Connecting Enterprise Networks to Internet

Connecting Enterprise Networks to an ISP

- Modern corporate IP networks connect to the global Internet.

- Requirements that must be determined for connecting an enterprise to an ISP include the following:
  - Public IP address space
  - Enterprise-to-ISP connection link type and bandwidth
  - Connection redundancy
  - Routing protocol

Public IP Address Space

- Public IP addresses are used:
  - By internal enterprise clients to access the Internet using NAT.
  - To make enterprise servers accessible from the Internet using static NAT.

- Public IP addresses are available from ISPs and RIRs.
  - Most enterprises acquire their IP addresses and AS number from ISPs.
  - Large enterprises may want to acquire IP addresses and AS number from a RIR.

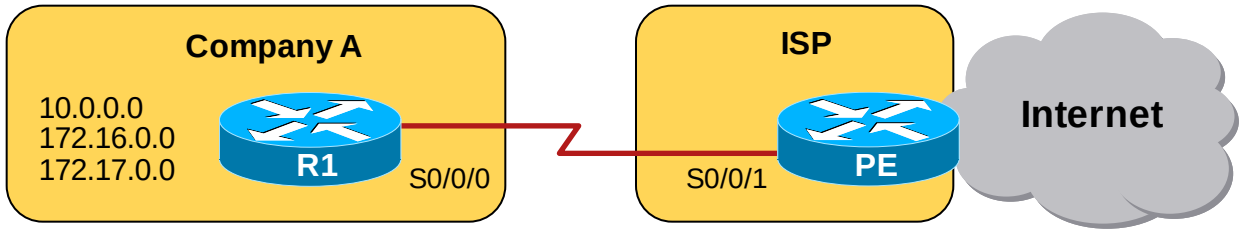
Connection and Routing Questions

- Which connection options does the ISP offer?
- Which routing options does the ISP offer?
- Will the enterprise network be connected to multiple ISPs?
- Does the routing need to support one link to an ISP or multiple links, to one or multiple ISPs?
- Is traffic load balancing over multiple links required?
- How much routing information needs to be exchanged with the ISP?
- Does the routing need to respond to the changes in the network topology, such as when a link goes down?

Using Static Routes Example

- Static routes are the simplest way to implement routing with an ISP.
  - Typically a customer has a single connection to an ISP and the customer uses a default route toward the ISP while the ISP deploys static routes toward the customer.

```
R1(config)# router eigrp 110
R1(config-router)# network 10.0.0.0
R1(config-router)# exit
R1(config)# ip default-network 0.0.0.0
R1(config)# ip route 0.0.0.0 0.0.0.0 serial 0/0/0
```

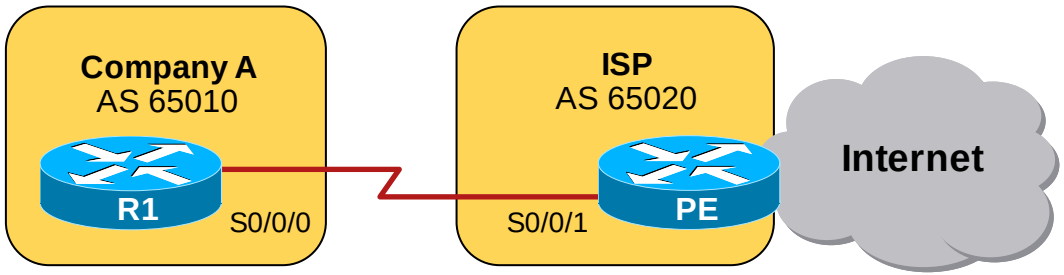



```
PE(config)# ip route 10.0.0.0 255.0.0.0 serial 0/0/1
PE(config)# ip route 172.16.0.0 255.255.0.0 serial 0/0/1
PE(config)# ip route 172.17.0.0 255.255.0.0 serial 0/0/1
```

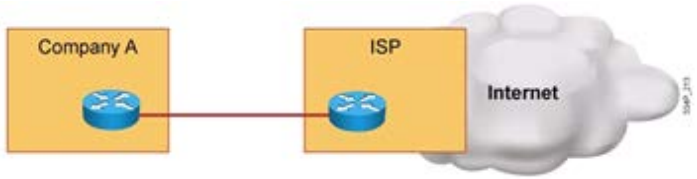
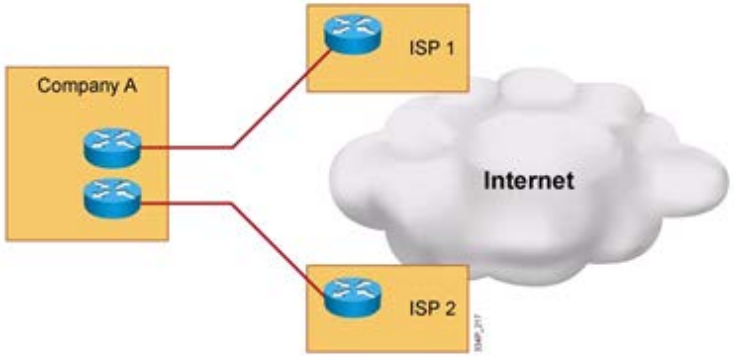
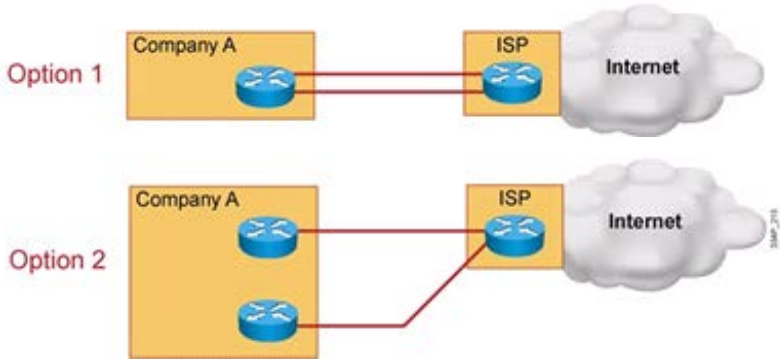
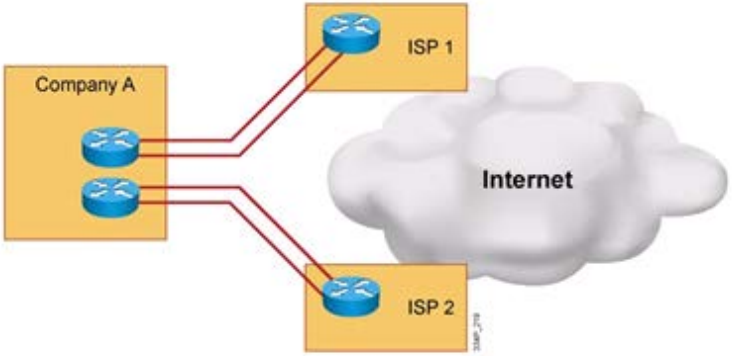
Using BGP

- BGP can be used to dynamically exchange routing information.

- BGP can also be configured to react to topology changes beyond a customer-to-ISP link.

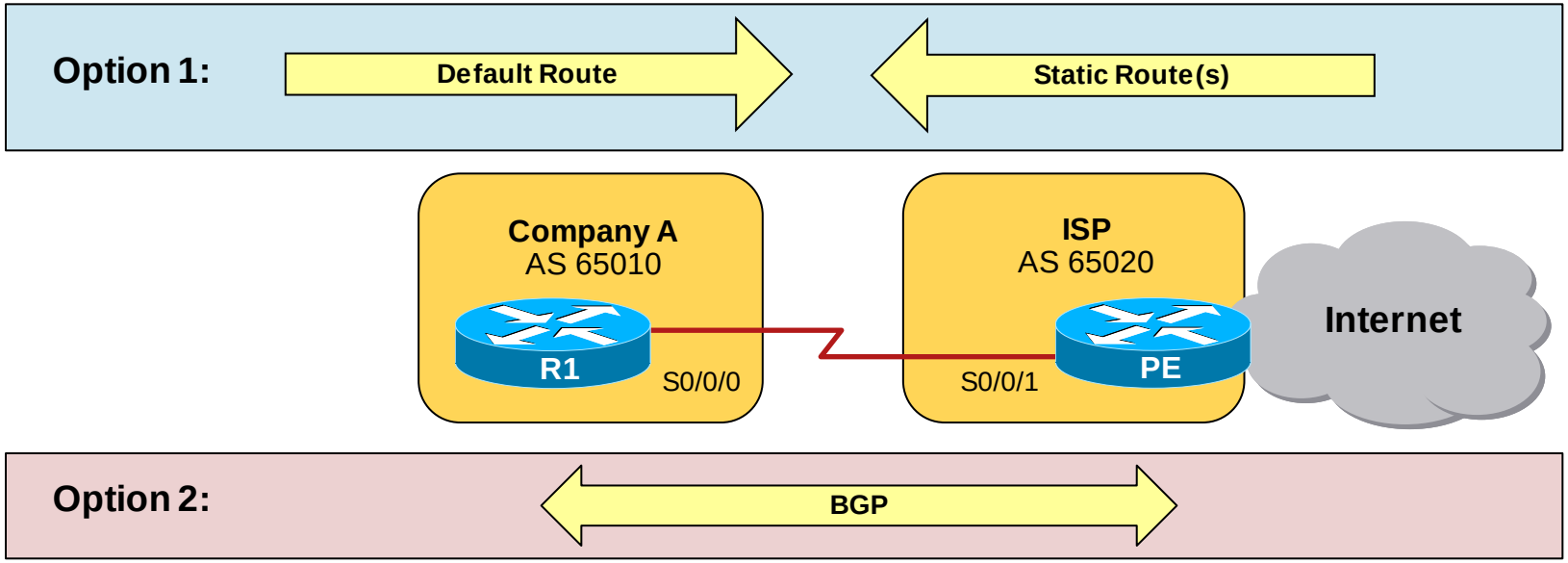


Connection Redundancy

Connecting to One ISP	Connecting to Two or more ISPs
Single-homed 	**Multihomed** 
Dual-homed 	**Dual-multihomed** 

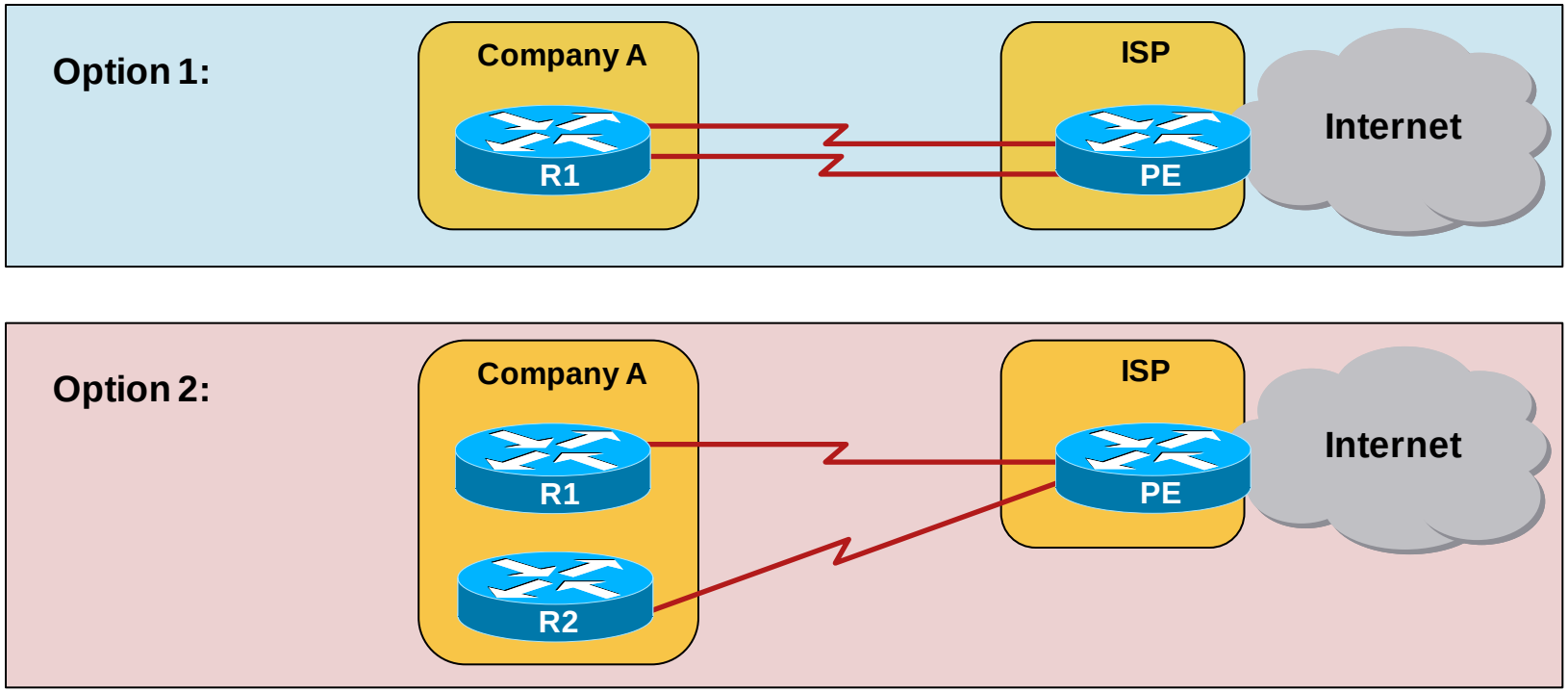
Connecting to One ISP: Single-Homed

- The connection type depends on the ISP offering (e.g., leased line, xDSL, Ethernet) and link failure results in a no Internet connectivity.
- The figure displays two options:
  - **Option 1**: Static routes are typically used with a static default route from the customer to the ISP, and static routes from the ISP toward customer networks.
  - **Option 2**: When BGP is used, the customer dynamically advertises its public networks and the ISP propagates a default route to the customer.



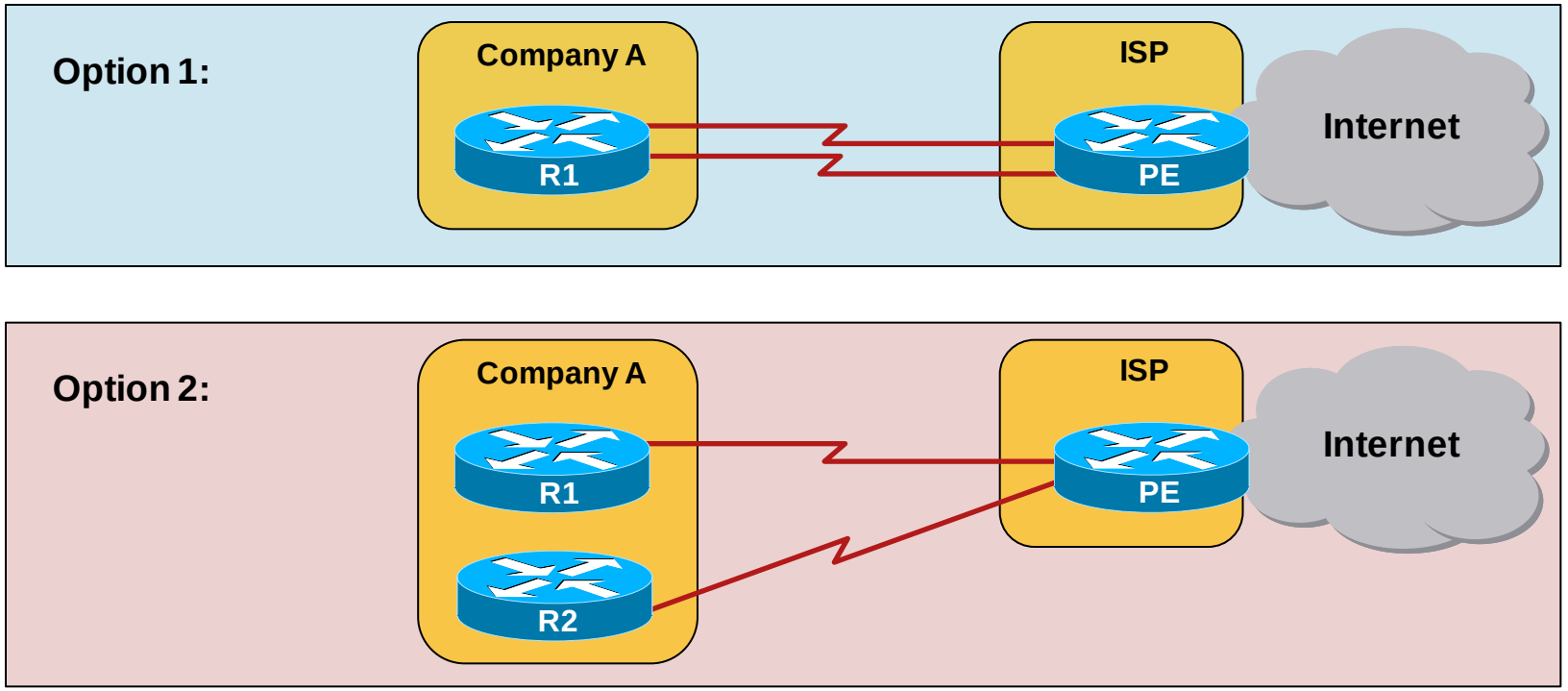
Connecting to One ISP: Dual-Homed

- The figure displays two dual-homed options:
  - **Option 1**: Both links can be connected to one customer router.
  - **Option 2**: To enhance resiliency, the two links can terminate at separate routers in the customer's network.



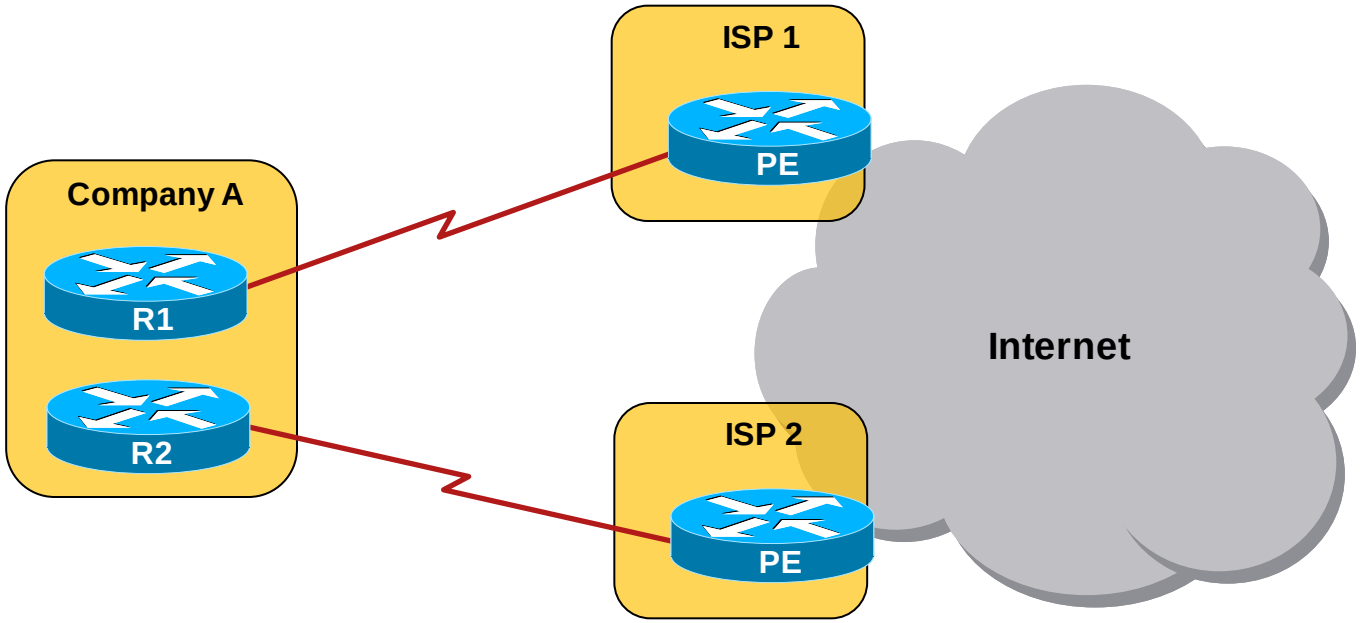
Connecting to One ISP: Dual-Homed

- Routing deployment options include:
  - Primary and backup link functionality in case the primary link fails.
  - Load sharing using Cisco Express Forwarding (CEF).
- Regardless, routing can be either static or dynamic (BGP).



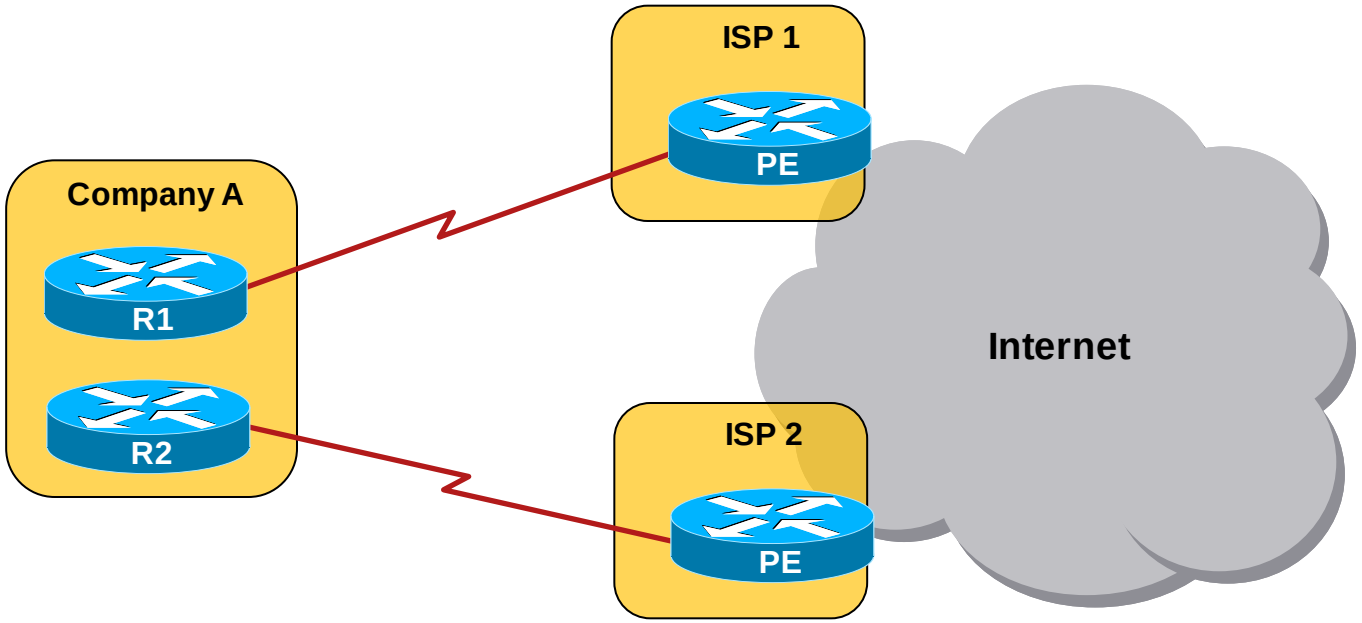
Connecting to Multiple ISPs: Multihomed

- Connections from different ISPs can terminate on the same router, or on different routers to further enhance the resiliency.
- Routing must be capable of reacting to dynamic changes therefore BGP is typically used.



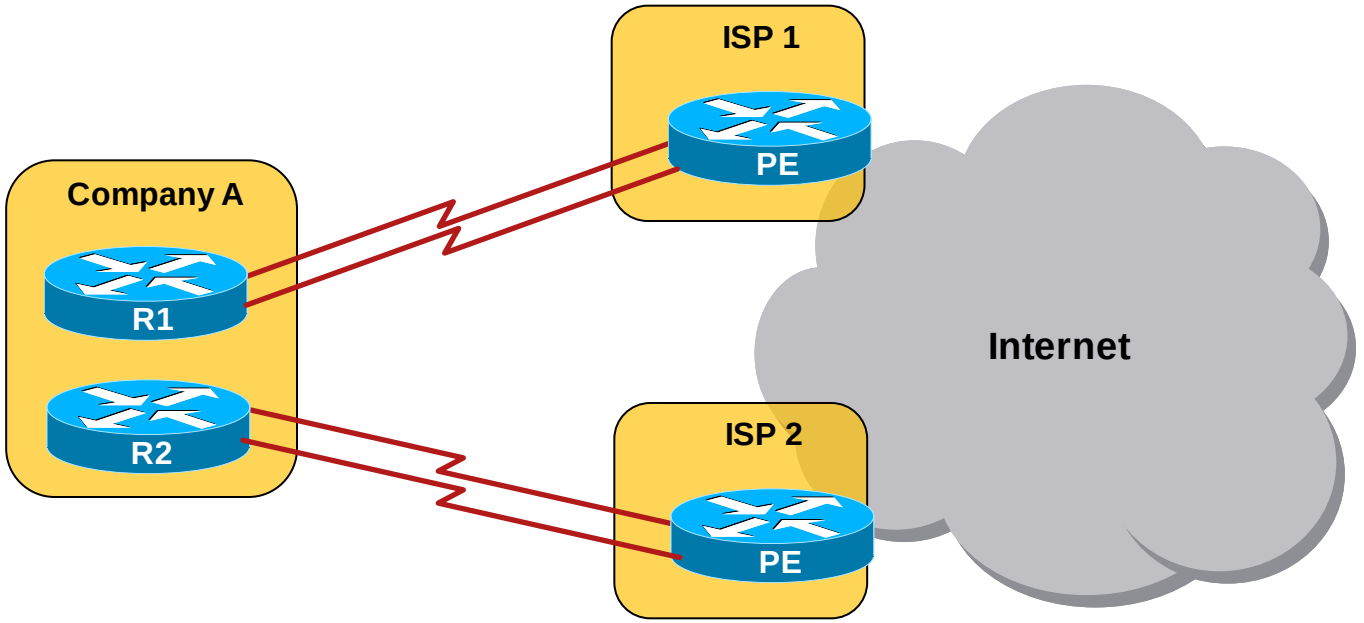
Connecting to Multiple ISPs: Multihomed

- Multihomed benefits include:
  - Achieving an ISP-independent solution.
  - Scalability of the solution, beyond two ISPs.
  - Resistance to a failure to a single ISP.
  - Load sharing for different destination networks between ISPs.



Connecting Multiple ISPs: Dual-Multihomed

- Dual multihomed includes all the benefits of multihomed connectivity, with enhanced resiliency.
- The configuration typically has multiple edge routers, one per ISP, and uses BGP.



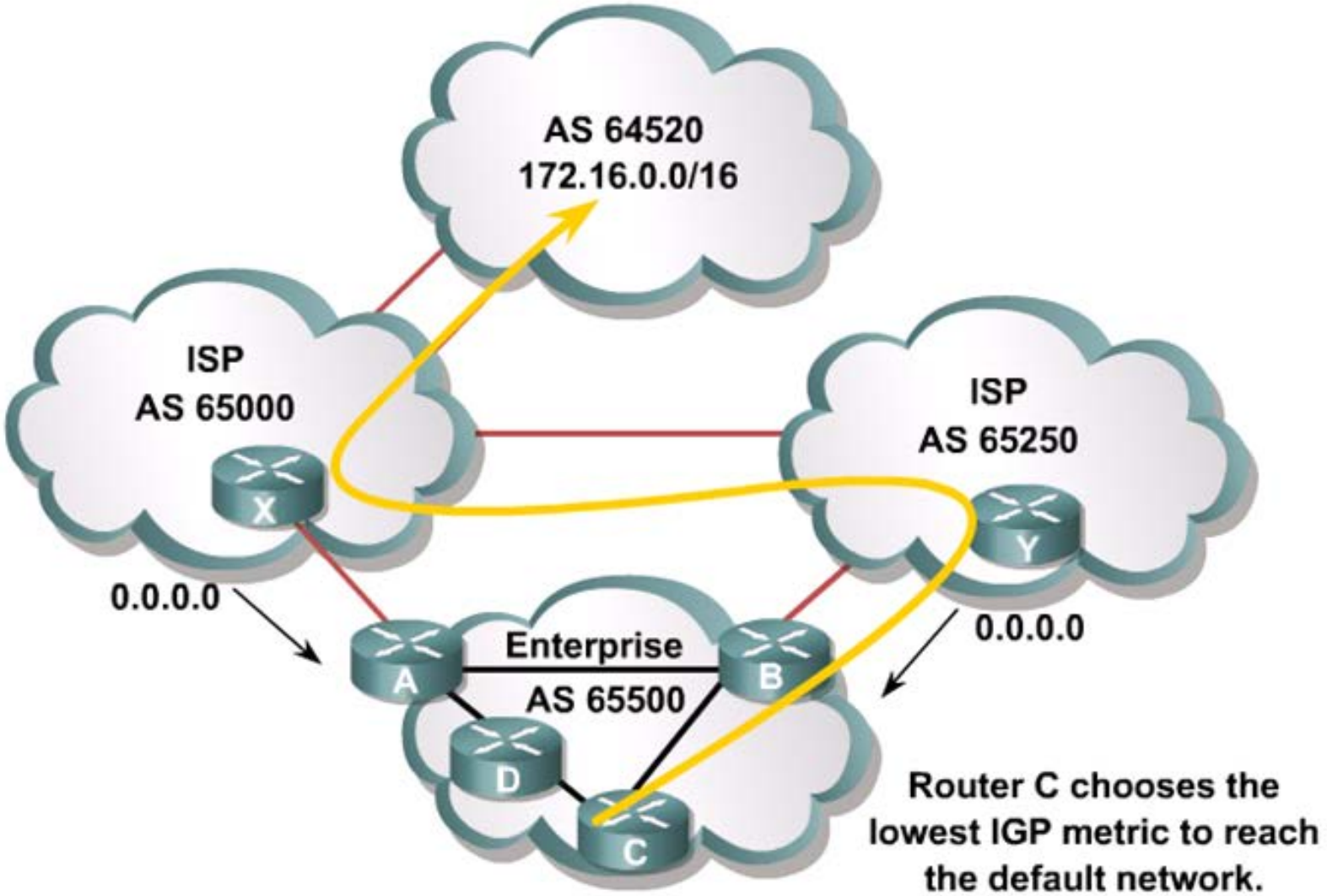
Three Multihoming Connection Options

1. Each ISP passes only a default route to the AS.
   - The default route is passed on to internal routers.

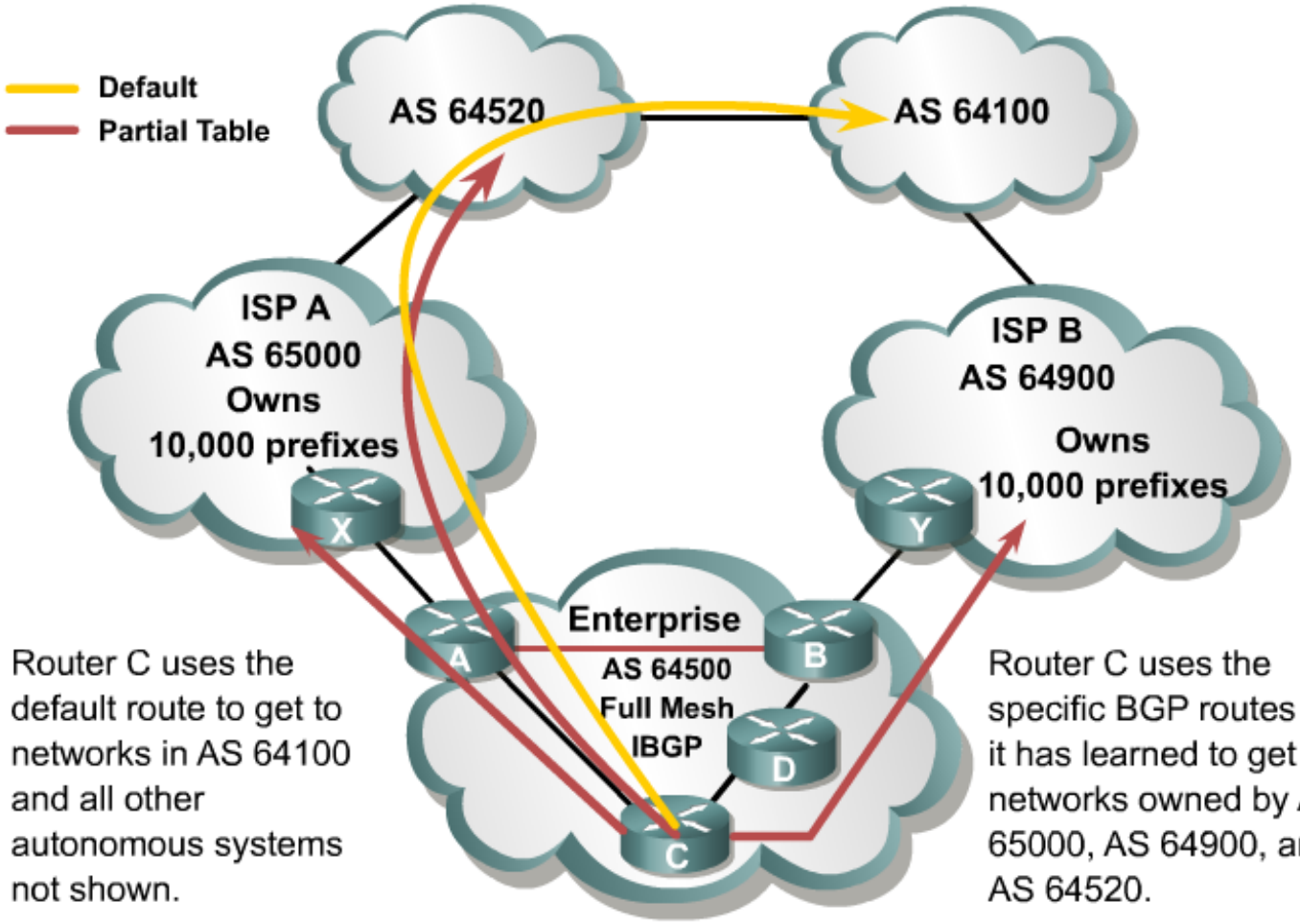
2. Each ISP passes only a default route and provider-owned specific routes to the AS.
   - These routes may be propagated to internal routers, or all internal routers in the transit path can run BGP to exchange these routes.

3. Each ISP passes all routes to the AS.
   - All internal routers in the transit path run BGP to exchange these routes.

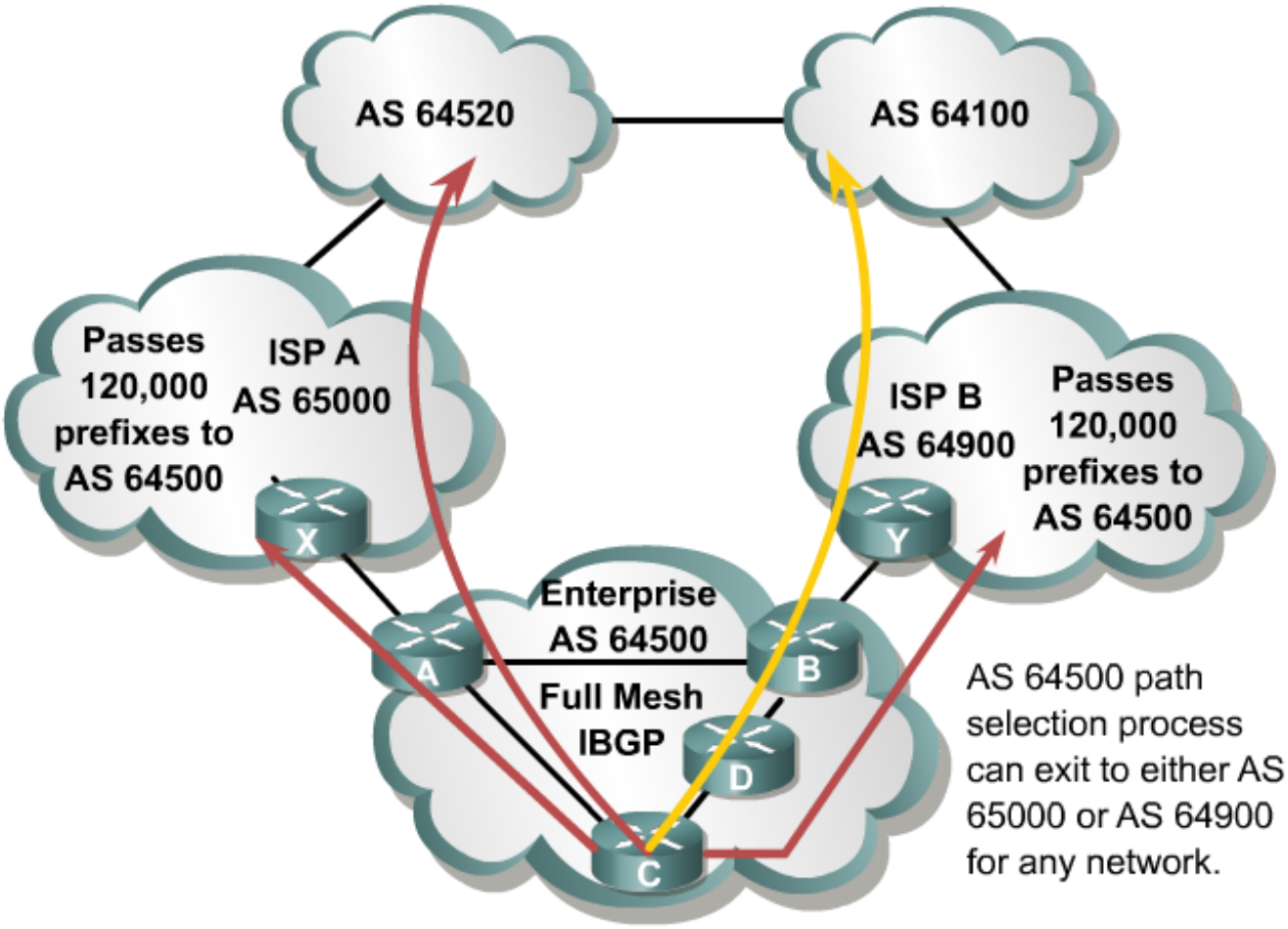
Default Routes from All Providers



Default Routes and Partial Updates



Full Routes from All Providers



When to Use BGP

- Most appropriate when the effects of BGP are well-understood and at least one of the following conditions exists:
  - The AS has multiple connections to other autonomous systems.
  - The AS allows packets to transit through it to reach other autonomous systems (eg, it is a service provider).
  - Routing policy and route selection for traffic entering and leaving the AS must be manipulated.

When Not to Use BGP

- Do not use BGP if one or more of the following conditions exist:
  - A single connection to the Internet or another AS.
  - Lack of memory or processor power on edge routers to handle constant BGP updates.
  - You have a limited understanding of route filtering and the BGP path-selection process.
- In these cases, use static or default routes instead.