

Segment Routing - Automated Steering

This document gives an example of how Automated Steering works in Segment Routing based on the below topology. Traffic flow will be examined from CE1 to CE2 based on policies set by the ingress PE (PE2). No custom SR Flexible-Algorithms are used.

What is Automated Steering?

Automated Steering (or AS) is a Segment Routing feature that enables the steering of a service route into a valid SR Policy based on its **next-hop** and **color**.

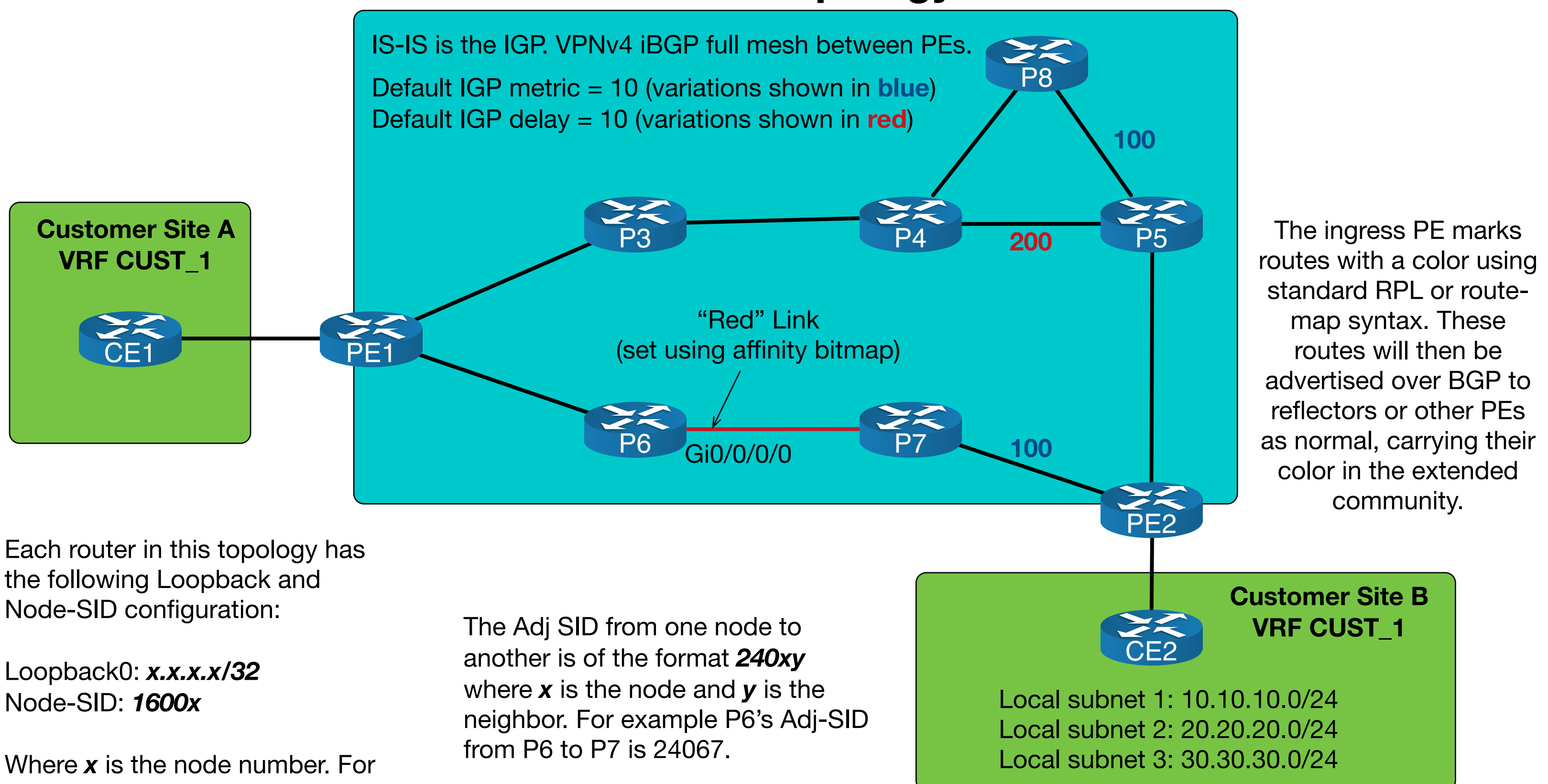
What is an SR Policy?

An SR Policy is essentially a SID list that is either explicitly defined, or dynamically created according to an optimisation criteria (e.g. lowest metric) and/or any optional restrictions (e.g. avoid certain links). SR Policies can be created explicitly, either through configuration or via PCE, or dynamically using ODN (On Demand Next-hop). This document explores explicitly create policies that create dynamic SID lists.

What is Color?

Color is a BGP opaque extended community defined in RFC 5512 used to mark routes. It is just a number but it is colloquially referenced using a color name. Don't confuse this with the term "link-color" which refers to the affinity bits on a TE link. Both are used here to illustrate the difference.

Network Topology



Example Policies

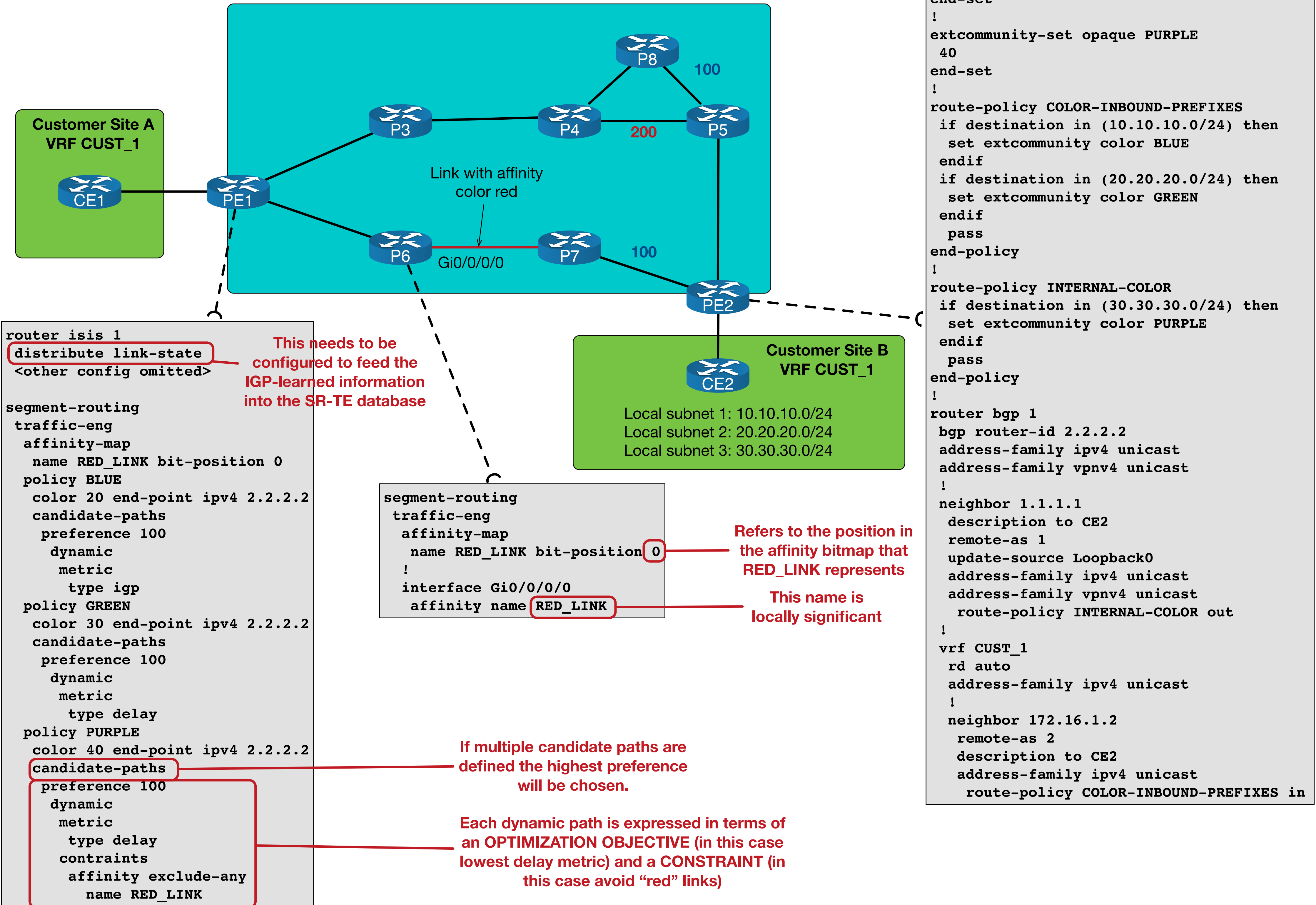
Goal	Color
Traffic from Customer site A to 10.10.10.10 should follow path with smallest IGP metric	BLUE (20)
Traffic from Customer site A to 20.20.20.20 should follow path with smallest delay metric	GREEN (30)
Traffic from Customer site A to 30.30.30.30 should follow path with smallest delay metric avoiding red links	PURPLE (40)



Segment Routing - Automated Steering

Configuration

This page shows IOS-XR CLI configuration to setup the policies shown on the previous page. PE1 and PE2 have a loopback to loopback VPNv4 iBGP session between to each other. The PE to CE routing protocol used is eBGP. To illustrate the RPL variations available, subnet1 and subnet2 are tagged with their colors inbound to PE2 and subnet3 is tagged outbound to PE1.

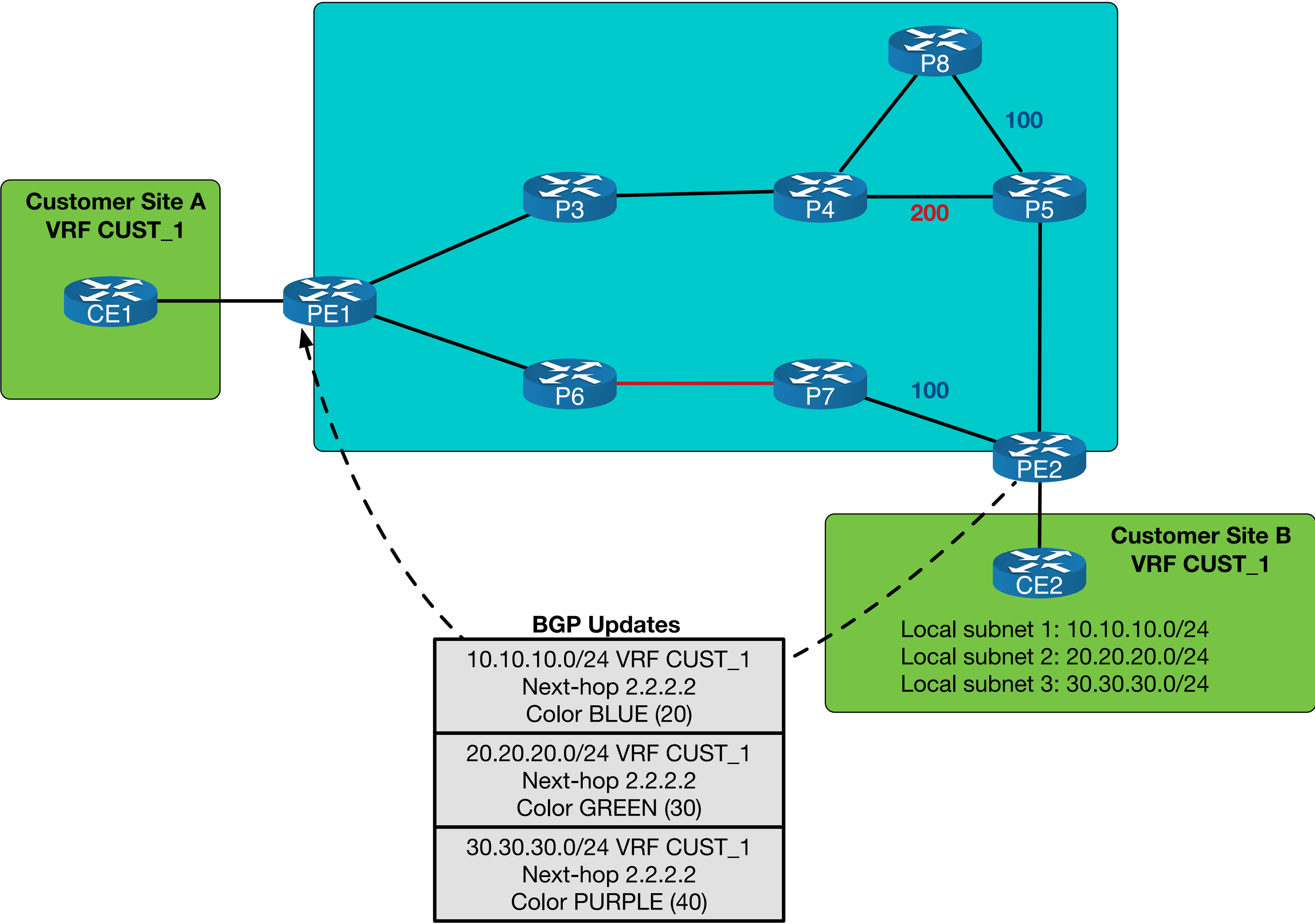




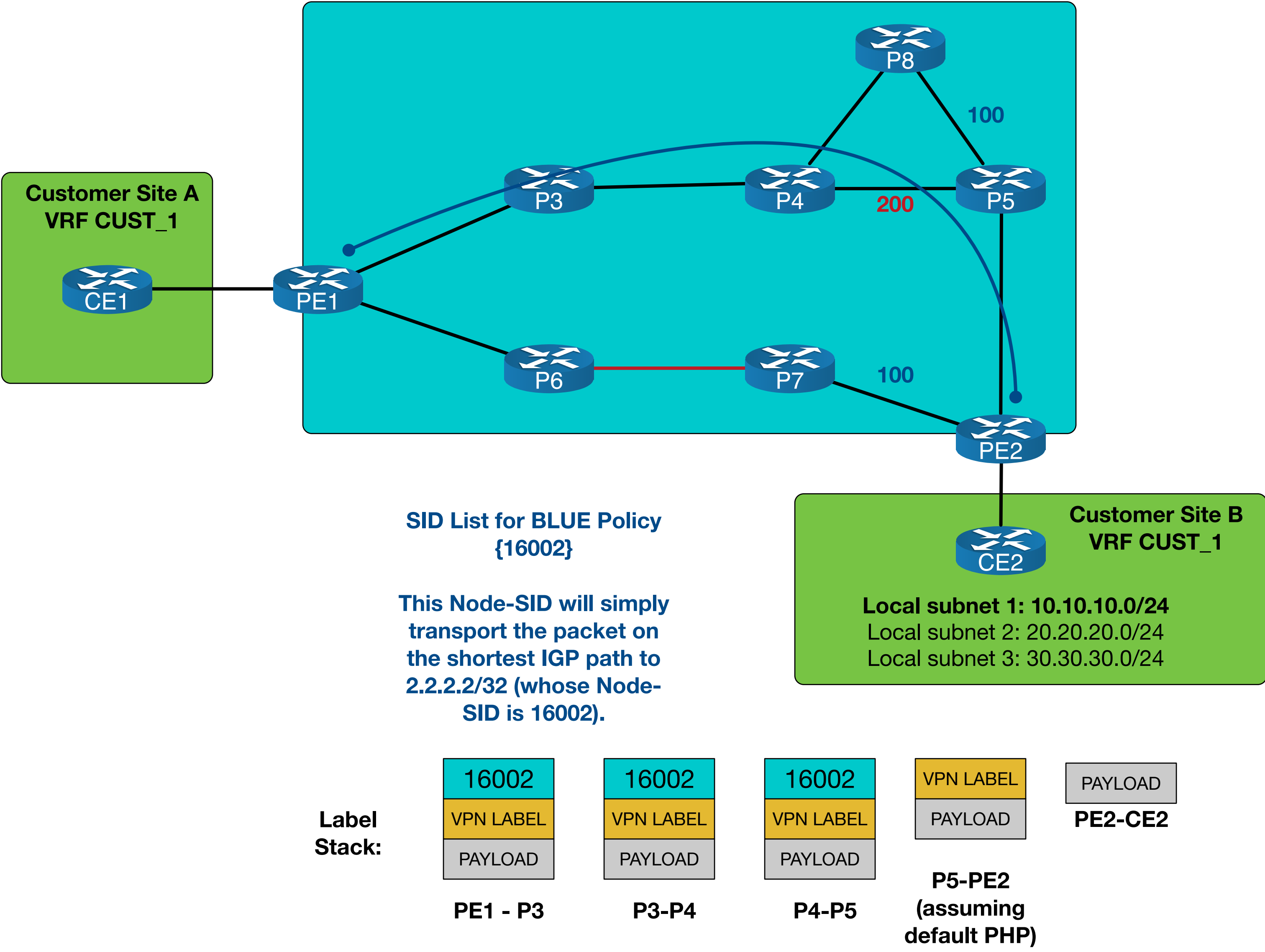
Segment Routing - Automated Steering

This page examines the SID lists that are created as a results of the 3 policies covered in this document. Each SID in the resulting SID list represents a segment used to adhere to the desired policy.

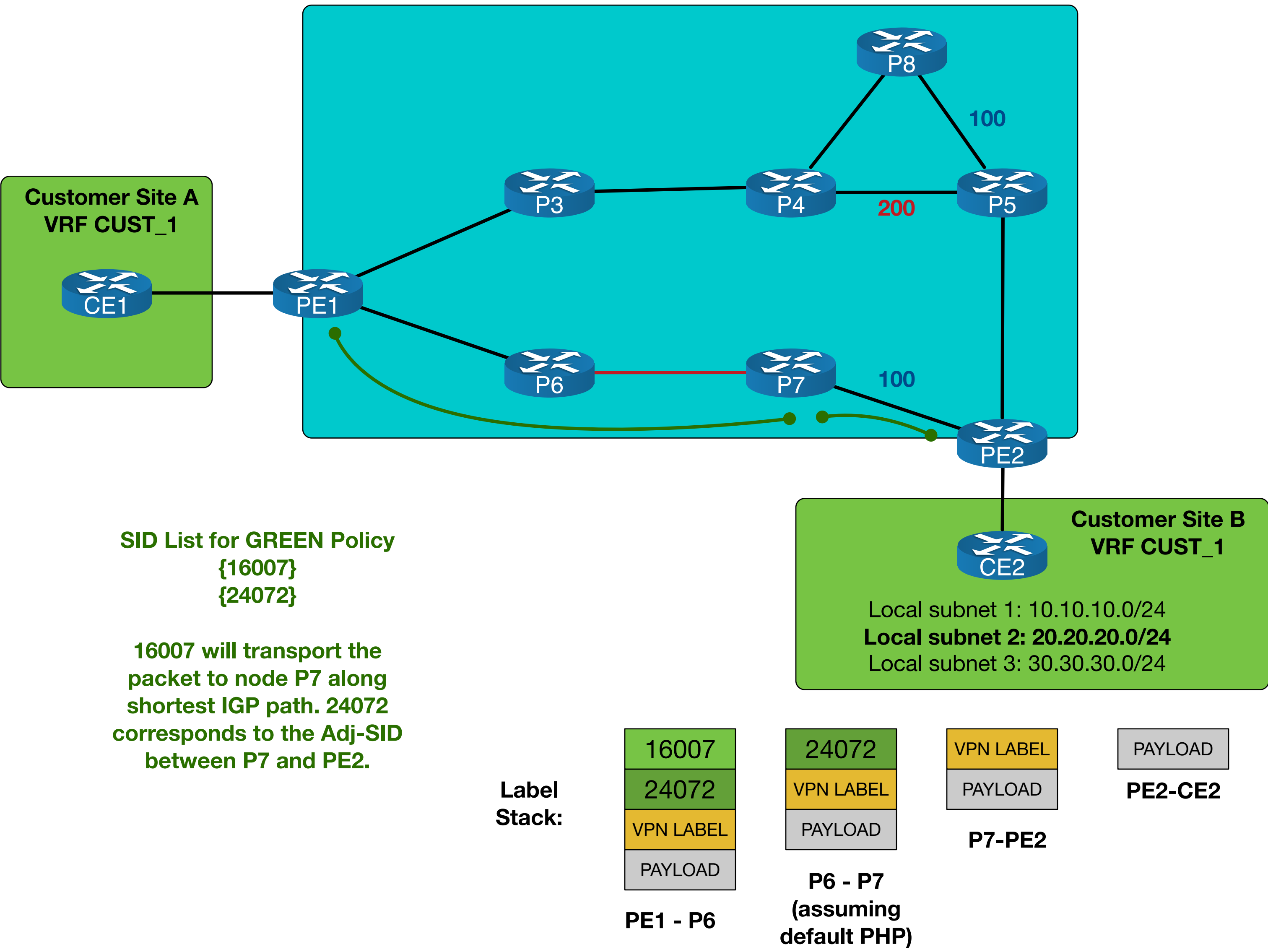
BGP Updates



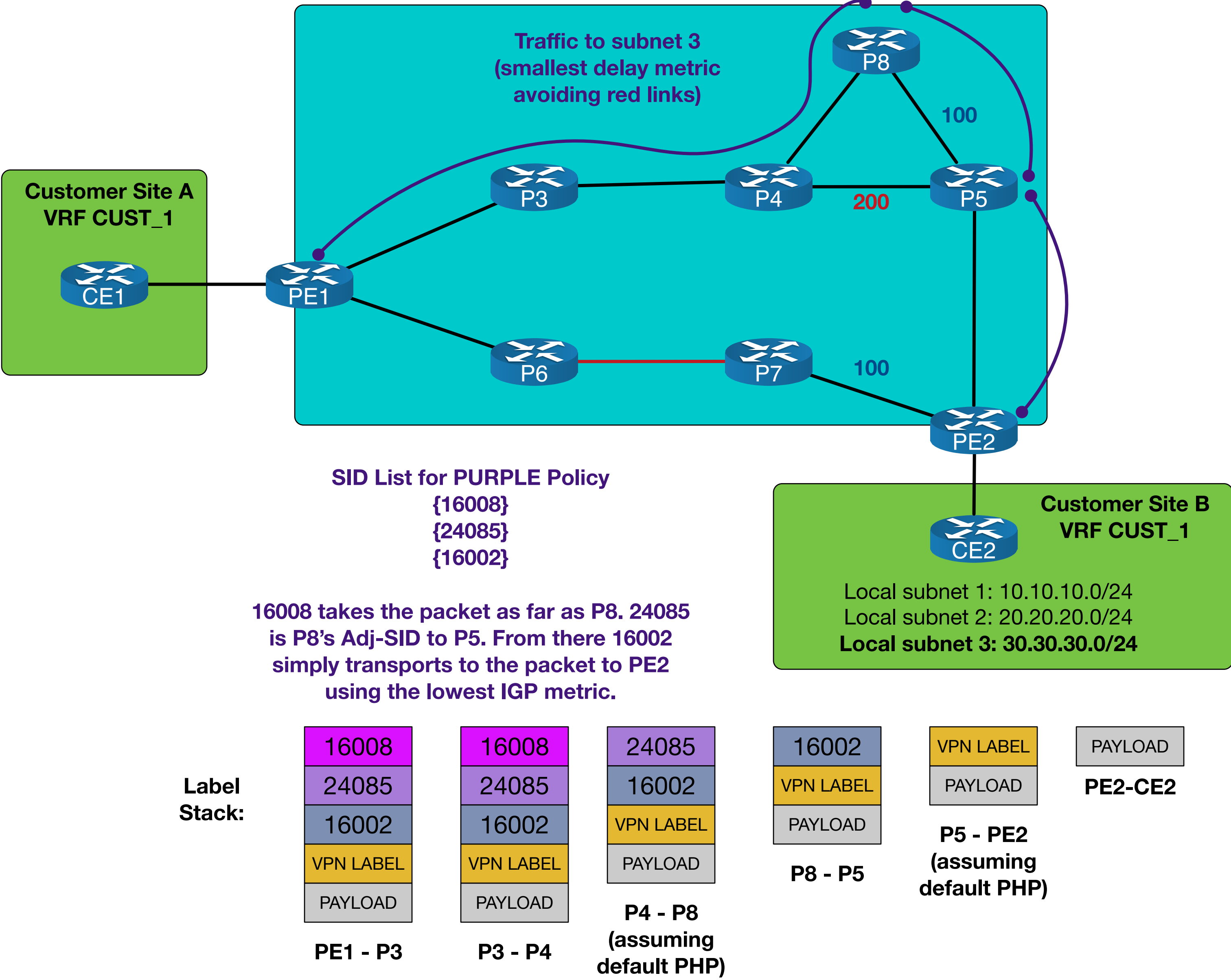
BLUE Policy Traffic Flow (Smallest IGP Metric)



GREEN Policy Traffic Flow (Smallest Delay Metric)



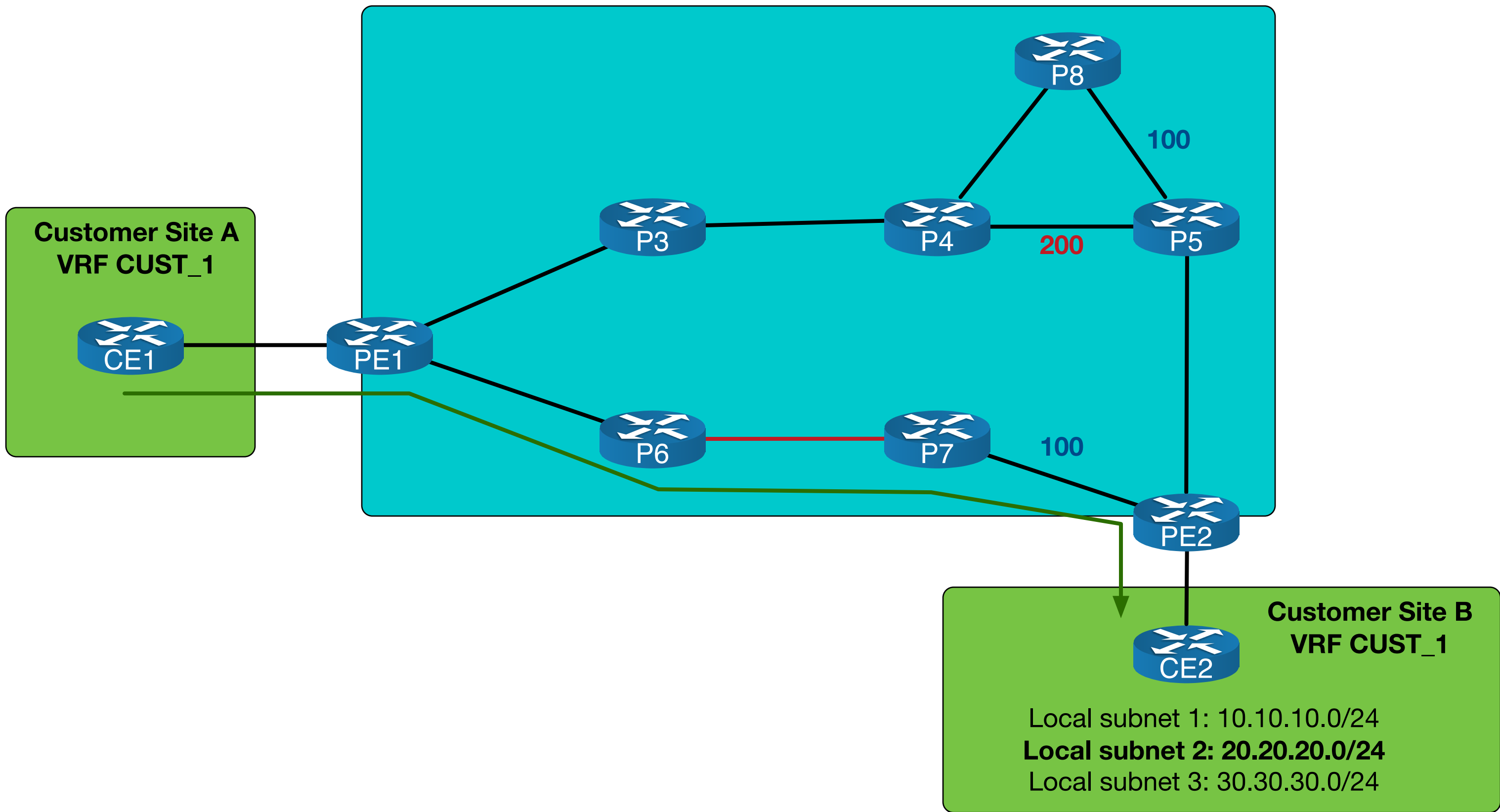
PURPLE Policy Traffic Flow (Smallest Delay Metric Avoiding red links)





Output - GREEN Policy

This page shows various CLI output from PE1 as it relates to the GREEN policy which specifies the lowest delay metric.



```
RP/0/0/CPU0:PE1# show bgp vrf CUST_1 20.20.20.0/24
BGP routing table entry for 20.20.20.0/24, Route Distinguisher: 1.1.1.1:0
Versions:
  Process bRIB/RIB SendTblVer
  Speaker 7 7
Last Modified: Aug 2 12:01:11.830 for 01:03:00
Paths: (1 available, best #1)
  Not advertised to any peer
  Path #1: Received by speaker 0
  Not advertised to any peer
  2
  2.2.2.2 C:30 (bsid:40002) (metric 40) from 2.2.2.2 (2.2.2.2)
    Received Label 92221 Origin IGP, metric 0, localpref 100, valid, internal, best,
group-best, import-candidate, imported
    Received Path ID 0, Local Path ID 1, version 7
    Extended community: Color:30 RT:1:1 SR policy color 30, up, registered, bsid 40002,
if-handle 0x00000410

Source AFI: VPNv4 Unicast, Source VRF: default, Source Route Distinguisher: 2.2.2.2:0
```

BGP Color Community

Locally significant Binding
SID used to present this
policy. This will appear in
CEF and the label
forwarding table as the
local label.

Standard IGP metric (not
delay metric)

The standard VPNv4
Label for this prefix

```
RP/0/0/CPU0:PE1# show segment-routing traffic-eng policy

Color: 30, End-point: 2.2.2.2
Name: srte_c_30_ep_2.2.2.2
Status:
  Admin: up Operational: up for 00:02:54 (since Aug 2 12:04:31.523)
Candidate-paths:
  Preference: 100 (configuration) (active)
  Name: GREEN
  Requested BSID: dynamic
  Dynamic (valid)
  Metric Type: delay, Path Accumulated Metric: 30
  16007 [Prefix-SID, 7.7.7.7]
  24072 [Adjacency-SID, 99.2.7.7 99.2.7.2]

Attributes:
  Binding SID: 40002
  Forward Class: 0
  Steering BGP disabled: no
  IPv6 caps enable: yes
```

This is auto-generated based
on the color number and
destination.

Accumulated Delay Metric (not IGP metric)

Calculated SID list for this policy

```
RP/0/0/CPU0:PE1# show cef vrf CUST_1 20.20.20.0/24
20.20.20.0/24, version 1, internal 0x50000001 0x0 (ptr 0xa14f440c) [1], 0x0 (0x0), 0x208 (0xa16ac190)
Updated Aug 2 12:04:40.728
Prefix Len 24, traffic index 0, precedence n/a, priority 3
via local-label 40002, 3 dependencies, recursive [flags 0x6000]
  path-idx 0 NHID 0x0 [0xa171651c 0x0]
  recursion-via-label
  next hop VRF 'default', table 0xe0000000
  next hop via 40002/0/21
  next hop srte_c_30_ep_2.2.2.2 labels imposed {ImplNull 92221}
```

The ImplNull in this output
indicates that the local BSID
should be referenced (40002). This
will in turn cause the calculated
SID-List to be placed on to the
packet (with 92221, the VPN label,
as the bottom of stack label)

```
RP/0/0/CPU0:PE1# traceroute vrf CUST_1 20.20.20.1

Type escape sequence to abort.
Tracing the route to 20.20.20.1
 1 99.1.6.6 [MPLS: Labels 16007/24072/92221 Exp 0] 19 msec 9 msec 9 msec
 2 99.6.7.7 [MPLS: Labels 24072/92221 Exp 0] 9 msec 10 msec 9 msec
 3 99.2.7.2 [MPLS: Label 92221 Exp 0] 9 msec 9 msec 9 msec
 4 172.16.1.2 9 msec 9 msec 9 msec
```