Reviewing Enterprise Routing Protocols

Designing IP Addressing and Selecting Routing Protocols

Distance Vector and Link-State Comparison

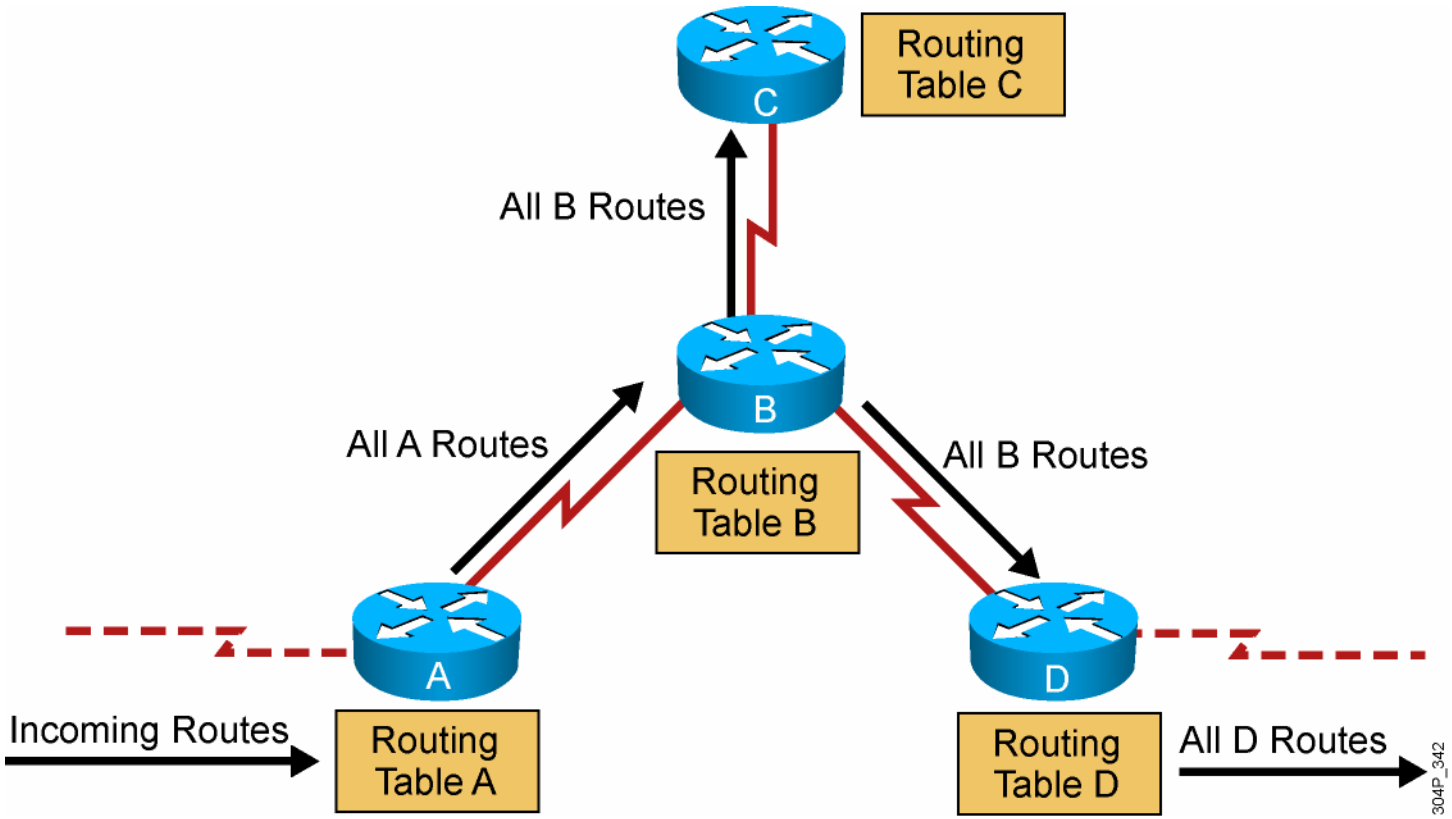
Distance vector protocol characteristics:

- Slow convergence
- Easy implementation and maintenance
- Limited scalability

Link-state protocol characteristics:

- Fast convergence
- Good scalability
- Less routing traffic overhead
- More knowledge needed for implementation and maintenance

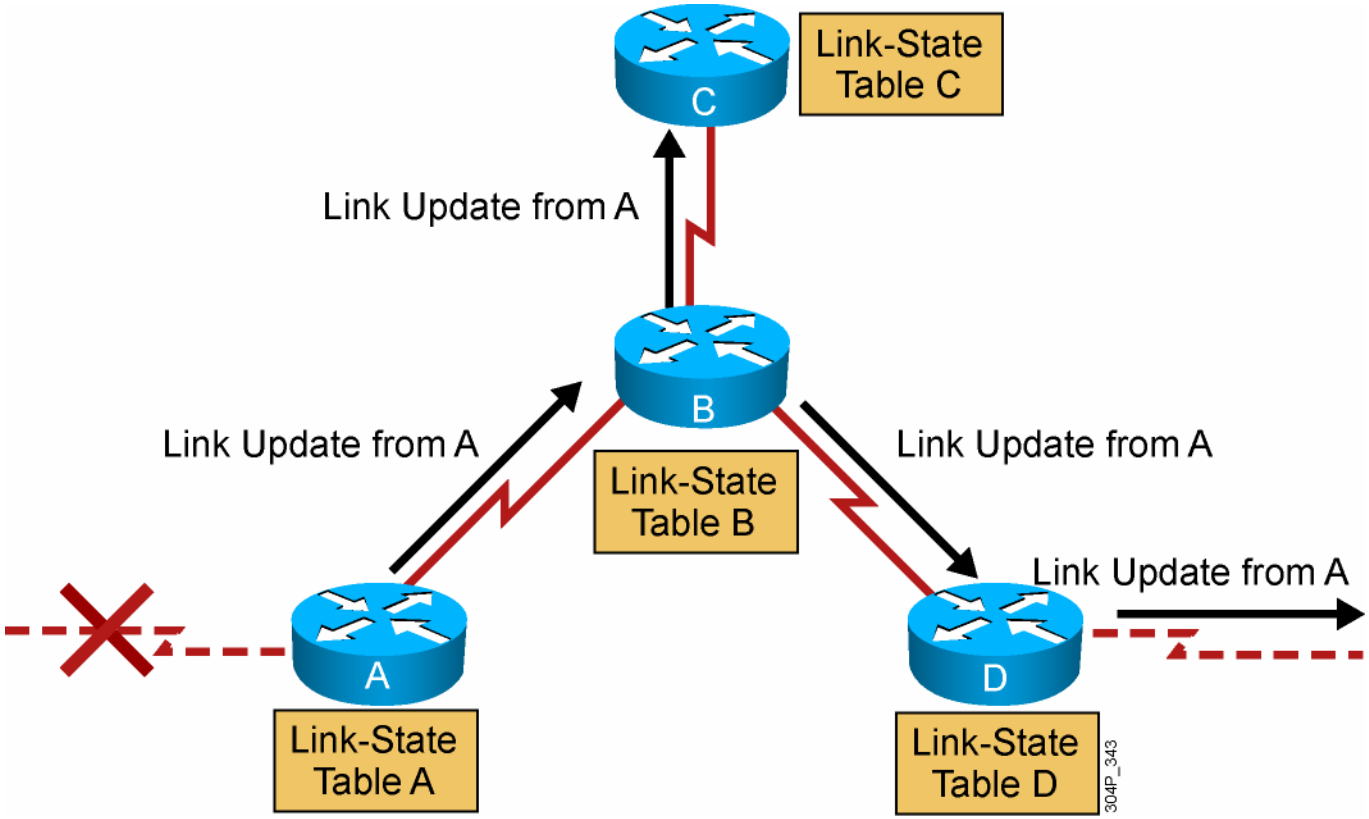
Example: Distance Vector Routing



Routing updates are periodic:

- Include whole routing tables
- Use gratuitous updates (except RIPv2)

Example: Link-State Routing



Triggered updates:

- Include data on link states of changing links
- Use multicast propagation

Interior vs. Exterior Routing Protocols

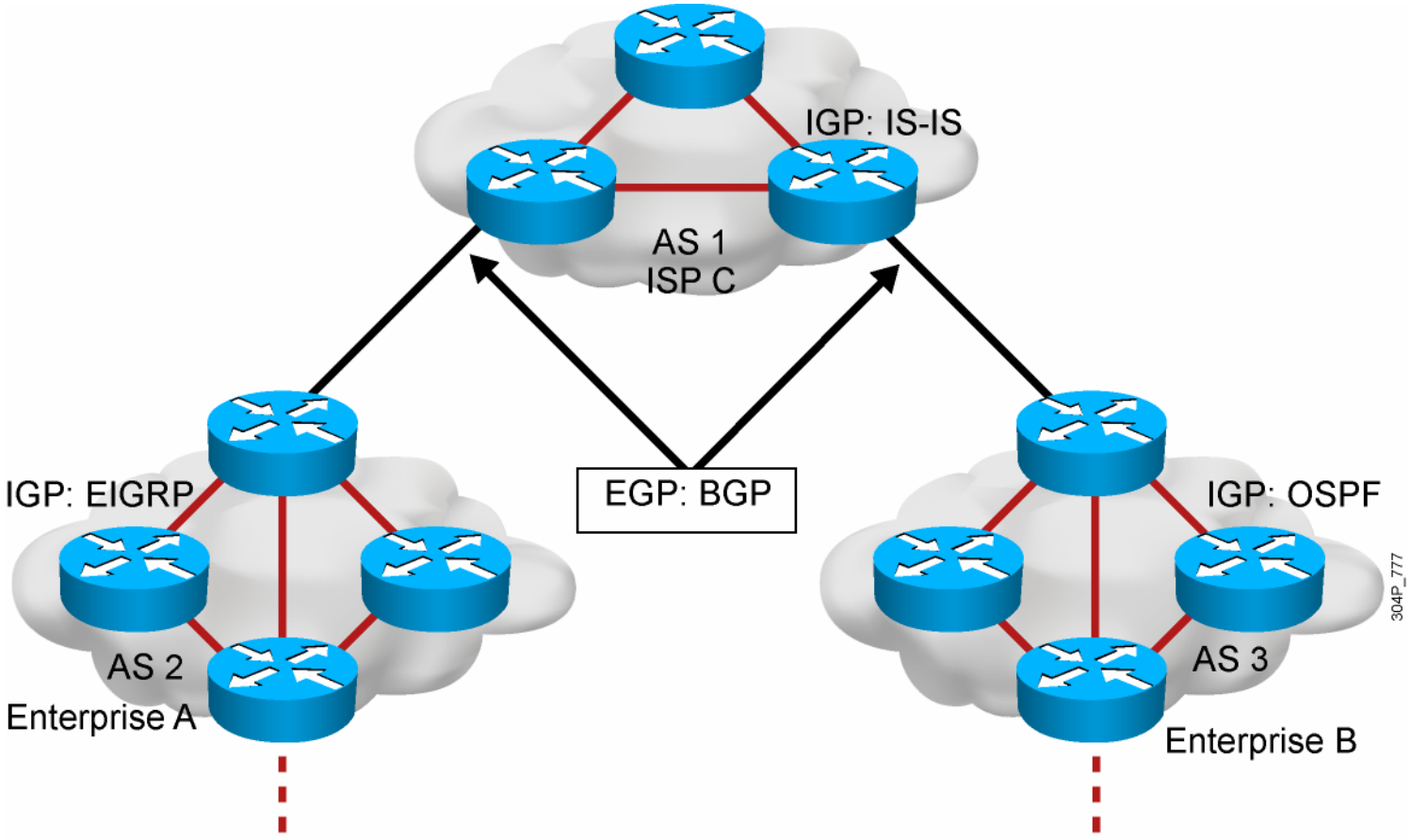
Interior Gateway Protocols (IGPs):

- Routing inside autonomous systems
- Fast convergence and easy configuration
- Low administrator influence on routing decisions

Exterior gateway protocols (EGPs):

- Routing between autonomous systems
- Slow convergence and more complex configuration
- High administrator influence on routing decisions

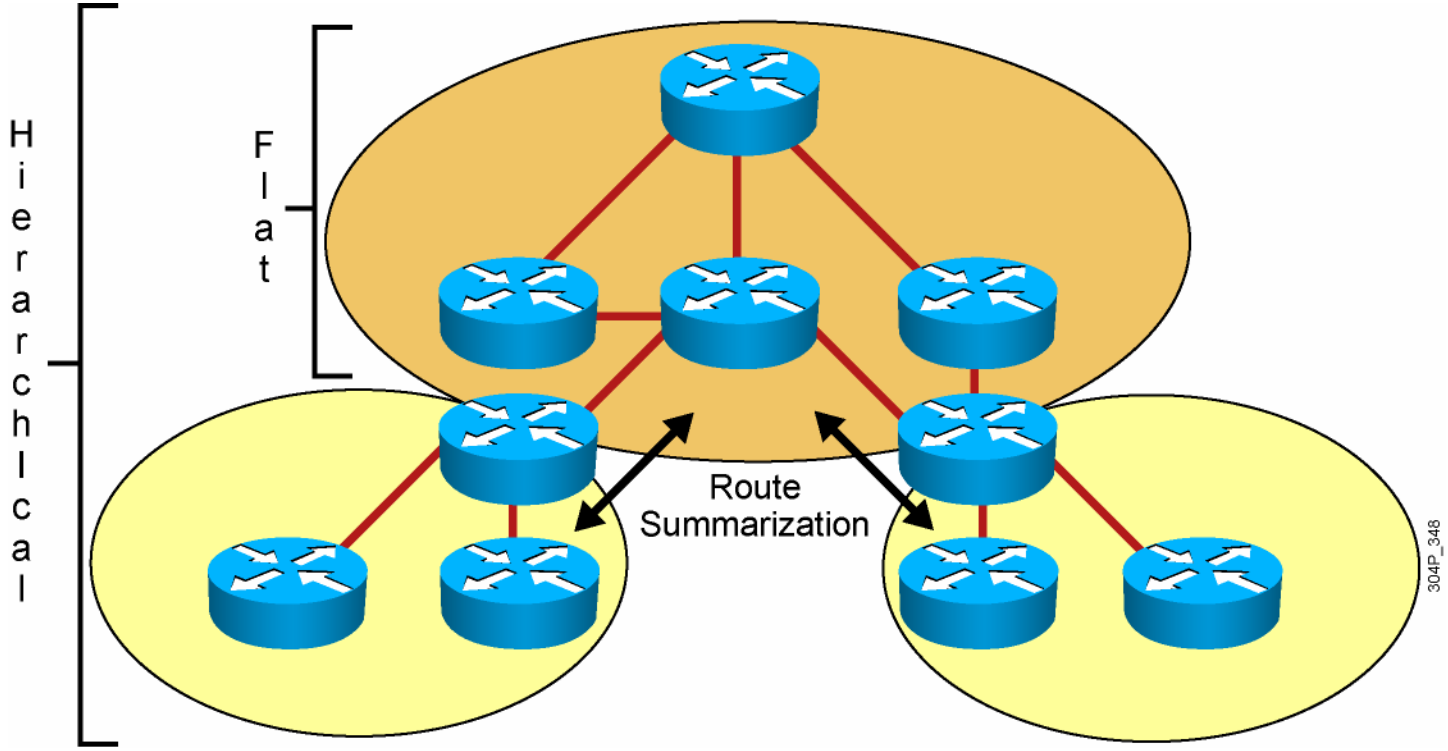
Example: Interior vs. Exterior Routing Protocols



Hierarchical vs. Flat Routing Protocols

- Flat routing protocols propagate all routing information throughout the network:
  - Classful routing protocols
  - Not appropriate for large networks
  - RIPv1, IGRP, RIPv2 (classless)
- Hierarchical routing protocols divide large networks into smaller areas:
  - Classless routing protocols
  - Limited route propagation between areas
  - EIGRP, OSPF, IS-IS

Example: Flat and Hierarchical Networks



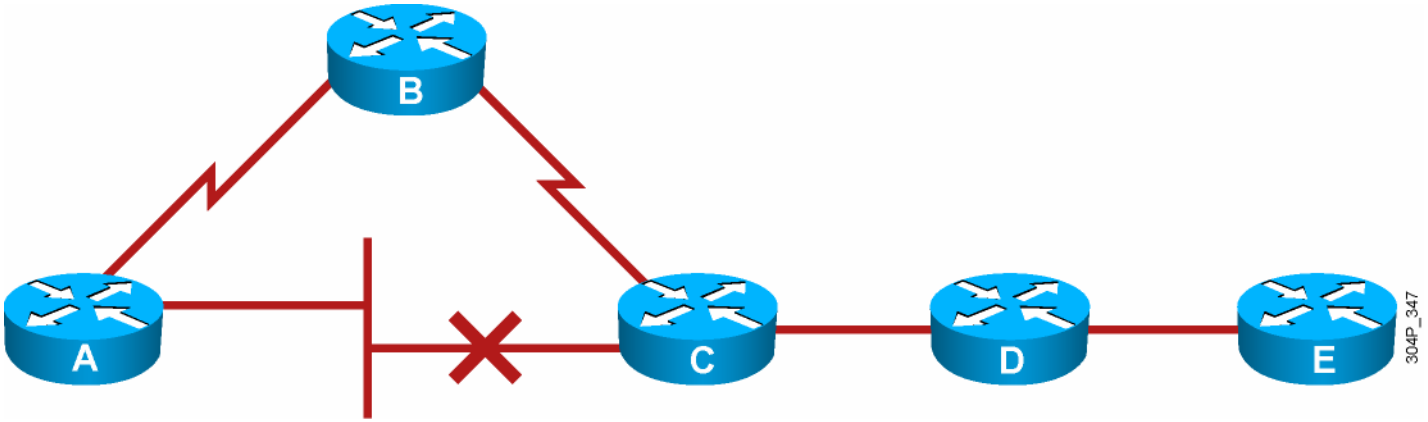
Comparing flat and hierarchical networks:

- Hierarchical structure means less routing traffic overhead.
- Summarization is the key.

Routing Protocol Convergence

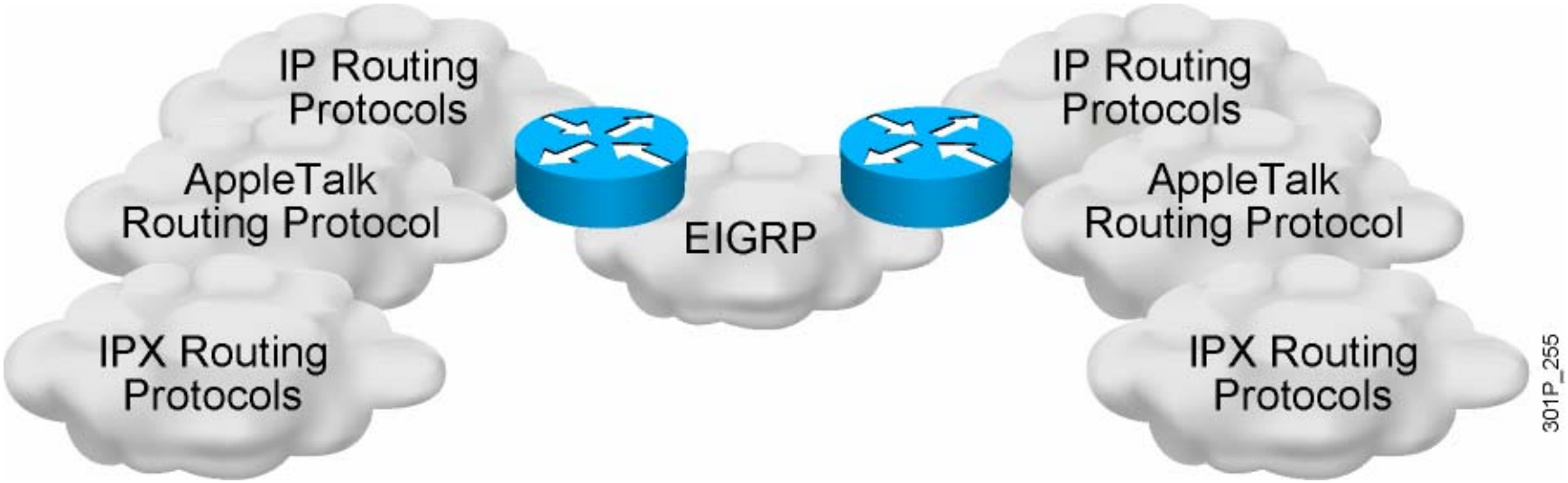
- A converged network is a stable network with all needed routing information.
- Network convergence takes place:
  - Initially on network startup
  - On topological changes
- Enterprise routing protocols should have short convergence times.

Routing Protocol Convergence Comparison



Protocol	Convergence Time to Router E
RIP	Holddown + 1 or 2 update intervals
EIGRP	Matter of seconds
OSPF	Matter of seconds

Enhanced IGRP (EIGRP)



- Advanced distance vector protocol based on IGRP with some link-state protocol features
- Supports VLSM

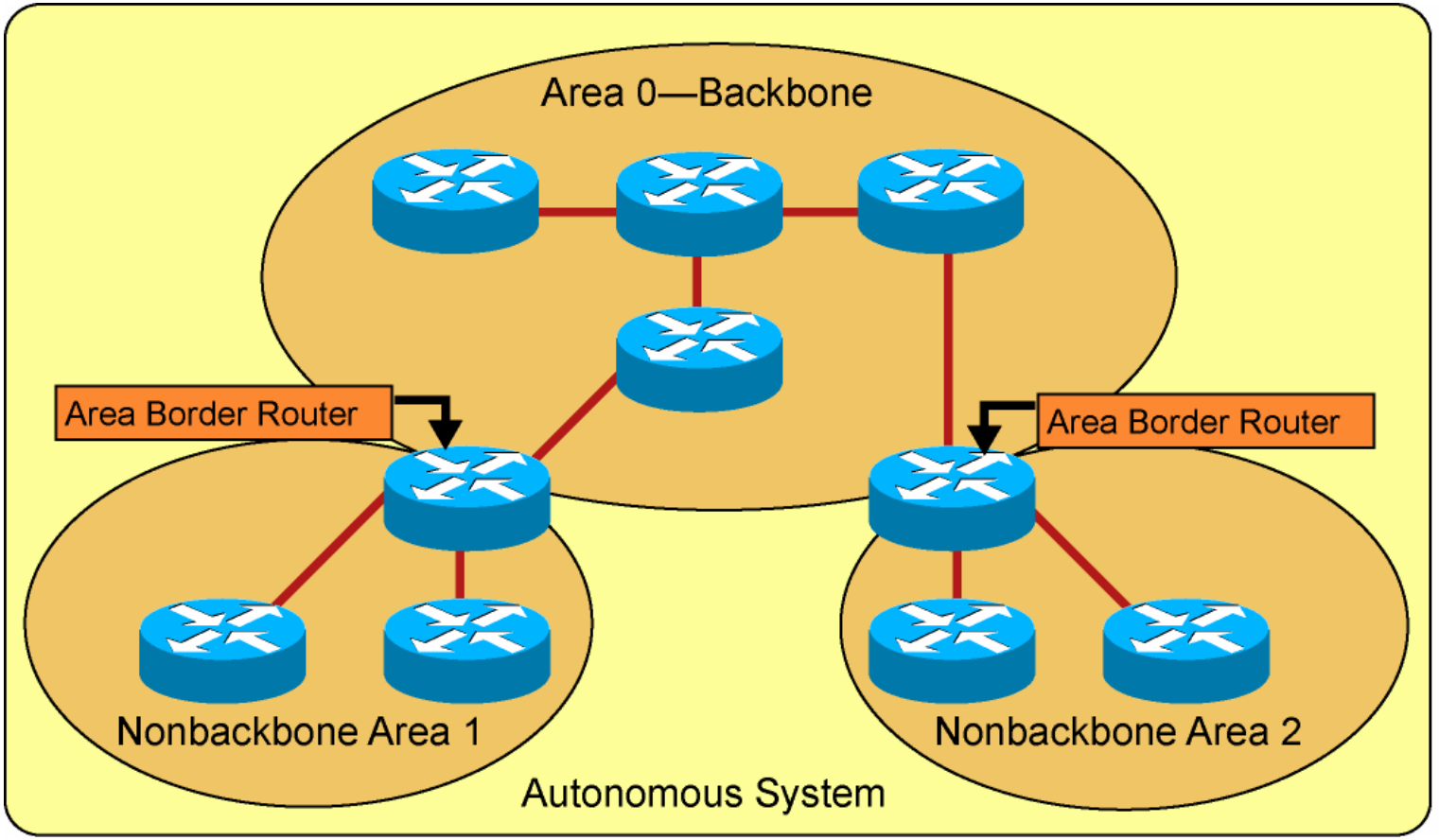
EIGRP Characteristics

EIGRP Characteristics	Implemented By
Fast convergence	Diffusing Update Algorithm (DUAL)
Improved scalability	Manual summarization, fast convergence
Use of VLSM	Subnet mask in updates
Reduced bandwidth usage	No periodic updates
Multiple network layer protocol support	IPv4, IPv6 (Protocol Dependent Modules for IPX, AppleTalk)

Open Shortest Path First (OSPF)

- Developed in 1988 by IETF, version 2 is described in RFC 2328.
- OSPF was devised for use in large, scalable networks where RIP failed:
  - Improved speed of convergence
  - Network reachability (no hop-count limitations)
  - Support for VLSM
  - Improved path calculation

Example: OSPF Multiarea Network



OSPF Characteristics

OSPF Characteristics	Implemented By
Fast convergence	Link-state updates (triggered), SPF calculation
Very good scalability	Multiple-area design
Use of VLSM	Subnet mask in updates
Reduced bandwidth usage	No periodic updates

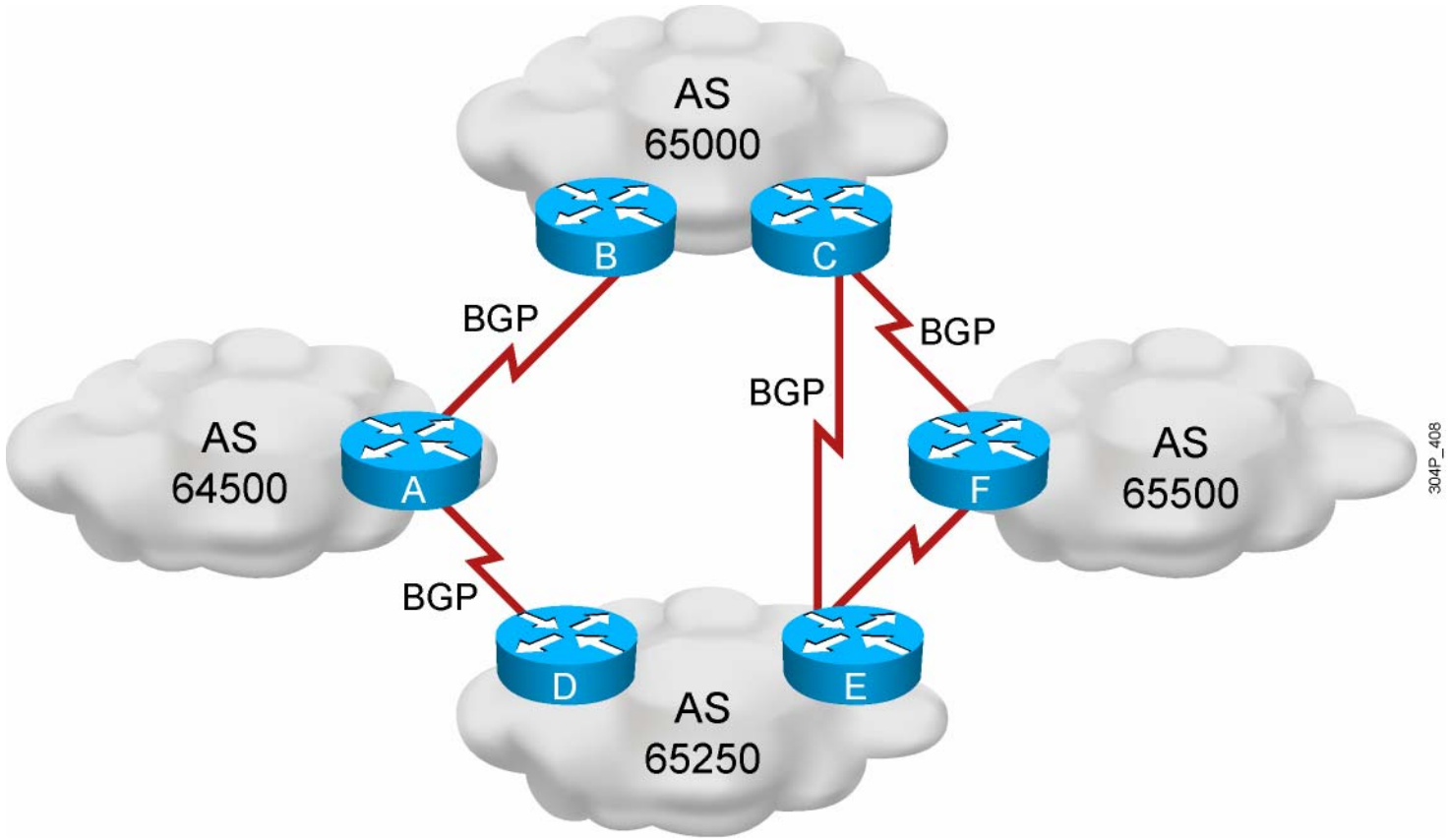
Integrated IS-IS

- Link-state protocol
  - Supports IPv4, IPv6, and OSI CLNP
  - Support for VLSM
  - Based on Level 2 backbone to which Level 1 areas are attached
- Typically deployed in service provider environments, with enterprise network administrators having limited knowledge of IS-IS

Border Gateway Protocol (BGP)

- BGP is an exterior gateway protocol (EGP) used in Internet routing.
- BGP is a path vector protocol with enhancements:
  - Suited for strategic routing policies used between autonomous systems
  - Allows administrators to adjust parameters to influence routing

BGP Network Implementation



BGP is primarily used for inter-AS system routing.

Internal BGP

- BGP can run between routers within one autonomous system.
- IBGP neighbors need not be directly connected (use static routes or an IGP to convey reachability information).
- Other IBGP uses:
  - Intra-autonomous system policy implementations
  - QoS Policy Propagation on BGP (QPPB)
  - MPLS VPNs (using multiprotocol IBGP)

Recommended Enterprise Routing Protocol Comparison

Enterprise Characteristics	EIGRP	OSPF
Fast convergence	Yes	Yes
Very good scalability	Yes	Yes
Use of VLSM	Yes	Yes
Multiple network layer protocol support	Yes	No
Mixed vendor devices	No	Yes

Summary

- Protocols with hierarchical and link-state attributes support the fastest network convergence.
- EIGRP and OSPF are the recommend IGPs for the enterprise.
  - EIGRP is a Cisco proprietary protocol for routing IPv4, IPv6, IPX, and AppleTalk traffic.
  - OSPF is a standardized protocol for routing IPv4, developed to replace RIP in larger, more diverse media networks. It also can support IPv6.
  - BGP is a representative EGP. It is primarily used to interconnect autonomous systems or to connect enterprises to an ISP.