAN-CV-Value-110
 set metric 110
 set community 13979:110 additive
!
route-map IPV4_WAN_To_LAN_Routes permit 30
 match ip address prefix-list IPV4-LAN-CV-Value-100
 set metric 120
 set community 13979:100 additive
!
route-map IPV4_WAN_To_LAN_Routes permit 40
 match ip address prefix-list IPV4-LAN-CV-Value-90
 set metric 130
 set community 13979:90 additive
!
route-map IPV4_WAN_To_LAN_Routes permit 50
 match ip address prefix-list IPV4-LAN-CV-Value-80
 set metric 140
 set community 13979:80 additive
!
route-map IPV4_LAN_To_WAN_Routes permit 10
 match ip address prefix-list IPV4-LAN-TO-WAN-Routes
!
route-map IPV4_Customer_Networks permit 10
 match ip address prefix-list IPV4-WAN-CV-Value-120
```

```
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map IPV4_Customer_Networks permit 20
 match ip address prefix-list IPV4-WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map IPV4_Customer_Networks permit 30
 match ip address prefix-list IPV4-WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map IPV4_Customer_Networks permit 40
 match ip address prefix-list IPV4-WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map IPV4_Customer_Networks permit 50
 match ip address prefix-list IPV4-WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map IPV6_WAN_To_LAN_Routes permit 10
 match ipv6 address prefix-list IPV6-LAN-CV-Value-120
 set metric 100
 set community 13979:120 additive
!
route-map IPV6_WAN_To_LAN_Routes permit 20
 match ipv6 address prefix-list IPV6-LAN-CV-Value-110
 set metric 110
 set community 13979:110 additive
!
route-map IPV6_WAN_To_LAN_Routes permit 30
 match ipv6 address prefix-list IPV6-LAN-CV-Value-100
 set metric 120
 set community 13979:100 additive
!
route-map IPV6_WAN_To_LAN_Routes permit 40
 match ipv6 address prefix-list IPV6-LAN-CV-Value-90
 set metric 130
 set community 13979:90 additive
!
route-map IPV6_WAN_To_LAN_Routes permit 50
 match ipv6 address prefix-list IPV6-LAN-CV-Value-80
 set metric 140
 set community 13979:80 additive
!
route-map IPV6_LAN_To_WAN_Routes permit 10
 match ipv6 address prefix-list IPV6-LAN-TO-WAN-Routes
```

Cascaded Layer 3 Switch Example – 3560 Lihue

Note – this configuration provides an example of how to convert CV values to Local Preferences.

```
3560-Lihue#
```

```
!
vlan 240
 name CUCM-9-10-PHONES
!
vlan 500
 name BGP-R-IPV6-CER1
!
vlan 501
 name BGP-R-IPV6-CER2
!
vlan 502
 name BGP-R-IPV6-CROSS-LINK
!
!
!
!
!
!
interface Loopback0
 ip address 192.168.0.151 255.255.255.255
 ipv6 address 2001:506:16:100::151/128
 ipv6 enable
!
interface FastEthernet0/1
!
interface FastEthernet0/2
 description - Trunk To 3945-Las-Vegas (EBGP #2 Router)
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 501
 switchport mode trunk
 speed 100
 duplex full
 spanning-tree portfast trunk
!
interface FastEthernet0/23
 description - Trunk To 3560-Honolulu
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 502,503
 switchport mode trunk
!
interface FastEthernet0/24
 description - Trunk To Union-Station
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 240,4001
 switchport mode trunk
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 no ip address
 shutdown
!
interface Vlan240
 description - CUCM8.5 - Phones Vlan
 ip address 10.2.240.249 255.255.255.0
 standby version 2
 standby 1 ip 10.2.240.247
 standby 1 timers 1 3
 standby 1 priority 110
```

```
 standby 1 preempt
!
interface Vlan501
 description - BGP Link To CER1
 ip address 192.168.51.102 255.255.255.252
 ipv6 address 2002::501:102/126
!
interface Vlan502
 description - IBGP Link To Customer L2/L3 device
 ip address 192.168.52.102 255.255.255.252
 ipv6 address 2002::502:102/126
!
interface Vlan503
 description - Customer Core BGP Vlan
 ip address 192.168.53.102 255.255.255.240
 ipv6 address 2002::503:102/125
!
!
router bgp 65527
 bgp router-id 192.168.0.151
 bgp log-neighbor-changes
 neighbor 2002::501:101 remote-as 65000
 neighbor 2002::502:101 remote-as 65527
 neighbor 2002::503:101 remote-as 65000
 neighbor 192.168.51.101 remote-as 65000
 neighbor 192.168.52.101 remote-as 65527
 neighbor 192.168.53.101 remote-as 65000
 !
 address-family ipv4
  no neighbor 2002::501:101 activate
  no neighbor 2002::502:101 activate
  no neighbor 2002::503:101 activate
  neighbor 192.168.51.101 activate
  neighbor 192.168.51.101 send-community both
  neighbor 192.168.51.101 route-map IPV4_WAN_Routes in
  neighbor 192.168.51.101 route-map IPV4_LAN_Routes out
  neighbor 192.168.52.101 activate
  neighbor 192.168.52.101 next-hop-self
  neighbor 192.168.53.101 activate
  neighbor 192.168.53.101 send-community both
  neighbor 192.168.53.101 route-map IPV4_WAN_Routes in
  neighbor 192.168.53.101 route-map IPV4_LAN_Routes out
  no auto-summary
  no synchronization
  network 10.2.240.0 mask 255.255.255.0
  network 135.16.205.25 mask 255.255.255.255
  network 192.168.0.151 mask 255.255.255.255
 exit-address-family
 !
 address-family ipv6
  neighbor 2002::501:101 activate
  neighbor 2002::501:101 send-community both
  neighbor 2002::501:101 route-map IPV6_WAN_Routes in
  neighbor 2002::501:101 route-map IPV6_LAN_Routes out
  neighbor 2002::502:101 activate
  neighbor 2002::502:101 next-hop-self
  neighbor 2002::503:101 activate
  neighbor 2002::503:101 send-community both
  neighbor 2002::503:101 route-map IPV6_WAN_Routes in
  neighbor 2002::503:101 route-map IPV6_LAN_Routes out
  network 2001:506:16:100::151/128
```

```
 exit-address-family
!
ip route 135.16.205.25 255.255.255.255 10.2.240.250
!
ip bgp-community new-format
ip community-list 10 permit 13979:120
ip community-list 20 permit 13979:110
ip community-list 30 permit 13979:90
ip community-list 40 permit 13979:80
!
!
ip prefix-list IPV4-LAN-Routes description - Ipv4 LAN Routes To Be Sent To CE/WAN
ip prefix-list IPV4-LAN-Routes seq 5 permit 10.2.240.0/24
ip prefix-list IPV4-LAN-Routes seq 10 permit 135.16.205.25/32
ip prefix-list IPV4-LAN-Routes seq 15 permit 192.168.0.150/32
ip prefix-list IPV4-LAN-Routes seq 20 permit 192.168.0.151/32
ip prefix-list IPV4-LAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IPV4-WAN-Routes description - IPv4 Incoming WAN Routes
ip prefix-list IPV4-WAN-Routes seq 5 permit 192.160.103.2/32
ip prefix-list IPV4-WAN-Routes seq 10 permit 0.0.0.0/0
ip prefix-list IPV4-WAN-Routes seq 100 deny 0.0.0.0/0 le 32
!
!
ipv6 prefix-list IPV6-LAN-Routes description - Ipv6 LAN Routes To Be Sent To CE/WAN
ipv6 prefix-list IPV6-LAN-Routes seq 15 permit 2001:506:16:100::150/128
ipv6 prefix-list IPV6-LAN-Routes seq 20 permit 2001:506:16:100::151/128
ipv6 prefix-list IPV6-LAN-Routes seq 100 deny ::/0 le 128
!
ipv6 prefix-list IPV6-WAN-Routes description - IPv6 Incoming WAN Routes
ipv6 prefix-list IPV6-WAN-Routes seq 5 permit 2001:506:16:300::/64
ipv6 prefix-list IPV6-WAN-Routes seq 15 permit FDBD:7D50:BBE2:5C19::/64
ipv6 prefix-list IPV6-WAN-Routes seq 20 permit 2001:1890:1f8::/64

ipv6 prefix-list IPV6-WAN-Routes seq 25 permit ::/0
ipv6 prefix-list IPV6-WAN-Routes seq 100 deny ::/0 le 128
route-map IPV4_WAN_Routes permit 10
 match ip address prefix-list IPV4-WAN-Routes
 match community 10
 set local-preference 120
!
route-map IPV4_WAN_Routes permit 20
 match ip address prefix-list IPV4-WAN-Routes
 match community 20
 set local-preference 110
!
route-map IPV4_WAN_Routes permit 30
 match ip address prefix-list IPV4-WAN-Routes
 match community 30
 set local-preference 90
!
route-map IPV4_WAN_Routes permit 50
 match ip address prefix-list IPV4-WAN-Routes
 set local-preference 100
!
route-map IPV6_WAN_Routes permit 10
 match community 10
 match ipv6 address prefix-list IPV6-WAN-Routes
 set local-preference 120
!
route-map IPV6_WAN_Routes permit 20
```

```
 match community 20
 match ipv6 address prefix-list IPV6-WAN-Routes
 set local-preference 110
!
route-map IPV6_WAN_Routes permit 30
 match community 30
 match ipv6 address prefix-list IPV6-WAN-Routes
 set local-preference 90
!
route-map IPV6_WAN_Routes permit 40
 match ip address prefix-list IPV4-WAN-Routes
 match community 40
 match ipv6 address prefix-list IPV6-WAN-Routes
 set local-preference 80
!
route-map IPV6_WAN_Routes permit 50
 match ipv6 address prefix-list IPV6-WAN-Routes
 set local-preference 100
!
route-map IPV6_LAN_Routes permit 10
 match ipv6 address prefix-list IPV6-LAN-Routes
!
route-map IPV4_LAN_Routes permit 10
 match ip address prefix-list IPV4-LAN-Routes
```

4.3 *Router Configurations with HSRP*

This section provides templates and examples to configure integrated CUBEs to work with HSRP on the LAN. HSRP configurations will support two integrated CUBEs interconnected with an iBGP link.

4.3.1 Configuration Templates for Call Preservation with HSRP on LAN

The configurations provided in this section are in addition to the base CER configuration (see section 1.3 for links to the CER CCGs).

Refer to section 1.3.2 for a diagram of CERs with Call Preservation using HSRP.

The table below is provided to assist with gathering information for the template variables.

CER entry	Where is information obtained?
Interface Configuration	
Loopback interface IP address for BGP router-id	Private IP address determined by the customer. Used for BGP router-id.
Loopback interface IP address for CUBE IP Flexible Reach signaling	Public IP address. Can be AT&T or customer provided.
LAN sub-interface numbers	Determined by the customer.
VLAN IDs	Determined by the customer.

VLAN interface IP addresses (link to layer 2 switch)	Determined by the customer.
HSRP IP address (virtual IP)	Determined by the customer.
Routing Configuration	
BGP AS Number	Number provided by customer with initial order for AT&T VPN service.
Loopback interface IP address for BGP router-id	Private IP address determined by the customer. Used for BGP router-id.
AT&T PER IP address	Provided by customer with initial order for AT&T VPN service.
Remote AS number	Provided by AT&T.
CUBE IP Flexible Reach Signaling IP address	Public AT&T IP Flexible Reach Signaling IP address for the CUBE. Can be AT&T or customer provided.
IP address of VLAN interfaces	IP address required for each VLAN interface that is on the same network as the CER.
IP address of IP Border Elements	IP address of one of the AT&T IP Border Elements (customers are provided with at least two addresses). This is a public IP address that is provided by AT&T. Note: AT&T IP Border Element may have separate Signaling and Media IP addresses.

4.3.2 CER Configuration (BGP-R and HSRP) Template

This solution **only** supports two integrated CUBEs connected via an IBGP link. One router will be referred to as CER1 and the other router CER2.

HSRP Template:

```
ip cef
!
!
interface Loopback0
 description – Loopback for BGP router-id and management -
 ip address <IP address> 255.255.255.255
!
interface Loopback60000
```

IP Address used for BGP router-id. Each CER participating in BGP-R will get a unique IP address.

```
 description - Loopback for IP Flexible Reach Signaling IP address
 ip address <IP address> 255.255.255.255
!
interface GigabitEthernet <interface number>
 no ip address
 !
interface GigabitEthernet <sub- interface number for local/primary CUBE>
 description - Link to Customer's Layer 2/3 Device
 encapsulation dot1Q <VLAN ID>
 ip address <IP address> <subnet mask>
 standby version 2
 standby 1 ip <HSRP IP address>
 standby 1 timers 1 3
 standby 1 priority 120
 standby 1 preempt delay minimum 60
!
interface GigabitEthernet <sub- interface number for backup CUBE>
 description - Link to Layer 2/3 Device
 encapsulation dot1Q <VLAN ID>
 ip address <IP address> <subnet mask>
 standby version 2
 standby 1 ip <HSRP IP address>
 standby 1 timers 1 3
 standby 1 priority 110
 standby 1 preempt
!
****OPTION 1 for BGP Healing Link (RECOMMENDED OPTION) : Use this option if both CERs in HSRP group each have spare Gigabit Ethernet port.  These ports will be used to directly connect the CERs.  ****
interface GigabitEthernet<interface number>
 description - BGP Healing Link for HSRP
 ip address 1.1.1.<1 or 2> 255.255.255.252
!
****OPTION 2 for BGP Healing Link: Use this option if the CERs in the HSRP group do NOT each have a spare Gigabit Ethernet port.  In this case, the only option is to create another sub-interface off the LAN port already connected to the customer's Layer 2/3 device****
interface GigabitEthernet0/0/1.600
 description - BGP Healing Link for HSRP
```

Sub-interface IP address and HSRP IP address provided by customer.

Sub-interface IP address and HSRP IP address provided by customer. Subnet mask should be /29.

Suggestion:
CER1 can use IP address of 1.1.1.1.
CER2 can use IP address of 1.1.1.2.

Check to make sure VLAN ID of 600 is not in already in use.

```
encapsulation dot1Q 600
ip address 1.1.1.<1 or 2> 255.255.255.252
!
!
interface GigabitEthernet <Ethernet interface connecting to the Voice Quality Monitor>
ip address <LAN IP address determined by VQM model> <mask>
!
router bgp <AS number>
 bgp router-id <Loopback 0 IP address for BGP router-id>
 timers bgp 3 9
 neighbor <AT&T PER IP Address> remote-as <remote AS number>
 neighbor 1.1.1.<1 or 2> remote-as 6500
 !
 address-family ipv4
  network <Primary/local CUBE IP Flexible Reach IP address> mask 255.255.255.255
  network <Backup CUBE IP Flexible Reach IP  network> mask 255.255.255.248
  network <Loopback 0 IP Address for BGP/management ID> mask 255.255.255.255
  network <IP PBX and/or IP Phone network> mask <subnet mask>  **optional**
  network <VQM network > mask <subnet mask>
  network <IP Address of Data Network1> mask <subnet mask>
  network <IP Address of  Data Network2> mask <subnet mask>
  network <IP Address of Data Network3> mask <subnet mask>
  ***** NOTE - There can be multiple network statements*****
  neighbor <AT&T PER IP Address> activate
  neighbor <AT&T PER IP Address> send-community both
  neighbor <AT&T PER IP Address> soft-reconfiguration inbound
  neighbor <AT&T PER IP Address> route-map AVPN_Routes_In in
  neighbor <AT&T PER IP Address> route-map Customer_SBC_Networks out
  neighbor <AT&T PER IP Address> filter-list 1 in
  neighbor <IBGP Neighbor IP Address> activate
  neighbor <IBGP Neighbor IP Address> route-map IBGP_In in
  neighbor <IBGP Neighbor IP Address> next-hop-self
  no auto-summary
  no synchronization
 exit-address-family
!
```

Suggestion:
CER1 can use IP address of 1.1.1.1.
CER2 can use IP address of 1.1.1.2

"Network" statements for additional local hosts or networks that need to be redistributed with BGP. Network statements needed for VQM if present, are provided by AT&T. NOTE: There may already be existing network statements in the BGP configuration. All networks statements will now need to be added into the "ip prefix-list CV120" portion of the configuration (see farther down in template).

```
ip route <IP PBX/IP Phone network> <Subnet Mask> GigabitEthernet<sub-interface or ip address for IP PBX/IP phone network>
ip route <Backup CUBE IP Flexible Reach IP  network> 255.255.255.248 GigabitEthernet <iBGP Neighbor IP address>
!
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map IBGP_In permit 10
 match ip address prefix-list IBGP-In
!
route-map Customer_SBC_Networks permit 10   **Route-map for Primary CUBE**
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community <PER AS number>:120 additive
!
route-map Customer_SBC_Networks permit 20      ** Route-map for Secondary CUBE**
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community <PER AS number>:110 additive
!
!
!
ip prefix-list CV120 description – Primary CUBE Route
ip prefix-list CV120 seq 5 permit <Primary CUBE IP Flexible Reach IP Address>/32
ip prefix-list CV120 seq 10 permit <Loopback 0 IP Address for BGP/management ID>/32
ip prefix list CV120 seq 18 permit <IP PBX and/or IP Phone network>/<Prefix Size>
ip prefix list CV120 seq 19 permit <VQM Network>/<Prefix Size>
ip prefix-list CV120 seq 20 permit <Network1>/<Prefix Size>
ip prefix-list CV120 seq 21 permit <Network2>/<Prefix Size>
ip prefix-list CV120 seq 22 permit <Network3>/<Prefix Size>
***NOTE - Insert additional prefix-list entries for each network statement***
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
```

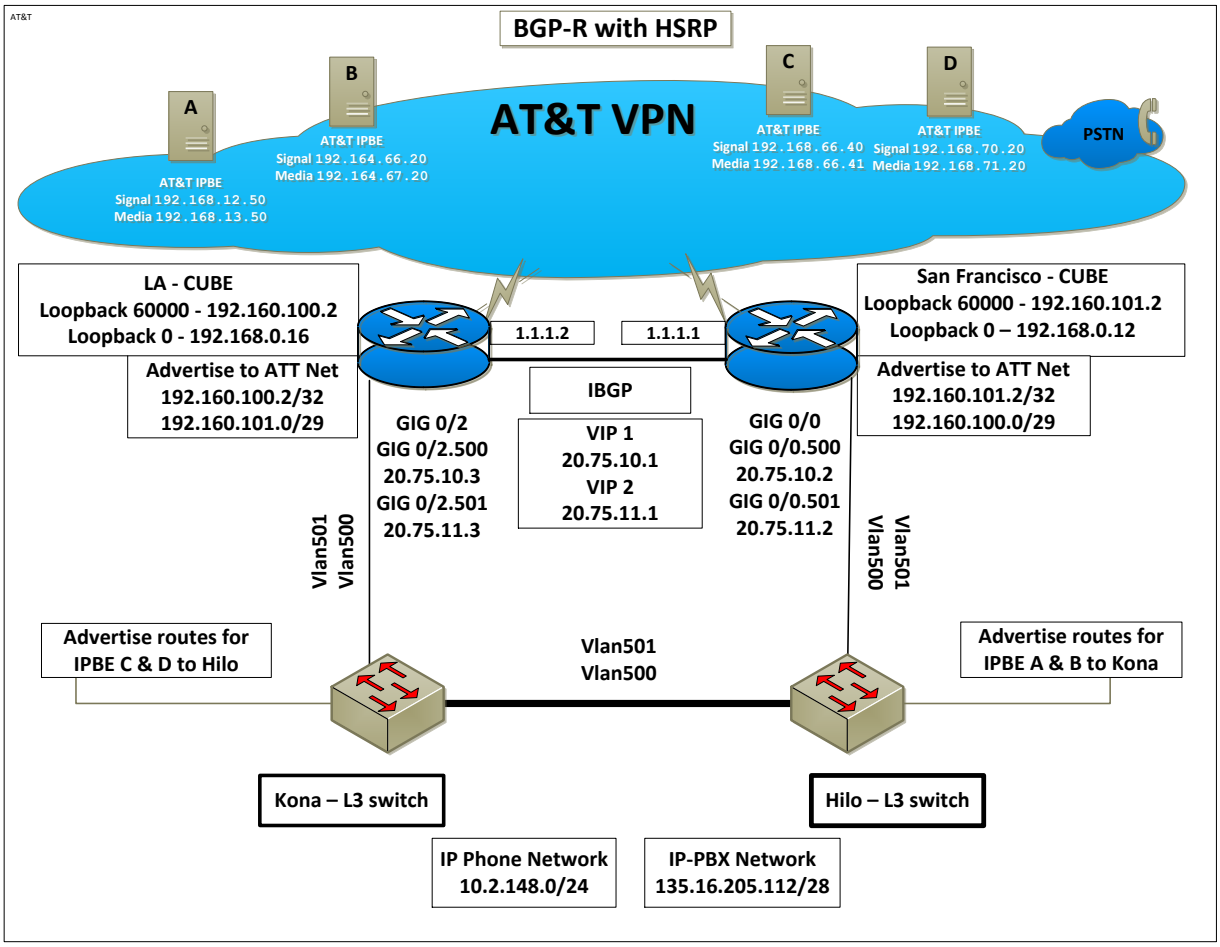
Insert one prefix list entry for each network statement that appears in the BGP section of the configuration. Start seq # at 20 and increase each "seq #" by 1.

```
ip prefix-list CV110 description – Secondary CUBE with CV of 110
ip prefix-list CV110 seq 5 permit <Secondary  CUBE IP Flexible Reach network>/29
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IBGP-In description - IBGP Routes Allowed In
ip prefix-list IBGP-In seq 5 deny <Primary CUBE IP Flexible Reach IP address>/32
ip prefix-list IBGP-In seq 10 deny <Secondary CUBE IP Flexible Reach network>/29
ip prefix-list IBGP-In seq 100 permit 0.0.0.0/0 le 32
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
access-list 3 permit any
```

Called by "filter-list 1 in" (under router bgp)

4.3.3 Example Configurations

The following information will be used to populate the sample configurations. Please refer to the diagram below:



Summary of IP Flexible Reach Signaling IP addresses:

CER1 = Los Angeles

- Primary CUBE = 192.160.100.2/32 with CV of 120 (primary route)
- Backup CUBE = 192.160.101.0/29 with CV of 110 (secondary route)

CER2 = San Francisco

- Primary CUBE = 192.160.101.2/32 with CV of 120 (primary route)
- Backup CUBE = 192.160.100.0/29 with CV of 110 (secondary route)

The following tables show the information that will need to be collected for BGP-R configurations:

CER Name	*Los Angeles*
Location Name	*Main Street*
CER LAN information (facing switch)	
Sub-interface #	*Gi 0/2.500*
IP address & mask	*20.75.10.3 mask 255.255.255.0*
HSRP IP address (virtual IP)	*20.75.10.1*
VLAN ID	*500*
Sub-interface #	*Gi 0/0.501*
IP address & mask	*20.75.11.3 mask 255.255.255.0*
HSRP IP address (virtual IP)	*20.75.11.1*
VLAN ID	*501*
OSPF/BGP Loopback IP address	*192.168.0.16*
IP PBX/IP Phone network & mask	*10.10.148.0 mask 255.255.255.0 & 135.16.205.116 mask 255.255.255.255*
Primary CUBE with CV Value = 120	
Signaling IP address	*192.160.100.2/32*
Backup CUBE with CV Value= 110	
Signaling IP address	*192.160.101.0/29*

CER Name	*San Francisco*
Location Name	*Fulton Street*
CER LAN information (facing switch)	
Sub-interface #	*Gi 0/0.500*
IP address & mask	*20.75.10.2 mask 255.255.255.0*
HSRP IP Address	*20.75.10.1*
VLAN ID	*500*
Sub-interface #	*Gi 0/0.501*
IP address & mask	*20.75.11.2 mask 255.255.255.0*
HSRP IP Address	*20.75.11.1*
VLAN ID	*501*
OSPF/BGP Loopback IP address	*192.168.0.12*
IP PBX/IP Phone network & mask	*10.10.148.0 mask 255.255.255.0 &*

	135.16.205.116 mask 255.255.255.255
Primary CUBE with CV Value = 120	
Signaling IP address	*192.160.101.2/32*
Backup CUBE with CV Value = 110	
Signaling IP address(es)	*192.160.100.0/29*

Los Angeles

```
3945E-Los-Angeles#show runn
ip cef
!
!
!
!
interface Loopback0
 description - Loopback for BGP router-id
 ip address 192.168.0.16 255.255.255.255
!
interface Loopback60000
 description - Loopback for Signaling and Media IP Address
 ip address 192.160.100.2 255.255.255.255
!
interface GigabitEthernet0/0
 description - WAN Physical Interface
 no ip address
 load-interval 30
 duplex auto
 speed 1000
 hold-queue 2048 in
 hold-queue 2048 out
!
!
interface GigabitEthernet0/0.508
 description - WAN Access Sub-Interface
 encapsulation dot1Q 508
 ip address 195.18.31.233 255.255.255.252
 ip virtual-reassembly in
 bfd interval 999 min_rx 999 multiplier 3
 no bfd echo
!
!
```

```
interface GigabitEthernet0/2
 description - Physical Link To Switch
 no ip address
 duplex full
 speed 100
!
interface GigabitEthernet0/2.500
 description - Link to Switch VLAN500
 encapsulation dot1Q 500
 ip address 20.75.10.3 255.255.255.0
 standby version 2
 standby 1 ip 20.75.10.1
 standby 1 timers 1 3
 standby 1 priority 120
 standby 1 preempt delay minimum 60
!
interface GigabitEthernet0/2.501
 description - Link to Switch VLAN501
 encapsulation dot1Q 501
 ip address 20.75.11.3 255.255.255.0
 standby version 2
 standby 2 ip 20.75.11.1
 standby 2 timers 1 3
 standby 2 priority 110
 standby 2 preempt
!
interface GigabitEthernet0/3
 description - BGP Healing Link for HSRP
 ip address 1.1.1.2 255.255.255.252
 duplex full
 speed 1000
!
!
router bgp 65000
 bgp router-id 192.168.0.16
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 1.1.1.1 remote-as 65000
 neighbor 195.18.31.234 remote-as 13979
 neighbor 195.18.31.234 fall-over bfd
 !
 address-family ipv4
  network 10.2.148.0 mask 255.255.255.0
  network 20.75.10.0 mask 255.255.255.0
  network 135.16.205.116 mask 255.255.255.255
  network 192.160.100.2 mask 255.255.255.255
  network 192.160.101.0 mask 255.255.255.248
  network 192.168.0.16 mask 255.255.255.255
  neighbor 1.1.1.1 activate
```

```
  neighbor 1.1.1.1 next-hop-self
  neighbor 1.1.1.1 route-map IBGP_In in
  neighbor 195.18.31.234 activate
  neighbor 195.18.31.234 send-community both
  neighbor 195.18.31.234 soft-reconfiguration inbound
  neighbor 195.18.31.234 route-map AVPN_Routes_In in
  neighbor 195.18.31.234 route-map Customer_SBC_Networks out
  neighbor 195.18.31.234 filter-list 1 in
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
ip route 10.2.148.0 255.255.255.0 GigabitEthernet0/2.500
ip route 135.16.205.116 255.255.255.255 GigabitEthernet0/2.500
ip route 192.160.101.0 255.255.255.248 1.1.1.1
!
!
ip prefix-list CV120 description Primary SBC route
ip prefix-list CV120 seq 5 permit 192.160.100.2/32
ip prefix-list CV120 seq 10 permit 192.168.0.16/32
ip prefix-list CV120 seq 15 permit 10.2.148.0/24
ip prefix-list CV120 seq 20 permit 135.16.205.112/28
ip prefix-list CV120 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description - Secondary Backup IP Flexible Reach Signaling IP Address with CV
of 110
ip prefix-list CV110 seq 5 permit 192.160.101.0/29
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
!
ip prefix-list IBGP-In description - IBGP Routes Allowed In
ip prefix-list IBGP-In seq 5 deny 192.160.100.2/32
ip prefix-list IBGP-In seq 10 deny 192.160.101.0/29
ip prefix-list IBGP-In seq 100 permit 0.0.0.0/0 le 32
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_SBC_Networks permit 20
```

```
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map IBGP_In permit 10
 match ip address prefix-list IBGP-In
!
access-list 3 permit any
!
3945E-Los-Angeles#
```

San Francisco

```
3945C-San-Francisco#show runn

ip cef
!
!
!
!
!
interface Loopback0
 description - Loopback for BGP router-id
 ip address 192.168.0.12 255.255.255.255
!
interface Loopback60000
 description - Loopback for IP Flex Signaling and Media IP Address
 ip address 192.160.101.2 255.255.255.255
!
!
interface GigabitEthernet0/0
 description - Trunk to Switch
 no ip address
 duplex full
 speed 100

!
interface GigabitEthernet0/0.500
 description - Link to Switch VLAN500
 encapsulation dot1Q 500
 ip address 20.75.10.2 255.255.255.0
 standby version 2
 standby 1 ip 20.75.10.1
 standby 1 timers 1 3
 standby 1 priority 110
 standby 1 preempt
!
interface GigabitEthernet0/0.501
 description - Link to Switch VLAN501
```

```
 encapsulation dot1Q 501
 ip address 20.75.11.2 255.255.255.0
 standby version 2
 standby 2 ip 20.75.11.1
 standby 2 timers 1 3
 standby 2 priority 120
 standby 2 preempt delay minimum 60
!
interface GigabitEthernet0/1
 description - BGP Healing Link for HSRP
 ip address 1.1.1.1 255.255.255.252
 duplex full
 speed 1000

!
interface GigabitEthernet0/2
 description - WAN Physical Interfaces
 no ip address
 duplex auto
 speed 1000
!
interface GigabitEthernet0/2.2814
 description - WAN Access sub-interface
 encapsulation dot1Q 2814
 ip address 192.168.130.45 255.255.255.252
 bfd interval 999 min_rx 999 multiplier 3
 no bfd echo
!
!
router bgp 65000
 bgp router-id 192.168.0.12
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 1.1.1.2 remote-as 65000
 neighbor 192.168.130.46 remote-as 13979
 neighbor 192.168.130.46 fall-over bfd
 !
 address-family ipv4
  network 10.2.148.0 mask 255.255.255.0
  network 20.75.9.0 mask 255.255.255.0
  network 135.16.205.116 mask 255.255.255.255
  network 192.160.100.0 mask 255.255.255.248
  network 192.160.101.2 mask 255.255.255.255
  network 192.168.0.12 mask 255.255.255.255
  neighbor 1.1.1.2 activate
  neighbor 1.1.1.2 next-hop-self
  neighbor 1.1.1.2 route-map IBGP_In in
  neighbor 192.168.130.46 activate
  neighbor 192.168.130.46 send-community both
```

```
  neighbor 192.168.130.46 soft-reconfiguration inbound
  neighbor 192.168.130.46 route-map AVPN_Routes_In in
  neighbor 192.168.130.46 route-map Customer_SBC_Networks out
  neighbor 192.168.130.46 filter-list 1 in
 exit-address-family
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
ip route 10.2.148.0 255.255.255.0 GigabitEthernet0/0.501
ip route 135.16.205.116 255.255.255.255 GigabitEthernet0/0.501
ip route 192.160.100.0 255.255.255.248 1.1.1.2
!
!
!
ip prefix-list CV100 description - Community Value 100 - 3rd Highest Priority
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV110 description - Secondary Backup IP Flexible Reach Signaling IP Address with CV
of 110
ip prefix-list CV110 seq 5 permit 192.160.100.0/29
ip prefix-list CV110 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description - Community Value 80 - 5th Highest Priority
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description - Community Value 90 - 4th Highest Priority
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV100 description - Community Value 100 - 3rd Highest Priority
ip prefix-list CV100 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV80 description - Community Value 80 - 5th Highest Priority
ip prefix-list CV80 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list CV90 description - Community Value 90 - 4th Highest Priority
ip prefix-list CV90 seq 100 deny 0.0.0.0/0 le 32
!
ip prefix-list IBGP-In description - IBGP Routes Allowed In
ip prefix-list IBGP-In seq 5 deny 192.160.101.2/32
ip prefix-list IBGP-In seq 10 deny 192.160.100.0/29
ip prefix-list IBGP-In seq 100 permit 0.0.0.0/0 le 32
!
route-map AVPN_Routes_In permit 10
 match ip address 3
 set weight 64000
!
route-map AVPN_Routes_In_Primary permit 10
```

```
 match ip address 3
 set weight 64000
!
route-map Customer_Networks permit 30
 match ip address prefix-list CV100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_Networks permit 40
 match ip address prefix-list CV90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_Networks permit 50
 match ip address prefix-list CV80
 set as-path prepend 64600
 set community 13979:80 additive
!
route-map Customer_SBC_Networks permit 10
 match ip address prefix-list CV120
 set as-path prepend 64600
 set community 13979:120 65100:120 additive
!
route-map Customer_SBC_Networks permit 20
 match ip address prefix-list CV110
 set as-path prepend 64600
 set community 13979:110 65100:110 additive
!
route-map IBGP_In permit 10
 match ip address prefix-list IBGP-In
!
route-map AVPN_Routes_In_Backup permit 20
 match ip address 3
 set weight 60000
!
!
access-list 3 permit any
!
3945C-San-Francisco#
```

4.3.4 Example Configuration for Cascaded Layer 3 Switch with HSRP

The following sample configuration is provided to assist with configuring a cascaded Cisco Layer 3 Switch for use with BGP-R and HSRP. This example matches up with the integrated

CUBE configuration in this HSRP section. The red highlighted entries are variables that are specific to the customer's environment.

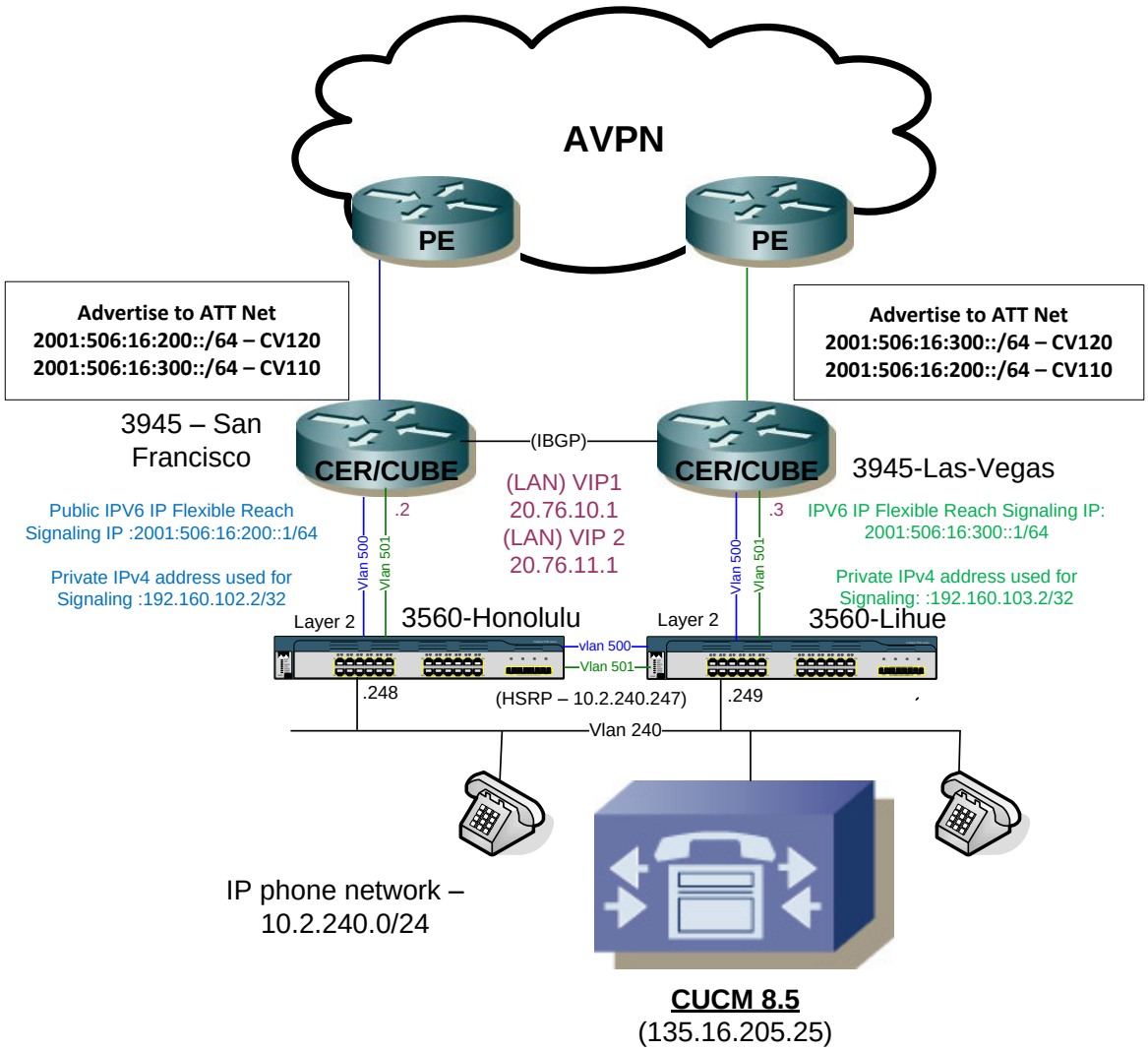
The cascaded Layer 3 Switch example is designed to have one physical interface facing the CERs with integrated CUBE and one physical interface facing the IP PBX/IP Phones. There is a trunk between the two Layer 3 Switches.

```
3750-Kona#show runn
!
vlan 148
 name KONA-PHONES
!
vlan 244
 name CUCM-VLAN
!
vlan 500
 name LosAngeles_VLAN
!
vlan 501
 name SanFrancisco_VLAN
!
vlan 502
 name Trunk_Btwn_Switches
!
!
!
!
!
interface Loopback0
 ip address 192.168.0.152 255.255.255.255
!
interface FastEthernet1/0/42
 description - Trunk to 3945E-Los-Angeles
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 500,501
 switchport mode trunk
 speed 100
 duplex full
 spanning-tree portfast trunk
!
interface FastEthernet1/0/43
 description - Trunk to 3945E-San-Fran - TEMP
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 500,501
 switchport mode trunk
 shutdown
 speed 100
 duplex full
 spanning-tree portfast trunk
```

```
!
!
!
interface FastEthernet1/0/47
 description - Trunk To 3550-Hilo
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 244,500-502
 switchport mode trunk
!
interface Vlan148
 description - Phones Vlan
 ip address 10.2.148.1 255.255.255.0
!
interface Vlan244
 description - Call Manager Vlan
 ip address 135.16.205.121 255.255.255.240
!
interface Vlan500
 ip address 20.75.10.10 255.255.255.0
!
interface Vlan501
 ip address 20.75.11.10 255.255.255.0
!
interface Vlan502
 ip address 20.75.8.1 255.255.255.0
!
ip classless
ip route 192.160.100.2 255.255.255.255 20.75.10.1
ip route 192.160.101.2 255.255.255.255 20.75.11.1
```

4.3.1 IPV6 Example Configurations

The following diagram will be used to populate the sample configurations.



3945 San Francisco

```
ip cef
ipv6 cef
```

```
!
!
!
interface Loopback0
 description BGP Loopback
 ip address 192.168.0.178 255.255.255.255
 ipv6 address 2001:506:16:100::178/128
!
interface Loopback60000
 description CUBE Loopback
 ip address 192.160.102.2 255.255.255.255
 ipv6 address 2001:506:16:200::1/64
!
!
!
interface GigabitEthernet0/0/1
 no ip address
 load-interval 30
 negotiation auto

!
interface GigabitEthernet0/0/1.500
 description IBGP Healing Link To 3945-Las Vegas
 encapsulation dot1Q 500
 ip address 1.1.1.1 255.255.255.252
 ipv6 address 2002::500:101/126
 ipv6 enable
!
!
interface GigabitEthernet0/0/2
 description - Trunk To 3560-Honolulu - Port gig0/1
 no ip address
 load-interval 30
 negotiation auto
 !
interface GigabitEthernet0/0/2.131
 description BGP-R OSPF Link to 3560-Honolulu
 encapsulation dot1Q 131
 ipv6 address 2002::131:101/126
 ipv6 enable
!
interface GigabitEthernet0/0/2.500
 description Link to 3550-Honolulu - Vlan500
 encapsulation dot1Q 500
 ip address 20.76.10.2 255.255.255.0
 standby version 2
 standby 1 ip 20.76.10.1
 standby 1 timers 1 3
 standby 1 priority 120
 standby 1 preempt delay minimum 60
 standby 1 track 1 decrement 50
 no cdp enable
!
interface GigabitEthernet0/0/2.501
 description Link to 3550-Honolulu - Vlan 501
 encapsulation dot1Q 501
 ip address 20.76.11.2 255.255.255.0
 standby version 2
 standby 2 ip 20.76.11.1
 standby 2 timers 1 3
 standby 2 priority 110
```

```
 standby 2 preempt
 standby 2 track 1 decrement 50
 no cdp enable
!
interface Serial1/0/0
 description – WAN Link
 bandwidth 41992
 ip address 195.18.32.9 255.255.255.252
 encapsulation ppp
 ipv6 address 2001:506:15:102::1/64
 dsu bandwidth 44210
 scramble
 framing c-bit
 cablelength 10
 hold-queue 32768 out
!
router bgp 65000
 bgp router-id 192.168.0.178
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 1.1.1.2 remote-as 65000
 neighbor 2001:506:15:102::2 remote-as 13979
 neighbor 2002::500:102 remote-as 65000
 neighbor 195.18.32.10 remote-as 13979
 !
 address-family ipv4
  network 10.2.240.0 mask 255.255.255.0
  network 135.16.205.25 mask 255.255.255.255
  network 172.50.128.0 mask 255.255.128.0
  network 192.160.102.2 mask 255.255.255.255
  network 192.168.0.178 mask 255.255.255.255
  network 195.18.32.8 mask 255.255.255.252
  neighbor 1.1.1.2 activate
  neighbor 1.1.1.2 next-hop-self
  neighbor 195.18.32.10 activate
  neighbor 195.18.32.10 allowas-in
 exit-address-family
 !
 address-family ipv6
  network 2001:506:15:102::/64
  network 2001:506:16:100::178/128
  network 2001:506:16:178::/64
  network 2001:506:16:200::/64
  network 2002::131:100/126
  neighbor 2001:506:15:102::2 activate
  neighbor 2001:506:15:102::2 send-community both
  neighbor 2001:506:15:102::2 advertisement-interval 1
  neighbor 2001:506:15:102::2 allowas-in
  neighbor 2001:506:15:102::2 soft-reconfiguration inbound
  neighbor 2001:506:15:102::2 route-map AVPN_Routes_In in
  neighbor 2001:506:15:102::2 route-map Customer_Networks out
  neighbor 2001:506:15:102::2 filter-list 1 in
  neighbor 2002::500:102 activate
  neighbor 2002::500:102 next-hop-self
  neighbor 2002::500:102 route-map IBGP_Routes_In in
 exit-address-family
!
ip route 10.2.240.0 255.255.255.0 20.76.10.10
ip route 135.16.205.25 255.255.255.255 20.76.10.10
!
ip bgp-community new-format
```

```
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
!
ipv6 prefix-list ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list ALLOW-ANY seq 100 permit ::/0 le 128
!
ipv6 prefix-list IBGP-Routes-In description - IBGP Routes Allowed In
ipv6 prefix-list IBGP-Routes-In seq 10 deny 2001:506:16:200::/64
ipv6 prefix-list IBGP-Routes-In seq 10 deny 2001:506:16:300::/64
ipv6 prefix-list IBGP-Routes-In seq 100 permit ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list WAN-CV-Value-120 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list WAN-CV-Value-120 seq 10 permit 2001:506:16:100::178/128
ipv6 prefix-list WAN-CV-Value-120 seq 15 permit 2001:506:16:178::/64
ipv6 prefix-list WAN-CV-Value-120 seq 20 permit 2002::131:100/126
ipv6 prefix-list WAN-CV-Value-120 seq 25 permit 2001:506:16:100::150/128
ipv6 prefix-list WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list WAN-CV-Value-110 seq 5 permit 2001:506:16:300::/64
ipv6 prefix-list WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list WAN-CV-Value-80 seq 100 deny ::/0 le 128
!
route-map AVPN_Routes_In permit 10
 match ipv6 address prefix-list ALLOW-ANY
 set weight 64000
!
route-map IBGP_Routes_In permit 10
 match ipv6 address prefix-list IBGP-Routes-In
!
route-map Customer_Networks permit 10
 match ipv6 address prefix-list WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_Networks permit 20
 match ipv6 address prefix-list WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_Networks permit 30
 match ipv6 address prefix-list WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_Networks permit 40
 match ipv6 address prefix-list WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_Networks permit 50
```

```
 match ipv6 address prefix-list WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
```

3945 Las Vegas

```
ip cef
ipv6 cef
!
!
!
!
interface Loopback0
 description - BGP Loopback
 ip address 192.168.0.11 255.255.255.255
 ipv6 address 2001:506:16:100::11/128
!
!
interface Loopback60000
 description CUBE Loopback
 ip address 192.160.103.2 255.255.255.255
 ipv6 address 2001:506:16:300::1/64
!
!
interface GigabitEthernet0/0
 description - WAN Link To Paddington-Station - Port 1/0/10
 no ip address
 load-interval 30
 duplex full
 speed 1000
!
interface GigabitEthernet0/0.2815
 encapsulation dot1Q 2815
 ip address 192.168.130.49 255.255.255.252
 ip virtual-reassembly in
 ipv6 address 2001:506:15:34::2/64
 bfd interval 999 min_rx 999 multiplier 3
 no bfd echo
!
interface GigabitEthernet0/1
 no ip address
 load-interval 30
 duplex full
 speed 100
 media-type rj45
 no keepalive
 hold-queue 4096 in
!
!
interface GigabitEthernet0/1.500
 description IBGP Healing Link To 3945 San Francisco
 encapsulation dot1Q 500
 ip address 1.1.1.2 255.255.255.252
 ipv6 address 2002::500:102/126
 ipv6 enable
!
!
interface GigabitEthernet0/2
 no ip address
```

```
 load-interval 30
 duplex full
 speed 100
 media-type rj45
!
interface GigabitEthernet0/2.132
 description BGP-R OSPF Link to 3560-Lihue
 encapsulation dot1Q 132
 ipv6 address 2002::132:101/126
 ipv6 enable
!
interface GigabitEthernet0/2.500
 description Link to 3550-Lihue - Vlan500
 encapsulation dot1Q 500
 ip address 20.76.10.3 255.255.255.0
 standby version 2
 standby 1 ip 20.76.10.1
 standby 1 timers 1 3
 standby 1 priority 110
 standby 1 preempt delay minimum 60
 standby 1 track 1 decrement 50
!
interface GigabitEthernet0/2.501
 description Link to 3550-Honolulu - Vlan 501
 encapsulation dot1Q 501
 ip address 20.76.11.3 255.255.255.0
 standby version 2
 standby 2 ip 20.76.11.1
 standby 2 timers 1 3
 standby 2 priority 120
 standby 2 preempt
 standby 2 track 1 decrement 50
!
!
router bgp 65000
 bgp router-id 192.168.0.11
 bgp log-neighbor-changes
 timers bgp 3 9
 neighbor 1.1.1.1 remote-as 65000
 neighbor 2001:506:15:34::1 remote-as 13979
 neighbor 2001:506:15:34::1 fall-over bfd
 neighbor 2002::132:102 remote-as 65527
 neighbor 2002::500:101 remote-as 65000
 neighbor 192.168.130.50 remote-as 13979
 !
 address-family ipv4
  network 10.2.240.0 mask 255.255.255.0
  network 135.16.205.25 mask 255.255.255.255
  network 172.23.64.0 mask 255.255.192.0
  network 192.160.103.2 mask 255.255.255.255
  network 192.168.0.11 mask 255.255.255.255
  network 192.168.130.48 mask 255.255.255.252
  neighbor 1.1.1.1 activate
  neighbor 1.1.1.1 next-hop-self
  no neighbor 2001:506:15:34::1 activate
  neighbor 192.168.130.50 activate
  neighbor 192.168.130.50 allowas-in
 exit-address-family
 !
 address-family ipv6
  network 2001:506:15:34::/64
```

```
  network 2001:506:16:11::/64
  network 2001:506:16:100::11/128
  network 2001:506:16:300::/64
  network 2002::132:100/126
  neighbor 2001:506:15:34::1 activate
  neighbor 2001:506:15:34::1 send-community both
  neighbor 2001:506:15:34::1 allowas-in
  neighbor 2001:506:15:34::1 soft-reconfiguration inbound
  neighbor 2001:506:15:34::1 route-map AVPN_Routes_In in
  neighbor 2001:506:15:34::1 route-map Customer_Networks out
  neighbor 2001:506:15:34::1 filter-list 1 in
  neighbor 2002::132:102 activate
  neighbor 2002::132:102 send-community both
  neighbor 2002::132:102 soft-reconfiguration inbound
  neighbor 2002::132:102 route-map LAN_To_WAN_Routes in
  neighbor 2002::132:102 route-map WAN_To_LAN_Routes out
  neighbor 2002::500:101 activate
  neighbor 2002::500:101 next-hop-self
  neighbor 2002::500:101 route-map IBGP_Routes_In in
 exit-address-family
!
!
ip bgp-community new-format
ip as-path access-list 1 deny _64600_
ip as-path access-list 1 permit .*
!
ip route 10.2.240.0 255.255.255.0 20.76.11.11
ip route 135.16.205.25 255.255.255.255 20.76.11.11
!
!
!
ipv6 prefix-list ALLOW-ANY description - APPLY TO ALL INCOMING EBGP ROUTES
ipv6 prefix-list ALLOW-ANY seq 100 permit ::/0 le 128
!
ipv6 prefix-list IBGP-Routes-In description - IBGP Routes Allowed In
ipv6 prefix-list IBGP-Routes-In seq 10 deny 2001:506:16:300::/64
ipv6 prefix-list IBGP-Routes-In seq 100 permit ::/0 le 128
!
!
ipv6 prefix-list WAN-CV-Value-120 description - CV 120 - Highest Priority
ipv6 prefix-list WAN-CV-Value-120 seq 5 permit 2001:506:16:300::/64
ipv6 prefix-list WAN-CV-Value-120 seq 10 permit 2001:506:16:11::/64
ipv6 prefix-list WAN-CV-Value-120 seq 15 permit 2002::132:100/126
ipv6 prefix-list WAN-CV-Value-120 seq 20 permit 2001:506:16:100::151/128
ipv6 prefix-list WAN-CV-Value-120 seq 25 permit 2001:506:16:100::11/128
ipv6 prefix-list WAN-CV-Value-120 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-110 description - CV 110 - 2nd Highest Priority
ipv6 prefix-list WAN-CV-Value-110 seq 5 permit 2001:506:16:200::/64
ipv6 prefix-list WAN-CV-Value-110 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-100 description - CV 100 - 3rd Highest Priority
ipv6 prefix-list WAN-CV-Value-100 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-90 description - CV 90 - 4th Highest Priority
ipv6 prefix-list WAN-CV-Value-90 seq 100 deny ::/0 le 128
!
ipv6 prefix-list WAN-CV-Value-80 description - CV 80 - 5th Highest Priority
ipv6 prefix-list WAN-CV-Value-80 seq 100 deny ::/0 le 128

!
```

```
route-map AVPN_Routes_In permit 10
 match ipv6 address prefix-list ALLOW-ANY
 set weight 64000
!
route-map IBGP_Routes_In permit 10
 match ipv6 address prefix-list IBGP-Routes-In
!
route-map Customer_Networks permit 10
 match ipv6 address prefix-list WAN-CV-Value-120
 set as-path prepend 64600
 set community 13979:120 additive
!
route-map Customer_Networks permit 20
 match ipv6 address prefix-list WAN-CV-Value-110
 set as-path prepend 64600
 set community 13979:110 additive
!
route-map Customer_Networks permit 30
 match ipv6 address prefix-list WAN-CV-Value-100
 set as-path prepend 64600
 set community 13979:100 additive
!
route-map Customer_Networks permit 40
 match ipv6 address prefix-list WAN-CV-Value-90
 set as-path prepend 64600
 set community 13979:90 additive
!
route-map Customer_Networks permit 50
 match ipv6 address prefix-list WAN-CV-Value-80
 set as-path prepend 64600
 set community 13979:80 additive
!
```

5. Bidirectional Forwarding Detection (BFD)

BFD is a feature to quickly determine circuit health and is supported on Ethernet ports on AT&T VPN from 1Mbit/s to 10Gbit/s in the US, and up to 1Gbit/s in "Most of World". BFD is enabled between the CER and PER to allow fast detection of a circuit problem so traffic can be rerouted over a backup link quickly. BFD allows for faster detection and re-convergence than can be achieved by tuned BGP timers. BFD is required for Call Preservation.

To configure BFD:

Step 1: Add the following to the main interface or sub-interface with the IP address:

```
no bfd echo
bfd interval 999 min_rx 999 multiplier 3
```

Step 2: Add the following to the BGP configuration:

```
neighbor <PER IP address> fall-over bfd
```

Example:

```
interface GigabitEthernet0/1
 no ip address
 load-interval 30
 media-type sfp
 hold-queue 32768 out
!
interface GigabitEthernet0/1.2625
 encapsulation dot1Q 2625
 ip address 192.168.240.34 255.255.255.252
 no bfd echo
 bfd interval 999 min_rx 999 multiplier 3
!
router bgp 65000
 no bgp default ipv4-unicast
 bgp log-neighbor-changes
 neighbor 192.168.240.33 remote-as 13979
 neighbor 192.168.240.33 fall-over bfd
```

6. BGP-R with AT&T Voice DNA on AT&T VPN Service

This section addresses the configuration changes that are required to add BGP-R to AT&T Voice DNA on AT&T VPN Service.

Please refer to the following document for details on configuring a customer managed CER in conjunction with AT&T Voice DNA: *"AT&T Voice DNA® on AT&T VPN Customer Configuration Guide"* (*http://www.corp.att.com/bvoip/vdna/implementation/ (login: att, password: attvoip)).*

6.1 *Scope*

- The following configurations will be supported:
  - Type A addressing scheme only (with /30 prefix supporting one EdgeMarc).
  - Customer managed CER with EdgeMarc setup using a "CE-Remote". The cascaded router in front of the EdgeMarc must be configured with OSPF or EBGP.
  - BGP routing to AT&T PER.
- The following is **not** supported:
  - Call preservation
  - HSRP on the LAN
  - Static routing to AT&T PER
  - Multi-site scenarios

6.2 *Configuration*

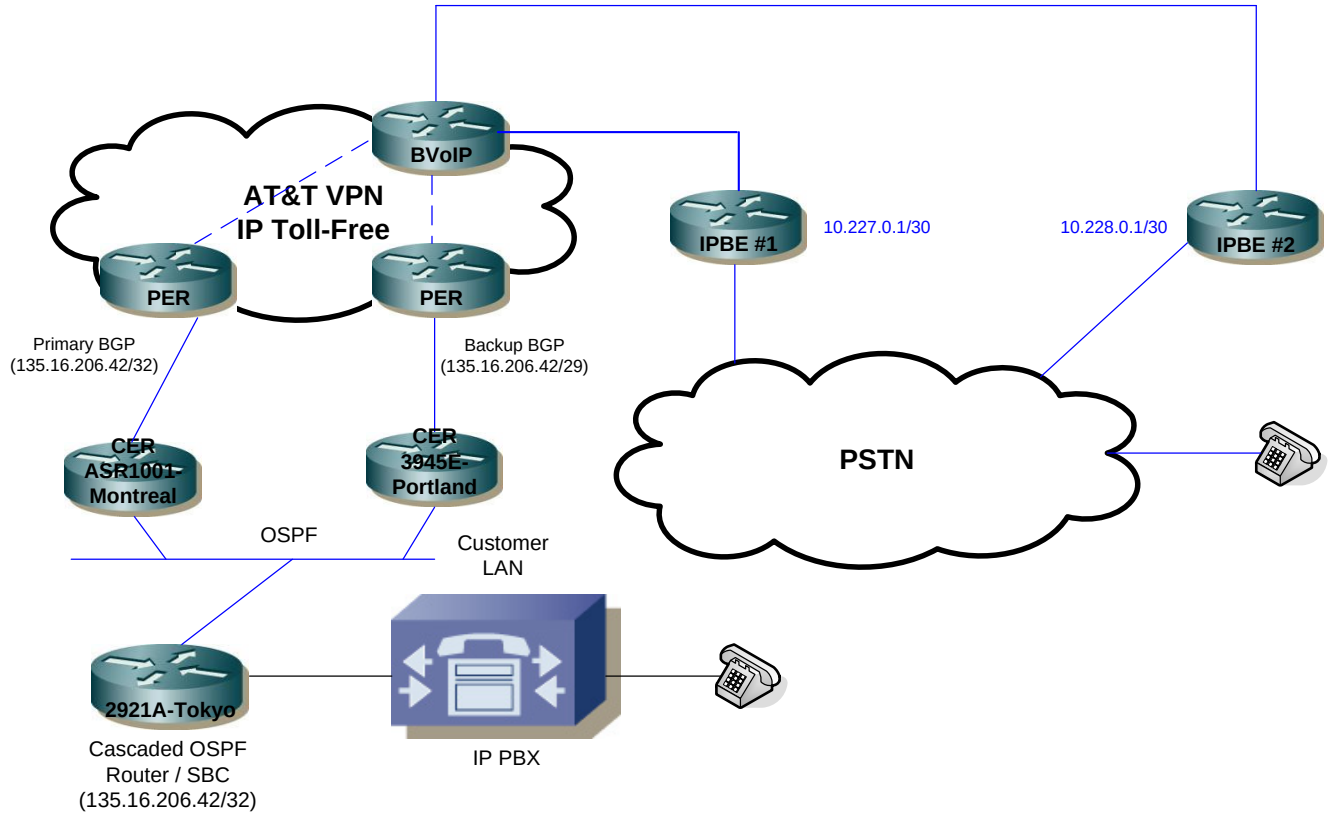
Follow the configurations detailed in this CCG, replacing the AT&T IP Flexible Reach Signaling IP address of the SBCs with the EdgeMarc.

Backup EdgeMarc devices will be configured with a prefix of /30 (instead of /29). Below is a table that summarizes the BGP community values (used for BGP-R) and the advertised prefix size:

EdgeMarc Route Priority	BGP Local-Preference	BGP Community Value	SBC Advertised Subnet Mask	SBC Advertised Prefix Size
Primary	120	13979:120	255.255.255.255	/32
Secondary	110	13979:110	255.255.255.252	/30
Tertiary	100	13979:100	255.255.255.252	/30
Quaternary	90	13979:90	255.255.255.252	/30
Quinary	80	13979:80	255.255.255.252	/30

7. Troubleshooting

The following section provides router commands to help you troubleshoot the BGP-R configuration. The CER outputs provided in this section will refer to the following diagram. For simplicity, only one SBC is shown in the diagram.



7.1 *Troubleshooting the CER*

This section lists commands to issue on the CER for BGP-R troubleshooting.

7.1.1 Check LAN and WAN Interfaces

On the CER, verify that the appropriate LAN and WAN interfaces are up with the “show ip interface brief” command. The interfaces should show the “Status” as up and the “Protocol” as up .

A sample output is shown below:

```
ASR1001-Montreal#show ip int brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   unassigned      YES NVRAM  up                    up
Gi0/0/0.405            unassigned      YES unset  up                    up
Gi0/0/0.756            195.18.32.221   YES NVRAM  up                    up
GigabitEthernet0/0/1   unassigned      YES NVRAM  administratively down down
GigabitEthernet0/0/2   172.30.0.1      YES NVRAM  administratively down down
GigabitEthernet0/0/3   unassigned      YES NVRAM  administratively down down
Gi0/0/3.2810           192.168.130.29  YES NVRAM  administratively down down
POS0/1/0               unassigned      YES NVRAM  up                    down
POS0/1/0.100           195.18.32.13    YES NVRAM  down                  down
POS0/1/1               195.18.31.25    YES manual up                    up
Serial0/2/0            195.18.32.9     YES NVRAM  administratively down down
Serial0/2/1            195.18.32.21    YES NVRAM  administratively down down
Serial0/2/2            unassigned      YES unset  administratively down down
Serial0/2/3            unassigned      YES unset  up                    up
Serial0/2/3.1          192.168.200.5   YES NVRAM  up                    up
GigabitEthernet0       unassigned      YES NVRAM  administratively down down
Loopback0              192.168.0.5     YES NVRAM  up                    up
ASR1001-Montreal#
```

7.1.2 Verify the BGP session

Verify that a BGP session has been established between the CER and the PER with the "show ip bgp neighbor" command. If the BGP session is established, then the BGP neighbor IP address will be listed. Also, the BGP state will be listed as "established, up" for the duration of time that it has been connected. If the BGP state is listed as "idle" or "active" then the BGP session is down.

This command will also provide information on the BGP timer settings for the session. For Call Preservation configurations hold time should be set for 9 seconds. The keepalive interval should be set for 3 seconds.

A sample output is shown below:

```
ASR1001-Montreal#show ip bgp sum
BGP router identifier 192.168.0.5, local AS number 65000
BGP table version is 4738, main routing table version 4738
426 network entries using 107352 bytes of memory
827 path entries using 72776 bytes of memory
78/72 BGP path/bestpath attribute entries using 16224 bytes of memory
30 BGP AS-PATH entries using 1184 bytes of memory
38 BGP community entries using 1440 bytes of memory
27 BGP extended community entries using 1044 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
```

```
BGP using 200020 total bytes of memory
424 received paths for inbound soft reconfiguration
BGP activity 15656/15230 prefixes, 37986/37159 paths, scan interval
60 secs

Neighbor        V           AS MsgRcvd MsgSent   TblVer  InQ OutQ
Up/Down  State/PfxRcd
195.18.31.26    4        13979  114864  110570     4738    0    0
3d22h         397

ASR1001-Montreal#show ip bgp neighbor
BGP neighbor is 195.18.31.26,  remote AS 13979, external link
  BGP version 4, remote router ID 10.144.10.6
  BGP state = Established, up for 3d22h
  Last read 00:00:01, last write 00:00:00, hold time is 9, keepalive
interval is 3 seconds
  Configured hold time is 9, keepalive interval is 3 seconds
  Minimum holdtime from neighbor is 0 seconds
  Neighbor sessions:
    1 active, is not multisession capable (disabled)
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Four-octets ASN Capability: advertised and received
    Address family IPv4 Unicast: advertised and received
    Enhanced Refresh Capability: advertised
    Multisession Capability:
    Stateful switchover support enabled: NO for session 1
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                3       1585
    Keepalives:        110511     113221
    Route Refresh:          0          0
    Total:             110515     114807
  Default minimum time between advertisement runs is 30 seconds

 For address family: IPv4 Unicast
  Session: 195.18.31.26
  BGP table version 4738, neighbor version 4738/0
  Output queue size : 0
  Index 33, Advertise bit 0
  33 update-group member
  Inbound soft reconfiguration allowed
  My AS number is allowed for 3 number of times
  Community attribute sent to this neighbor
  Inbound path policy configured
```

```
  Outbound path policy configured
  Incoming update AS path filter list is 1
  Route map for incoming advertisements is AVPN_Routes_In_Primary
  Route map for outgoing advertisements is
Customer_Primary_SBC_Networks
  Slow-peer detection is disabled
  Slow-peer split-update-group dynamic is disabled
                                Sent       Rcvd
  Prefix activity:              ----       ----
    Prefixes Current:              2        397 (Consumes 72248
bytes)
    Prefixes Total:                2       1921
    Implicit Withdraw:             0        814
    Explicit Withdraw:             0        710
    Used as bestpath:            n/a        397
    Used as multipath:           n/a          0
    Saved (soft-reconfig):       n/a        424 (Consumes 37312
bytes)

                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    filter-list:                        0        131
    Invalid Path:                     607        n/a
    Other Policies:                  1495        n/a
    Total:                           2102        131
  Number of NLRIs in the update sent: max 1, min 0
  Last detected as dynamic slow peer: never
  Dynamic slow peer recovered: never
  Refresh Epoch: 1
  Last Sent Refresh Start-of-rib: never
  Last Sent Refresh End-of-rib: never
  Last Received Refresh Start-of-rib: never
  Last Received Refresh End-of-rib: never
                                  Sent       Rcvd
        Refresh activity:         ----       ----
          Refresh Start-of-RIB       0          0
          Refresh End-of-RIB         0          0

  Address tracking is enabled, the RIB does have a route to
195.18.31.26
  Connections established 2; dropped 1
  Last reset 3d22h, due to Interface flap of session 1
  Transport(tcp) path-mtu-discovery is enabled
  Graceful-Restart is disabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled
Mininum incoming TTL 0, Outgoing TTL 1
Local host: 195.18.31.25, Local port: 57375
Foreign host: 195.18.31.26, Foreign port: 179
Connection tableid (VRF): 0
```

```
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0
bytes)

Event Timers (current time is 0xA8FE50D7):
Timer          Starts    Wakeups            Next
Retrans        110872        360             0x0
TimeWait            0          0             0x0
AckHold        113953     106064             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger      1116499    1116498      0xA8FE51D9
DeadWait            0          0             0x0
Linger              0          0             0x0

iss: 1960337930  snduna: 1962437852  sndnxt: 1962437852     sndwnd:
14959
irs: 4006839720  rcvnxt: 4009119256  rcvwnd:      15054  delrcvwnd:
1330

SRTT: 300 ms, RTTO: 303 ms, RTV: 3 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 374 ms, ACK hold: 200 ms
Status Flags: none
Option Flags: higher precendence, nagle, path mtu capable

Datagrams (max data segment is 4430 bytes):
Rcvd: 217177 (out of order: 0), with data: 114068, total data bytes:
2279535
Sent: 217091 (retransmit: 360 fastretransmit: 0),with data: 110513,
total data bytes: 2099921
```

7.1.3 Check advertisement of a local route for the SBC in the BGP table

Verify the CER is advertising a route for the SBC with the “show ip bgp” command. In the output, check for an entry with the /32 IP address of the SBC. The weight for that entry should be “32768”, indicating the BGP route is sourced locally (derived from OSPF).

Also, verify that you are receiving the IPBE route(s) from BVoIP via BGP. In this example, the IPBE routes are 10.227.0.0/30 and 10.228.0.0/30.

A sample output is shown below. In this example, the SBC IP address is 135.16.206.42.

```
ASR1001-Montreal#show ip bgp
BGP table version is 4738, local router ID is 192.168.0.5
```

```
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale, m multipath, b backup-path, x best-
external, f RT-Filter, a additional-path
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 0.0.0.0          195.18.31.26                           64000 13979 i
*> 3.3.3.0/29       195.18.31.26                           64000 13979 ?
*> 3.3.3.8/29       195.18.31.26                           64000 13979 65002 i.
.
.
.
*> 10.227.0.0/30    195.18.31.26                           64000 13979 64899 64899 i
*> 10.228.0.0/30    195.18.31.26                           64000 13979 64899 64899 i
.
.
.
*> 135.16.206.40/32 195.18.31.26                           64000 13979 13979 ?
*> 135.16.206.42/32 195.18.32.222           20           32768 ?
*> 135.16.206.43/32 195.18.31.26                           64000 13979 13979 ?
```

7.1.4 Verify the OSPF Session

Verify that an OSPF session has been established between the CER and the cascaded OSPF router with the "show ip ospf neighbor" command. If the OSPF session is established, then the OSPF neighbor IP address will be listed. In addition, check that the OSPF session is established on the CER LAN sub-interface.

A sample output is shown below:

```
ASR1001-Montreal# show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address
Interface
192.168.0.40      1   FULL/DR         00:00:39    195.18.32.222
GigabitEthernet0/0/0.756
ASR1001-Montreal#
```

7.1.5 Verify OSPF route to the SBC

Verify that the CER has a route to the SBC via the cascaded OSPF router with the command "show ip route <*SBC Signaling IP Address*>". The route to the SBC should be listed as the IP address of the OSPF neighbor listed in the "show ip ospf neighbor" output (see previous section).

A sample output is shown below. In this example, the SBC IP address is 135.16.206.42.

```
ASR1001-Montreal#show ip route 135.16.206.42
Routing entry for 135.16.206.42/32
  Known via "ospf 100", distance 110, metric 11, type intra area
  Redistributing via bgp 65000
  Advertised by bgp 65000 metric 20 match internal external 1 & 2
route-map OSPF_TO_BGP
  Last update from 195.18.32.222 on GigabitEthernet0/0/0.756, 3d23h
ago
  Routing Descriptor Blocks:
  * 195.18.32.222, from 192.168.0.40, 3d23h ago, via
GigabitEthernet0/0/0.756
      Route metric is 11, traffic share count is 1
ASR1001-Montreal#
```

7.1.6 Check configuration of route-maps

Verify that the route-maps have been configured on the CER with the "show route-map" command.

The CER should contain four route maps: 1) AVPN_Routes_In_Primary, 2) OSPF_TO_BGP, 3) Customer_Primary-SBC_Networks 4) BGP_2_OSPF. Confirm the BGP CV value configured on the CER by checking the output under the Customer_Primary_SBC_Networks route-map. The "community" entry will display the BGP CV value that is advertised.

A sample output is shown below.

```
ASR1001-Montreal#show route-map
route-map AVPN_Routes_In_Primary, permit, sequence 10
  Match clauses:
    ip address (access-lists): 3
  Set clauses:
    weight 64000
  Policy routing matches: 0 packets, 0 bytes
route-map OSPF_TO_BGP, permit, sequence 10
  Match clauses:
    ip address prefix-lists: OSPF-2-BGP
  Set clauses:
  Policy routing matches: 0 packets, 0 bytes
route-map Customer_Primary_SBC_Networks, permit, sequence 10
```

```
  Match clauses:
    ip address prefix-lists: Primary-SBC-Routes
  Set clauses:
    as-path prepend 64600
    community 13979:120 additive
  Policy routing matches: 0 packets, 0 bytes
route-map BGP_2_OSPF, permit, sequence 10
  Match clauses:
    ip address (access-lists): 1
  Set clauses:
    metric 20
    metric-type type-1
  Policy routing matches: 0 packets, 0 bytes
route-map BGP_2_OSPF, permit, sequence 20
  Match clauses:
    ip address (access-lists): 2
  Set clauses:
    metric 100
    metric-type type-2
  Policy routing matches: 0 packets, 0 bytes
ASR1001-Montreal#
```

7.2 *Troubleshooting with CUBE*

This section lists troubleshooting commands to issue on the Customer Managed CUBE for BGP-R troubleshooting.

7.2.1 Verify Route to IPBE

From the CUBE, verify the route to the AT&T IPBEs with the "show ip route <*IPBE IP address*>" command. The output of this command can be used to check the path that the VoIP packets will take. Verify the VoIP packets are routed through the primary CER (if the primary CER and LAN/WAN links are active) by checking the IP address entry (for single CER) or entries (for backup CER groups).

A sample output is shown below for a single CER.

```
2921A-Tokyo#show ip route 10.227.0.1
Routing entry for 10.227.0.0/30
  Known via "ospf 100", distance 110, metric 30
  Tag 13979, type extern 1
  Last update from 195.18.32.221 on GigabitEthernet0/1.756, 00:01:26
ago
  Routing Descriptor Blocks:
```

AT&T IPBE IP Address

```
  * 195.18.32.221, from 192.168.0.5, 00:01:26 ago, via
GigabitEthernet0/1.756
      Route metric is 30, traffic share count is 1
      Route tag 13979
2921A-Tokyo#
```

If the primary CER is down and VoIP packets are routed to a backup CER group, there can be additional entries in the "show ip route <IPBE IP address>" command.

A sample output is shown below for a backup CER group. In this case, the primary CER is down and VoIP packets are being routed to a backup CER group consisting of two CERs (resulting in one route entries).

```
2921A-Tokyo#show ip route 10.227.0.1
Routing entry for 10.227.0.0/30
  Known via "ospf 100", distance 110, metric 100
  Tag 13979, type extern 2, forward metric 20
  Last update from 195.18.32.217 on GigabitEthernet0/1.755, 00:00:32
ago
  Routing Descriptor Blocks:
  * 195.18.32.217, from 192.168.0.15, 00:00:32 ago, via
GigabitEthernet0/1.755
      Route metric is 100, traffic share count is 1
      Route tag 13979
2921A-Tokyo#
```

7.2.2 Verify Path for VoIP Packets

On a CUBE it is possible to verify the route to an AT&T IPBE with the "traceroute" command. The output of this command can be used to check the path that the VoIP packets will take. Verify the VoIP packets are routed through the primary CER (if the primary CER and WAN/LAN link are active). The traceroute commands must be 1) targeted for an AT&T IPBE IP address and 2) sourced from the Signaling IP address assigned by AT&T IP Flexible Reach and/or AT&T IP Toll-Free. Note: The AT&T IPBE will not respond to a traceroute because of security reasons.

A sample output from a CUBE SBC is shown below.

```
2921A-Tokyo#traceroute
Protocol [ip]:
Target IP address: 10.227.0.1
Source address: 135.16.206.42
Numeric display [n]:
Timeout in seconds [3]:
Probe count [3]:
Minimum Time to Live [1]:
```

```
Maximum Time to Live [30]:
Port Number [33434]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Type escape sequence to abort.
Tracing the route to 10.227.0.1

  1 195.18.32.221 0 msec 0 msec 0 msec
  2 195.18.31.26 0 msec 0 msec 0 msec
  3 10.227.0.2 4 msec 0 msec 0 msec
  4 10.227.0.1 0 msec *  0 msec
2921A-Tokyo#
```

Appendix A: Acronyms

Acronym	Translation
AS	Autonomous System
AT&T VPN	AT&T Virtual Private Network
BGP	Border Gateway Protocol
BGP-R	Border Gateway Protocol Resiliency
BVoIP	Business Voice over Internet Protocol
CCG	Customer Configuration Guide
CEF	Cisco Express Forwarding
CER	Customer Edge Router
CKT	Circuit
COS	Class of Service
CPE	Customer Premise Equipment
CUBE	Cisco Unified Border Element
CUCM	Cisco Unified Communications Manager
CV	Community Value
IAR	Inbound Alternate Routing
IETF	Internet Engineering Task Force
IOS	Internetwork Operation System
IP	Internet Protocol
IPBE	Internet Protocol Border Element
ISR	Integrated Services Router
ITU-T	International Telecommunication Union - Telecommunications
GW	Gateway
LAN	Local Area Network
MFA	Media Flow Around
MRS	Managed Router Services
NAT	Network Address Translation
OSPF	Open Shortest Path First
PBX	Private Branch Exchange
PER	Provider Edge Router
QOS	Quality of Service
RT	Real Time
RTCP	Real Time Control Protocol
RTP	Real Time Protocol
SBC	Session Border Controller
SIP	Session Initiation Protocol
UDP	User Datagram Protocol
VoIP	Voice over Internet Protocol
vmen	Voice Media Endpoint Network
VPN	Virtual Private Network
WAN	Wide Area Network

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