

# **AN INTRODUCTION TO IP ROUTING**

# KEY ROUTING CONCEPTS



## Layers

- bridges, switches and routers



## IP Service Model

- Provided to transport layer
  - Global namespace, host to host connectivity, best effort packet delivery
- Not include: Delivery guarantees on bandwidth, delay or loss



## IP Addressing

- Class vs. Classless
- IPv4 vs. IPv6



## IP Forwarding vs Ethernet Switching

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# KEY ROUTING CONCEPTS

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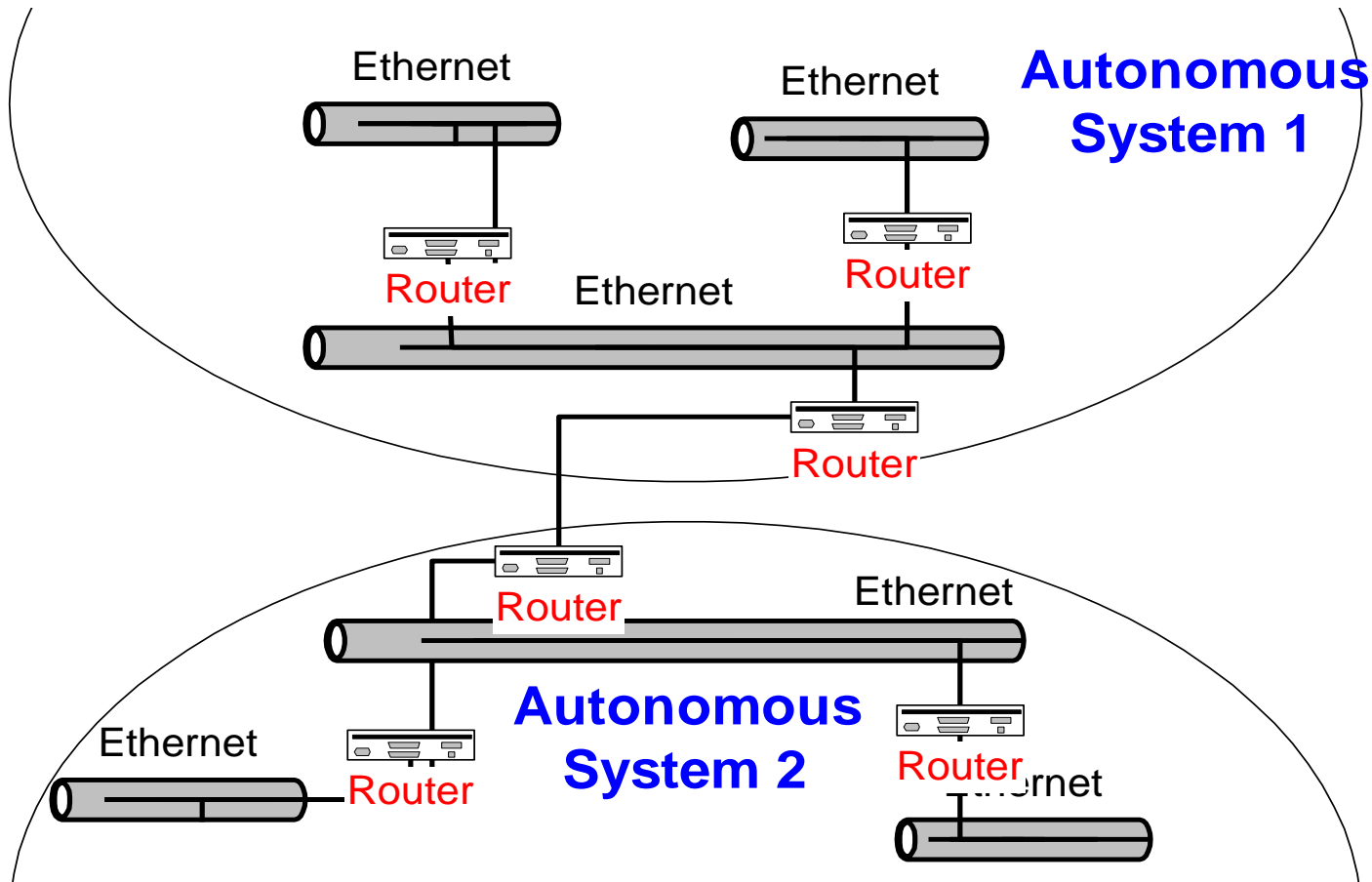
## Distance Vector vs. Link State Routing

- With distance vector routing, each node has information only about the next hop
- In link state routing, each node has a complete map of the topology

## Autonomous System, Gateway Router

- Inter-AS vs. intra-AS routings

# AUTONOMOUS SYSTEM



## INTRA-AS ROUTING

- Also known as Interior Gateway Protocols (IGP)
  
- Most common Intra-AS routing protocols:
  - RIP: Routing Information Protocol
  - OSPF: Open Shortest Path First
  - iBGP: Interior Border Gateway Routing Protocol
  - MANET: OLSR, 5449, 5614: Mobile Ad-hoc NETWORK protocols

## INTRA-AS ROUTING EXAMPLE: OSPF

- Provides authentication of routing messages
- Enables load balancing by allowing traffic to be split evenly across routes with equal cost
- Type-of-Service routing allows to setup different routes dependent on the TOS field
- Supports sub-netting
- Supports multicasting
- Allows hierarchical routing

## INTER-AS ROUTING

### BGP (Border Gateway Protocol)

### BGP provides each AS a means to:

- Obtain prefix reachability information from neighboring ASs.
- Propagate the reachability information to all routers internal to the AS.
- Determine “good” routes to subnets based on reachability information and policy.

### Allows an AS to advertise its existence to the rest

- BGP is neither a link state, nor a distance vector protocol. Routing messages in BGP contain complete routes.
- Network administrators can specify routing policies

## INTER-AS ROUTING EXAMPLE: BGP

- BGP's goal is to find any path (not an optimal one).
  - BGP selects the path with the shortest number of Ases in its path
  - Since the internals of the AS are never revealed, finding an optimal path is not feasible.
  
- For each autonomous system (AS), BGP distinguishes:
  - local traffic: traffic with source or destination in AS
  - transit traffic: traffic that passes through the AS
  - Stub AS: has connection to only one AS, only carry local traffic
  - Multi-homed AS: has connection to  $>1$  AS, but does not carry transit traffic
  - Transit AS: has connection to  $>1$  AS and carries transit traffic



## INTRA-AS VS. INTER-AS ROUTING

### Policy:

- Inter-AS: admin wants control over how its traffic routed, who routes through its network
- Intra-AS: single admin, so no policy decisions needed

### Scale:

- hierarchical routing saves table size, reduced update traffic

### Performance:

- Intra-AS: can focus on performance
- Inter-AS: policy may dominate over performance

# RESOURCES

**RFCs**