

# Inter-Autonomous-System Routing: Border Gateway Protocol

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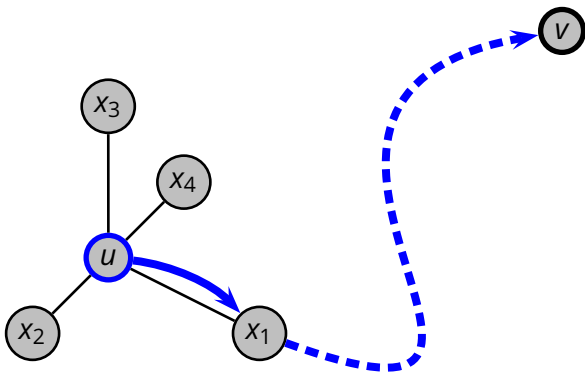
December 19, 2016

- Hierarchical routing
- BGP



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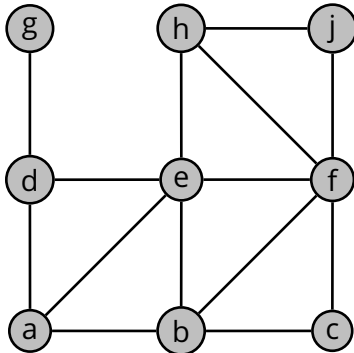
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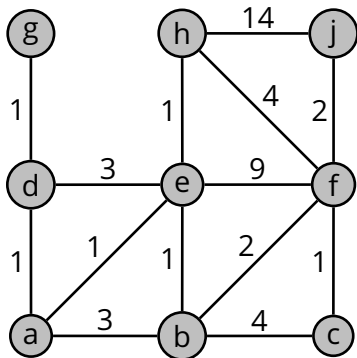
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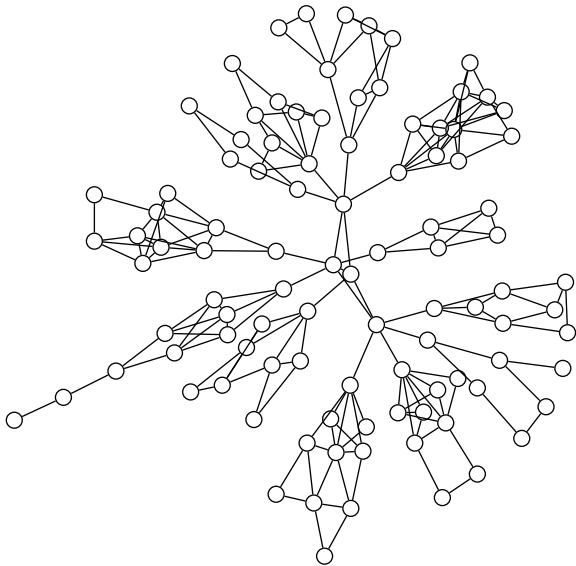
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- Also, our objective has been to find the least-cost paths between sources and destinations

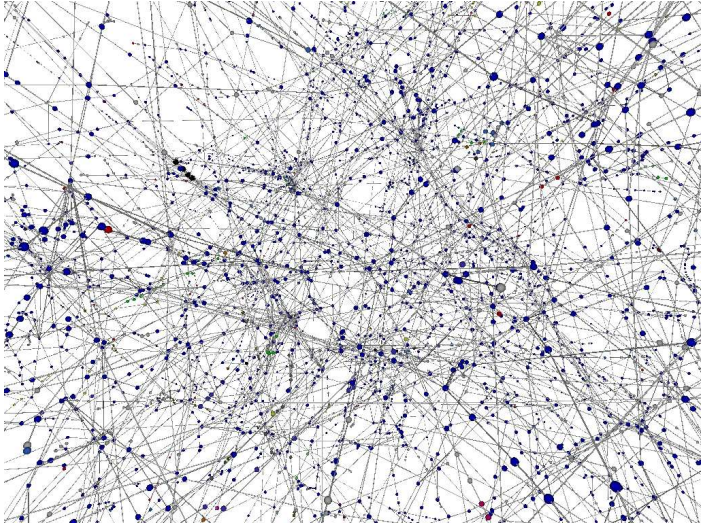
# More Realistic Topologies

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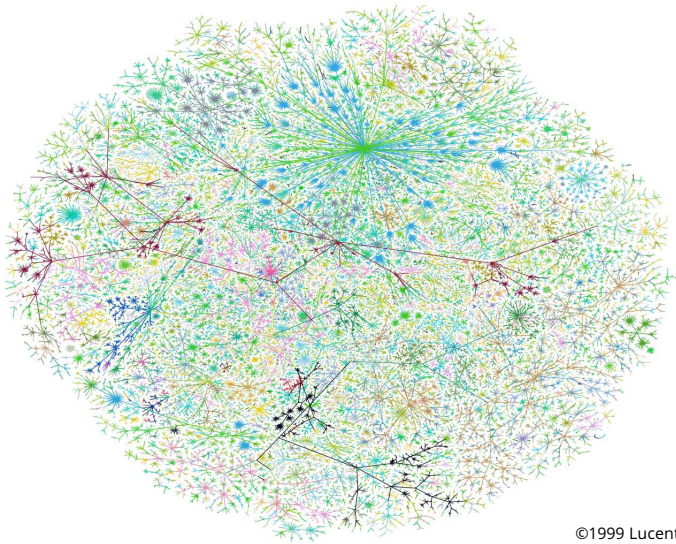
**Even More Realistic**

# Even More Realistic



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# An Internet Map



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# Higher-Level Objectives

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- ▶ an organization might not want to expose its internal network structure

# Hierarchical Structure

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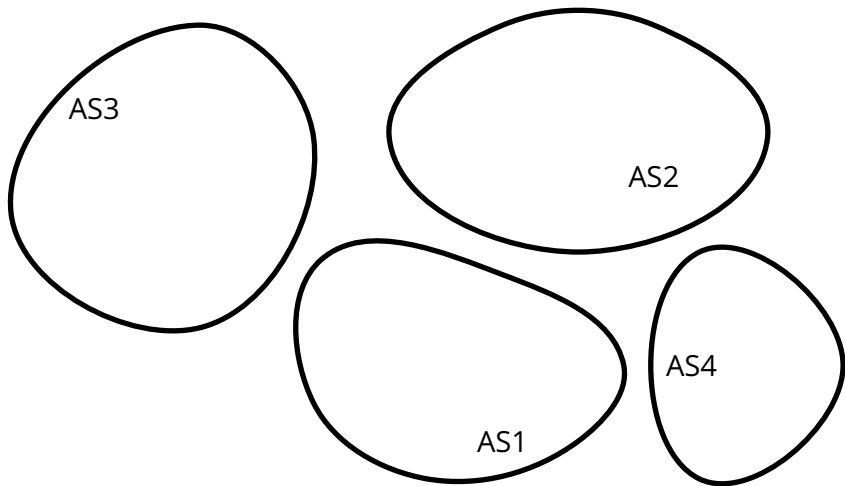
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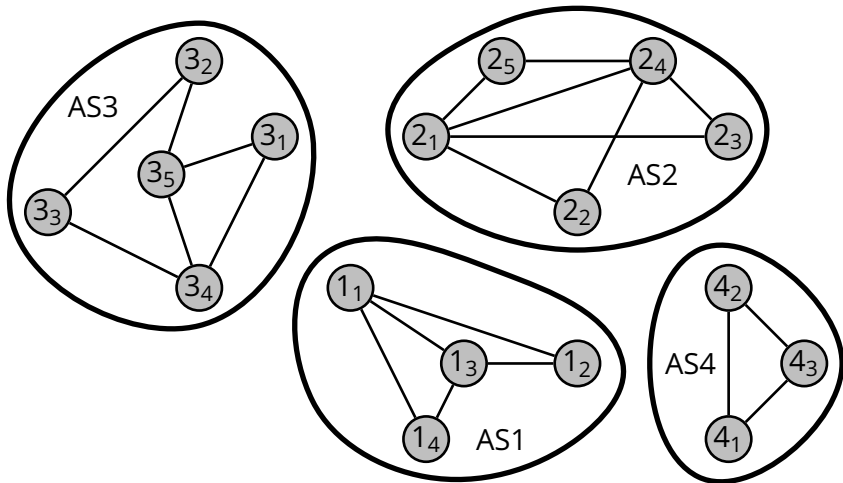
- Today's Internet is organized in ***autonomous systems (ASs)***
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- ***Gateway routers*** connect an autonomous system with other autonomous systems
- An *intra-autonomous system routing protocol* runs within an autonomous system (e.g., OSPF)
  - ▶ this protocol determines internal routes
    - ▶ internal router ↔ internal router
    - ▶ internal router ↔ gateway router
    - ▶ gateway router ↔ gateway router



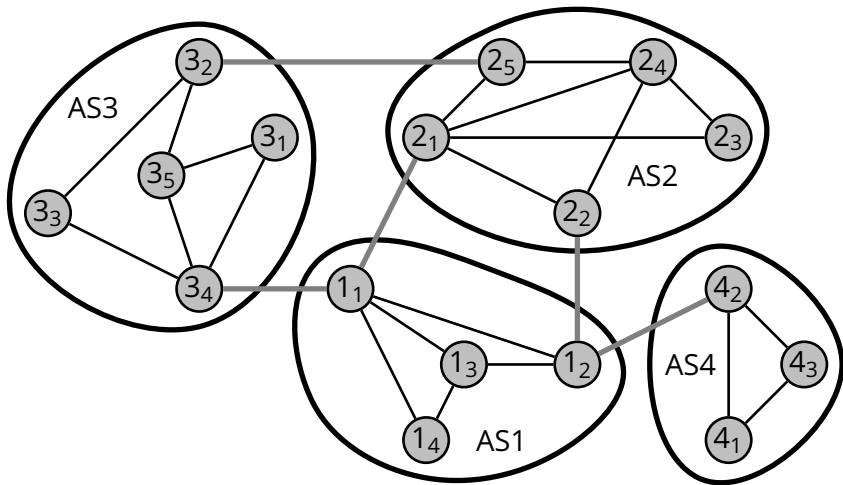
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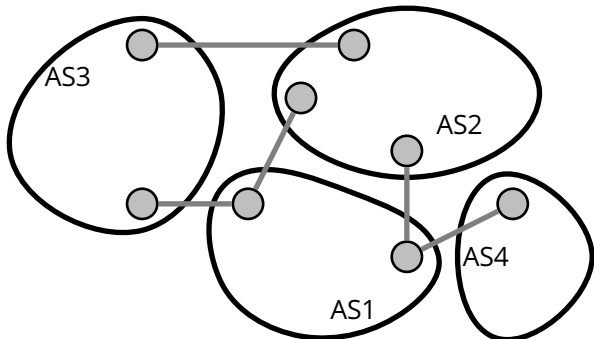
# Hierarchical Structure



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# Inter-AS Routing

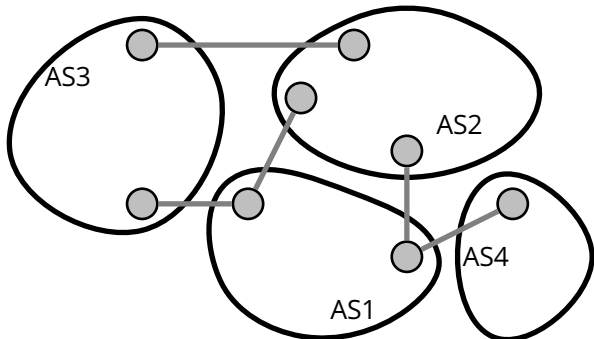
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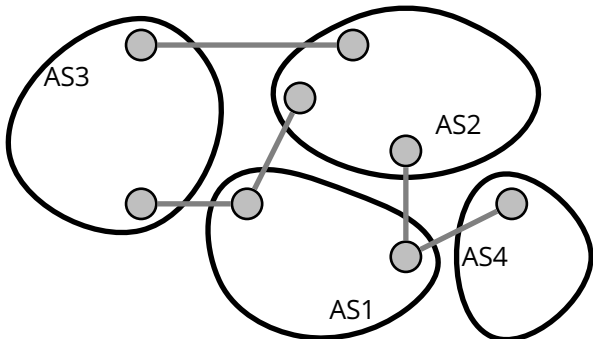
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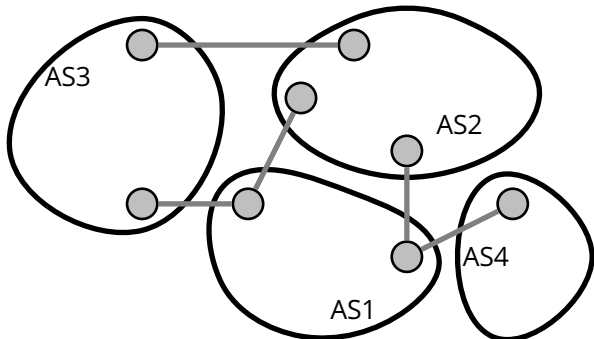


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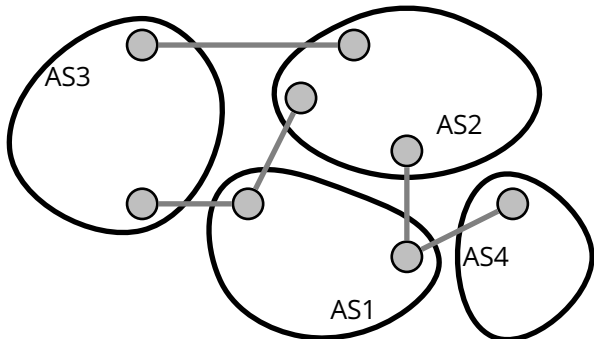
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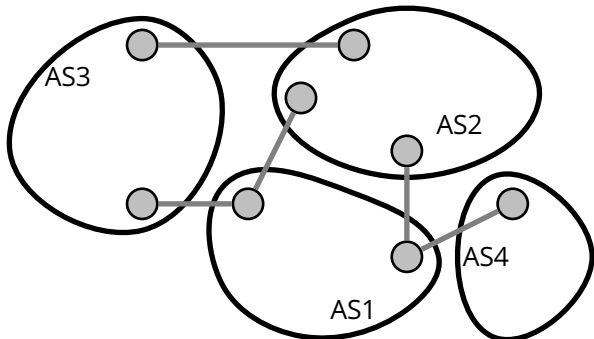


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- Both *inter-AS* and *intra-AS* routing information is used to compile the forwarding tables

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  - ▶ what if  $x$  is reachable through multiple gateway routers  $G_x, G'_x, \dots$ ?
    - ▶ use *intra-AS* routing information to determine the costs of the (least-cost) paths to  $G_x, G'_x, \dots$
    - ▶ “hot-potato” routing: send it through the closest gateway

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## ■ External subnet addresses are likely to “aggregate” in groups that admit compact representations

- ▶ this process is called *supernetting*

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  - ▶ BGP is a *path-vector* protocol

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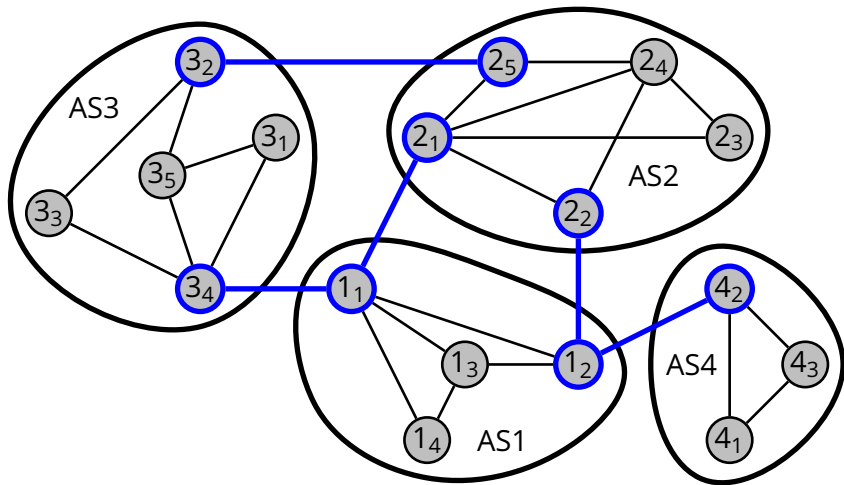
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- **BGP external session (eBGP):** a session across two autonomous systems
- **BGP internal session (iBGP):** a session within an autonomous system
  - ▶ note that internal sessions carry *inter-AS* information
  - ▶ *intra-AS* routing uses a separate protocol (e.g., OSPF)

# Gateway Routers and *eBGP*





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- **BGP import policy:** used to decide whether to accept or reject the route advertisement
  - ▶ e.g., a router may not want to send its traffic through one of the AS listed in *AS-PATH*

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