BGP and the Internet

Enterprise Multihoming

Enterprise Multihoming

- Common scenario in Internet today
- More and more non-SPs multihoming for:
  - service provider redundancy
  - link redundancy
- Issues on Internet today:
  - Routing Table size accelerating
  - more and more /24 prefixes appearing in Internet Routing Table
  - ASN consumption accelerating

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- The following examples
  - apply to smaller ISPs who don't yet have their own address block
  - require BGP but a private AS (ASN >64511) can and should be used
  - are good for the health of the Internet

Medium/Large ISP Multihoming

- ISPs should obtain their own address block and ASN
  - Get it from RIR
  - Makes multihoming easier
  - Makes changing upstreams easier
  - Does not cause so much fragmentation in Internet Routing Table

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Example One

Provider Redundancy

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- Common situation is enterprise multihoming
  - address space used by enterprise comes from both upstream ISPs
  - multihoming and loadsharing more difficult
  - want to avoid leaking subprefixes of upstream provider address space when possible
  - require provider redundancy (not just link redundancy)

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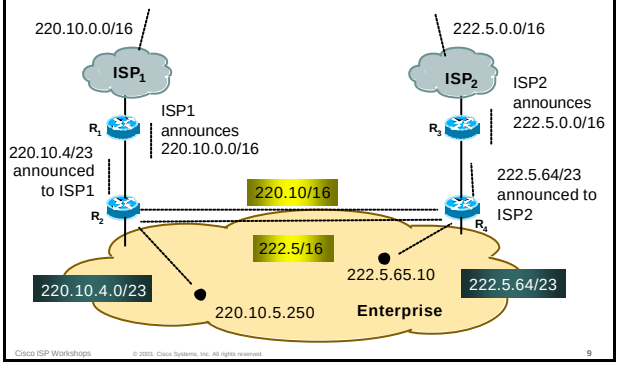
- Address space from upstream should match link bandwidth to upstream, e.g.
  - ISP1 ® Enterprise = 256kbps ® /22
  - ISP2 ® Enterprise = 128kbps ® /23
  - assumes address space is uniformly distributed across network
  - assumes that there is a requirement for 3x /23 in the Enterprise backbone
- Next example assumes equal bandwidth links from Enterprise to ISP1 and ISP2

Enterprise Multihoming Conditional Advertisement

- Conditional advertisement feature in BGP
  - loadsharing under normal conditions
  - subprefixes only announced in failure scenarios
  - requires upstreams to announce only one prefix to enterprise border network

Steady State



Steady State

- ISP1 has 220.10.0.0/16 address block
- ISP2 has 222.5.0.0/16 address block
- Enterprise customer multihomes
  - upstreams don't announce subprefixes
  - can use private AS (ASN>64511)
  - R2 and R4 originate default in their IGP
    - outbound traffic uses nearest exit (IGP metrics)

Steady State

- Router2 configuration:

```
router bgp 65534
 network 220.10.4.0 mask 255.255.254.0
 network 222.5.64.0 mask 255.255.254.0
 neighbor <R1> remote-as 150
 neighbor <R1> prefix-list isp1-in in
 neighbor <R1> prefix-list isp1-out out
 neighbor <R1> advertise-map isp2-sb non-exist-map isp2-bb
 neighbor <R4> remote-as 65534
 neighbor <R4> update-source loopback 0
!
ip route 220.10.4.0 255.255.254.0 null0 250
..next slide
```

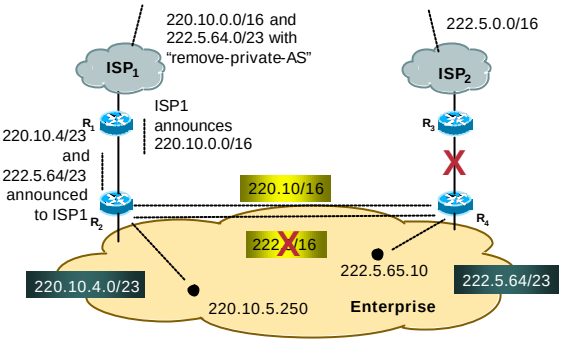

Steady State

```
ip route 222.5.64.0 255.255.254.0 null0 250
!
ip prefix-list isp1-out permit 220.10.4.0/23
ip prefix-list isp2-out permit 222.5.64.0/23
!
ip prefix-list isp1-in permit 220.10.0.0/16
ip prefix-list isp2-in permit 222.5.0.0/16
!
route-map isp2-sb permit 10
 match ip address prefix-list isp2-out
!
route-map isp2-bb permit 10
 match ip address prefix-list isp2-in
!
```

Steady State

- Router2 peers iBGP with Router4
  - hears ISP2's /16 prefix
- Router2 peers eBGP with Router1
  - hears ISP1's /16 prefix only
  - announces 220.10.4.0/23 only

Link Failure



Link Failure

- Peering between Router 4 and Router3 (ISP2) goes down
  - 222.5.0.0/16 prefix withdrawn
- Conditional advertisement process activated
  - Router2 starts to announce 222.5.64.0/23 to Router1
- Connectivity for Enterprise maintained

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- Conditional advertisement useful when address space comes from both upstreams
  - no subprefixes leaked to Internet unless in failure situation
- Alternative backup mechanism would be to leak /23 prefixes with longer AS path
  - routing table bloat, reachability issues

What goes in the Internet Routing Registry?

- ISP1 and ISP2 obviously put their own address blocks as route objects in the IRR
- ISP1 will put the ISP1 subprefix which Enterprise will announce into the IRR with origin-as of ISP2
- ISP2 will put the ISP2 subprefix which Enterprise will announce into the IRR with origin-as of ISP1
- No inconsistent origin AS, no "problem"

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Example Two

Link Redundancy

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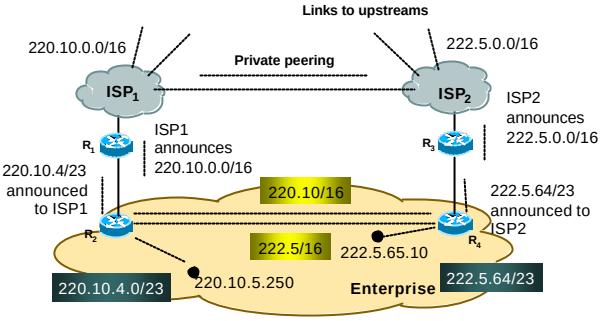
- Situation similar to previous example
  - address space used by enterprise comes from both upstream ISPs
  - use conditional advertisement
  - want to avoid leaking subprefixes of upstream provider address space into the Internet

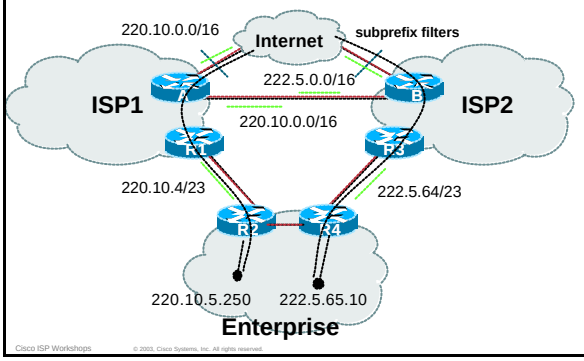
Steady State



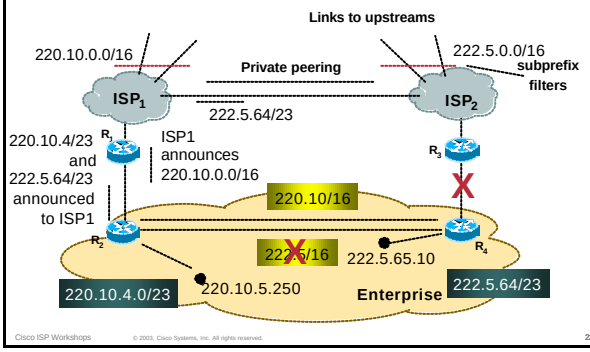
Steady State

- ISP1 and ISP2 have private peering
  - exchange each other's prefixes
  - enterprise customer is looking for link redundancy only
  - no subprefixes leaked to Internet
- Configuration of R2 as in previous example

Traffic Flow Steady State



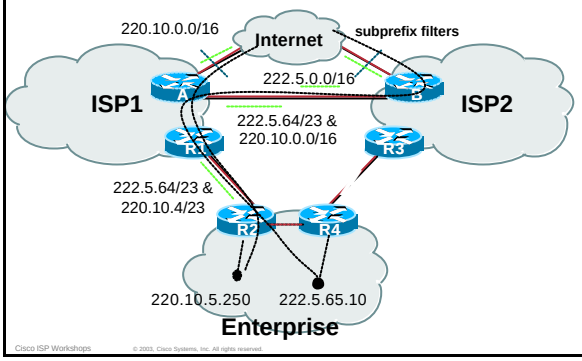
Link Failure



Link Failure

- R3 ® R4 link goes down
  - conditional advertisement effective
  - 222.5.64/23 announced by R2 to R1
  - 222.5.64/23 announced by ISP1 to ISP2
- Filters!
  - ISP1 and ISP2 filter subprefixes from their blocks outbound to Internet
  - backup yet no subprefixes leaked to Internet

Link Failure



Configuration

- RouterA ISP1 border router configuration:

```
router bgp 150
 network 220.10.0.0 mask 255.255.0.0
 neighbor <routerB> remote-as 140
 neighbor <routerB> prefix-list isp2-in in
 neighbor <routerB> prefix-list isp2-out out
 neighbor <upstream> remote-as 110
 neighbor <upstream> prefix-list rfc1918-dsua in
 neighbor <upstream> prefix-list myblock out
!
ip route 220.10.0.0 255.255.0.0 null0
..next slide
```


Configuration

```
ip prefix-list isp2-out permit 220.10.0.0/16
ip prefix-list isp2-out permit 222.5.64.0/23
!
ip prefix-list isp2-in permit 222.5.0.0/16
ip prefix-list isp2-in permit 220.10.4.0/23
!
ip prefix-list myblock permit 220.10.0.0/16
!
```

- The "myblock" prefix list ensures that no subprefixes are leaked to the Internet routing table

Recommendations

- Address space for Enterprise network should be obtained from both upstreams
  - according to link bandwidths
- Address space should be distributed according to utilisation
  - loadsharing is about address assignment policies, monitoring bandwidth utilisation, as well as BGP attribute manipulation
- Use a private AS – no need for a public AS
  - needs agreement between two upstreams

What goes in the Internet Routing Registry?

- ISP1 and ISP2 obviously put their own address blocks as route objects in the IRR
- No need for any other entries as no subprefixes appear in the global internet routing table
- No inconsistent origin AS, no "problem"

BGP and the Internet

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