6.033 Spring 2020
Lecture #10

- Scalable Routing
- Policy Routing
- BGP
Problems to Solve

How do we **route** (and address) scalably, while dealing with issues of policy and economy?

How do we **transport** data scalably, while dealing with varying application demands?

How do we **adapt** new applications and technologies to an inflexible architecture?
Problems to Solve

How do we route (and address) scalably, while dealing with issues of policy and economy?

How do we transport data scalably, while dealing with varying application demands?

How do we adapt new applications and technologies to an inflexible architecture?
Distributed Routing

1. Nodes learn about their neighbors via the HELLO protocol
Distributed Routing

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2. Nodes learn about other reachable nodes via advertisements
Distributed Routing

1. Nodes learn about their neighbors via the HELLO protocol

2. Nodes learn about other reachable nodes via advertisements

3. Nodes determine the minimum-cost routes (of the routes they know about)
problem: neither distance-vector nor link-state routing will scale to the size of the Internet
1. **hierarchy of routing:** route between ASes, and then within an AS
Scalable Routing

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2. **path-vector routing**: advertisements include the path, to better detect routing loops
Scalable Routing

1. **hierarchy of routing**: route between ASes, and then within an AS

2. **path-vector routing**: advertisements include the path, to better detect routing loops

3. **topological addressing**: assign addresses in contiguous blocks to make advertisements smaller

[(A, 2, <B, A>)]

18.0.0.0, …, 18.0.0.255

18.0.0.0/24
problem: ASes also need a means to implement policy
Common AS Relationships
arrows describe the flow of money; traffic may flow in both directions

customer/provider ("transit")
customer pays provider for transit
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peers
peers allow (free*) mutual access to each other’s customers

*as long as the amount of traffic in each direction is roughly equal
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customer pays provider for transit

**peers**

peers allow (free*) mutual access to each other’s customers

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Export Policies

goal: make money

customer/provider ("transit")

providers tell everyone about themselves and their customers, and tell their customers about everyone
customer/provider ("transit") providers tell everyone about themselves and their customers, and tell their customers about everyone
customer/provider ("transit")

providers tell everyone about themselves and their customers, and tell their customers about everyone!
Export Policies
goal: make money

customer/provider ("transit")
providers tell everyone about themselves and their customers, and tell their customers about everyone

peers
peers tell each other about their customers
Export Policies

goal: make money

customer/provider ("transit")
providers tell everyone about themselves and their customers, and tell their customers about everyone

peers
peers tell each other about their customers
Import Policies

goal: make money

customer > peer > provider
Import Policies

goal: make money

customer > peer > provider

(and then a variety of other attributes when this rule isn’t sufficient)
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does BGP scale?
Mark Imbriaco
@markimbriaco

BGP basically relies on the honor system

holly @girlziplocked

What's a dirty secret that everybody in your industry knows about but anyone outside of your line of work would be scandalized to hear?

Show this thread
• To route on the Internet means to route at an enormous scale. We deal with scale via three techniques: **path-vector routing**, a **hierarchy of routing**, and **topological addressing**.

• **BGP** provides a means for autonomous systems to do **policy routing**. While the protocol is simple, how it works in practice is enormously complex due to competing economic interests, among other things.

• Though BGP works on the Internet today, its ability (or inability) to **scale** is becoming a concern as the Internet continues to grow.