

# **BGP and the Internet**

## **Enterprise Multihoming**

# Enterprise Multihoming

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- **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**

# Enterprise Multihoming

- **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

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- **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**

# Enterprise Multihoming

## Example One

### Provider Redundancy

# Enterprise Multihoming

- **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)**

# Enterprise Multihoming

- **Address space from upstream should match link bandwidth to upstream, e.g.**

**ISP1 <sup>®</sup> Enterprise = 256kbps <sup>®</sup> /22**

**ISP2 <sup>®</sup> Enterprise = 128kbps <sup>®</sup> /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**

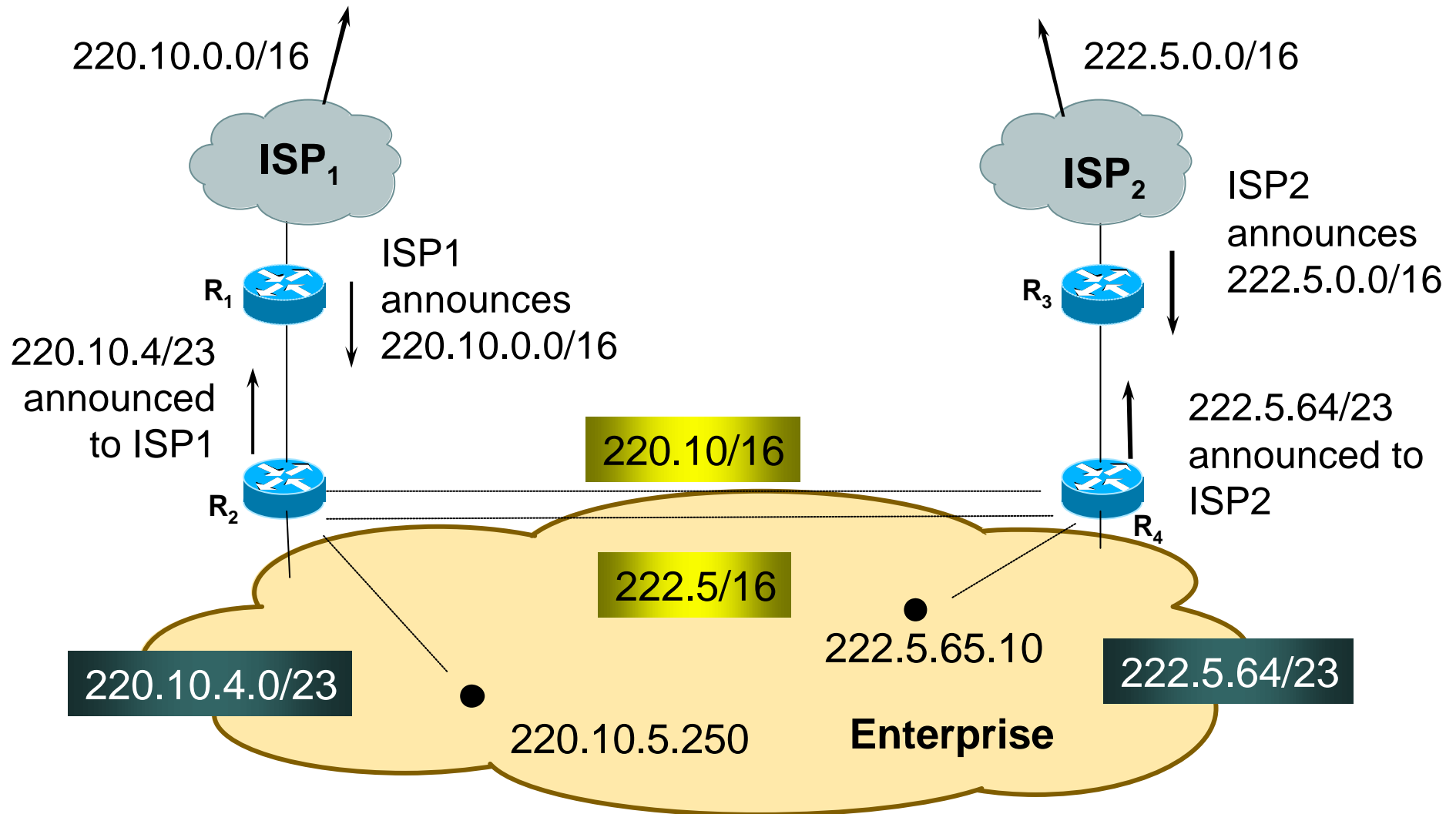
# Enterprise Multihoming Conditional Advertisement

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- **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
```

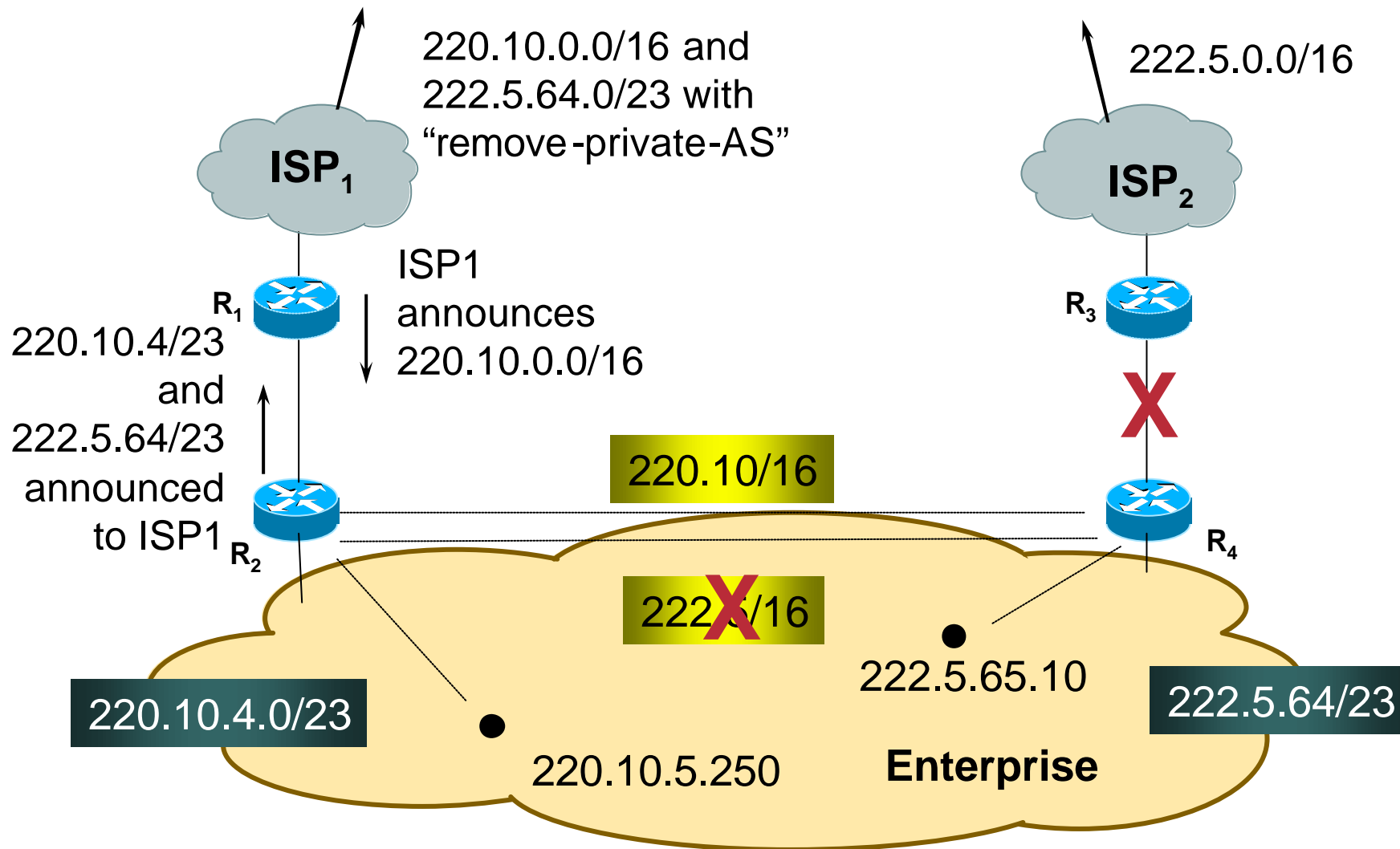
# Steady State

```
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**

# Enterprise Multihoming

- **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”**

# Enterprise Multihoming

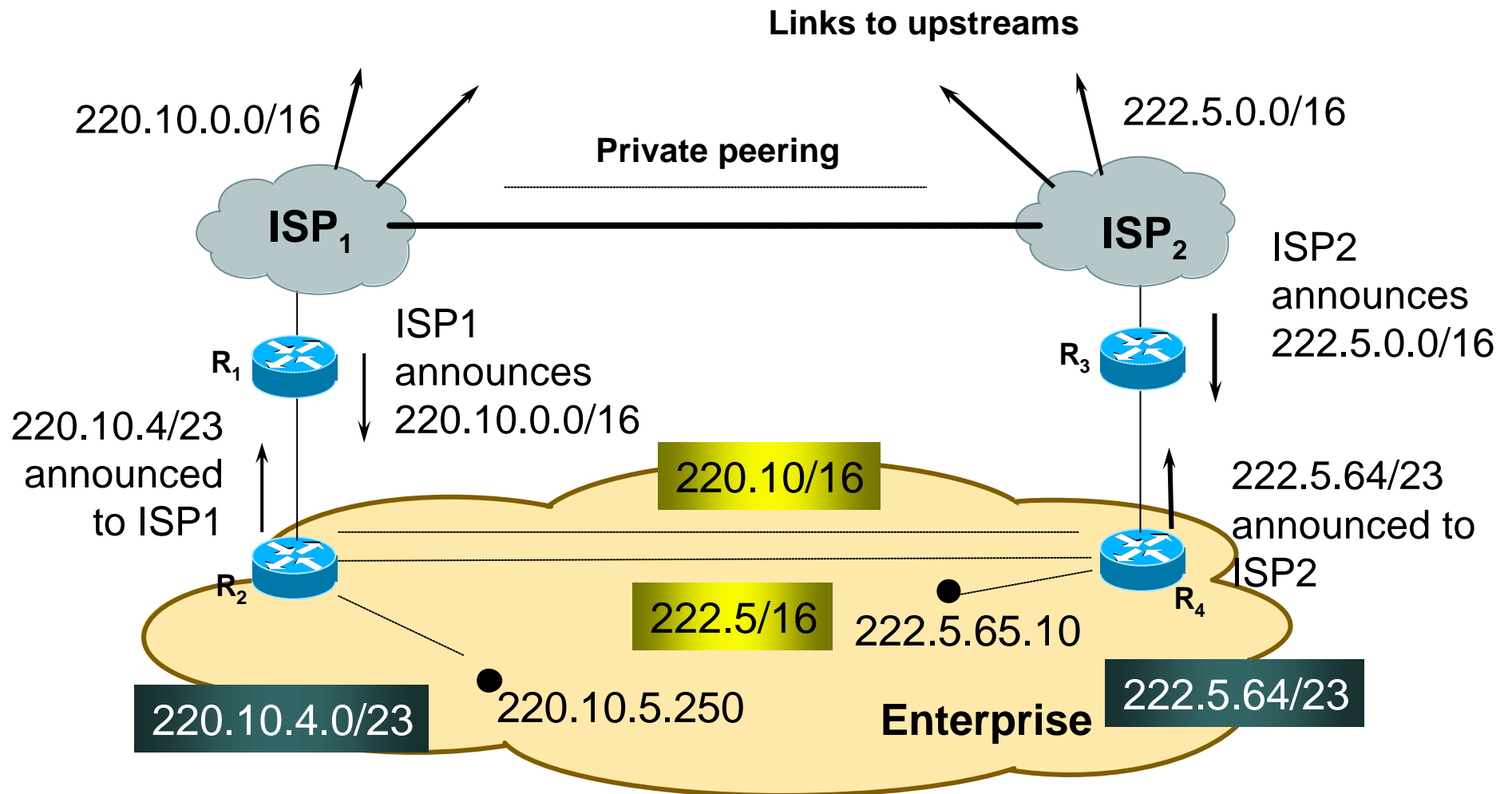
## Example Two

### Link Redundancy

# Enterprise Multihoming

- **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

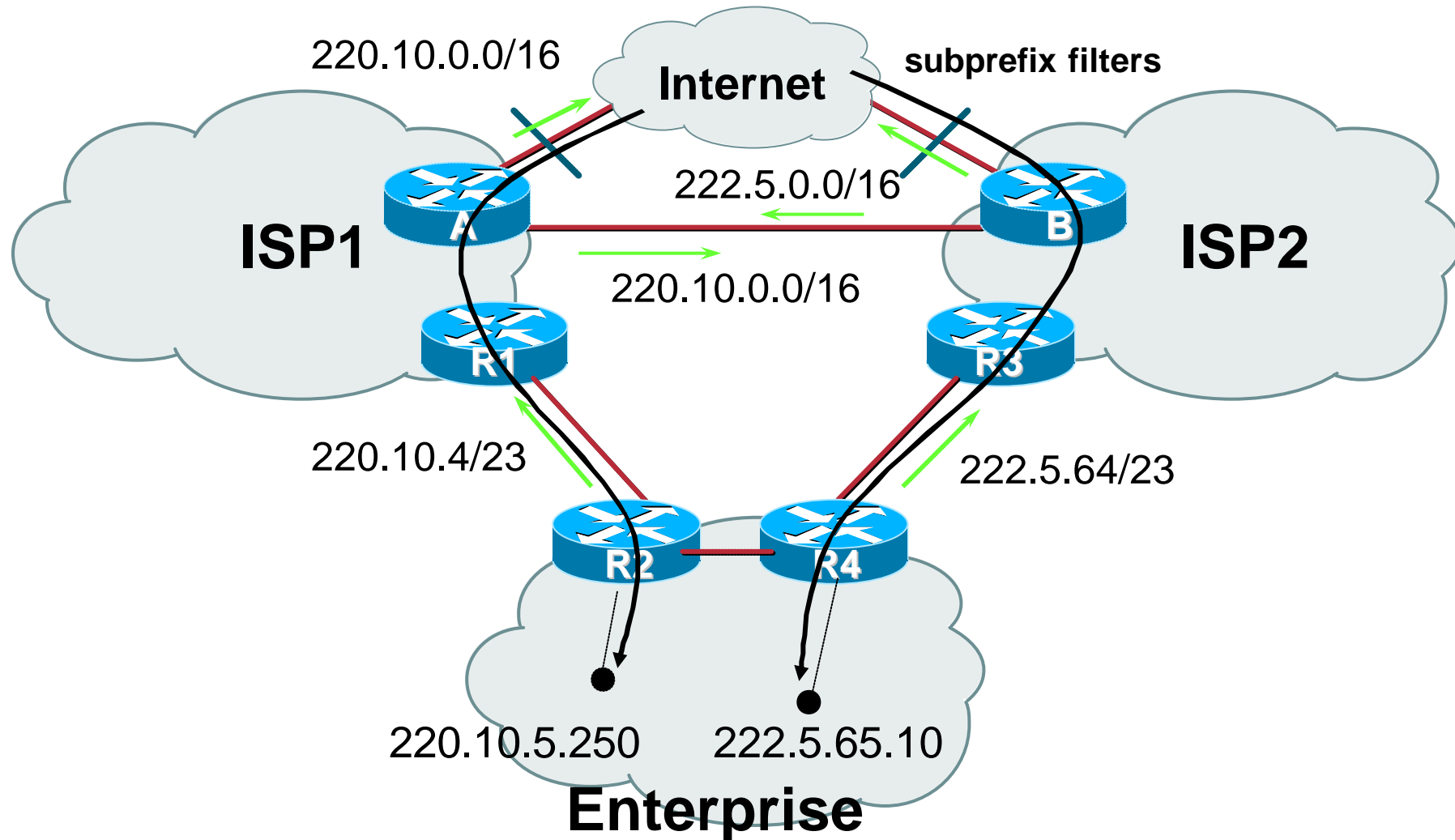


# Steady State

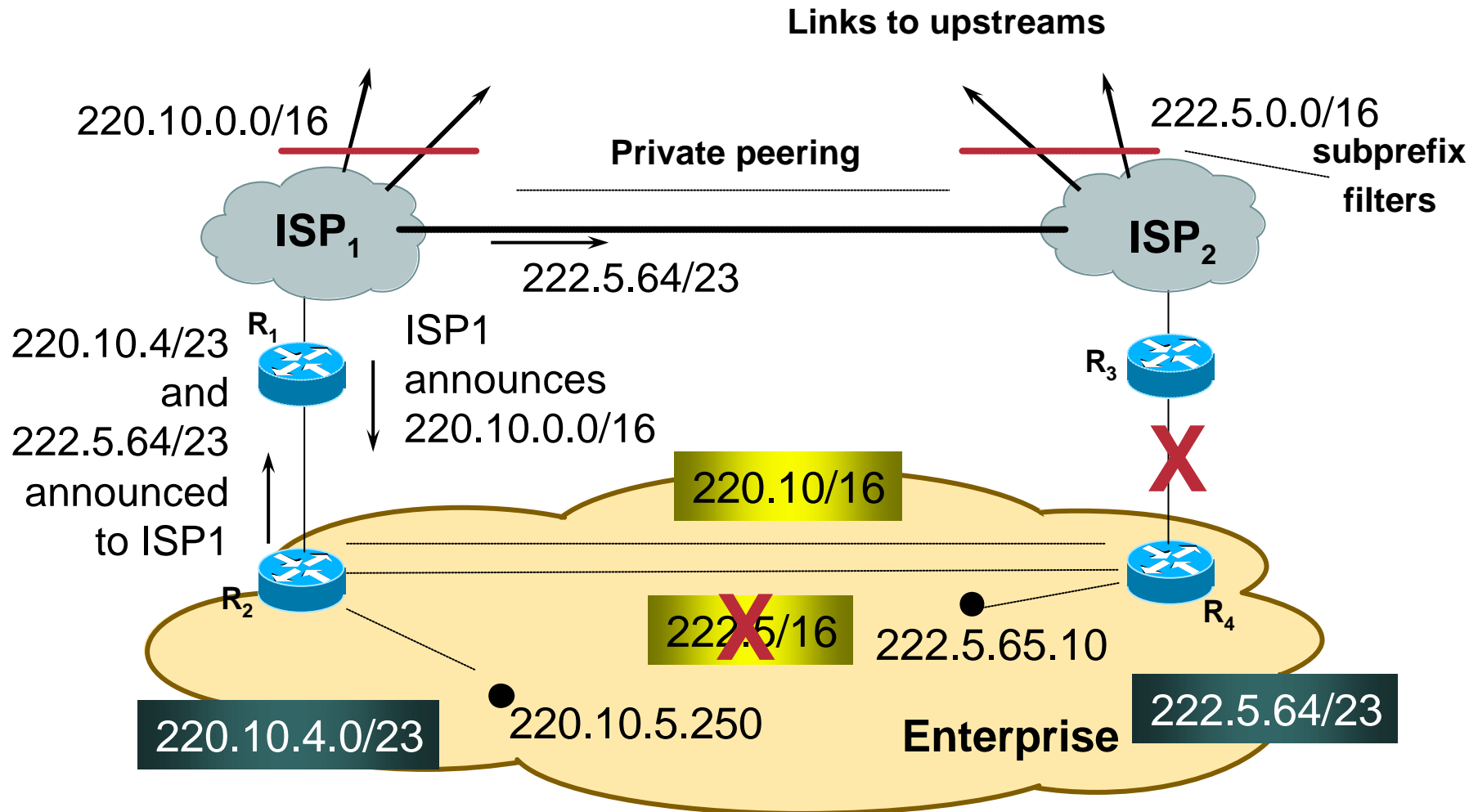
- **ISP1 and ISP2 have private peering**  
**exchange each other's prefixes**  
**enterprise customer is looking for link**  
**redundancy only**  
**no subprefixes leaked to Internet**
- **Configuration of R2 as in previous**  
**example**

# Traffic Flow Steady State

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# Link Failure

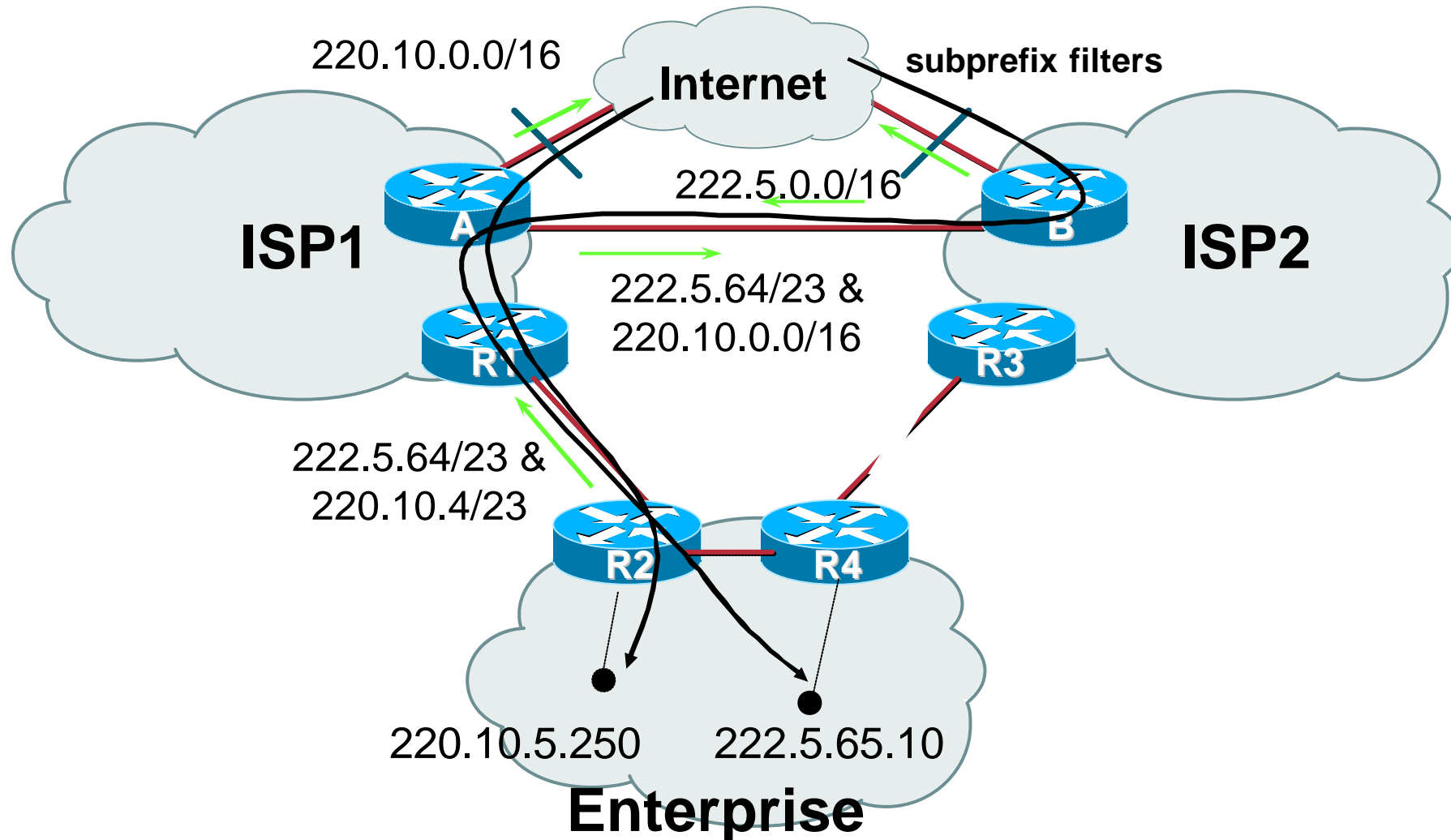


# Link Failure

- **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?

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- **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**

## **Enterprise Multihoming**