6.033 Spring 2017

Lecture #9

- Scalable Routing
- Policy Routing
- BGP
Internet of Problems

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?

BGP
**goal of a routing protocol:** allow each switch to know, for every node dst in the network, a route to dst
goal of a routing protocol: allow each switch to know, for every node \( \text{dst} \) in the network, a minimum-cost route to \( \text{dst} \)
goal of a routing protocol: build a routing table at each switch, such that \texttt{routing_table}[\texttt{dst}] contains a \textbf{minimum-cost route} to \texttt{dst}
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
Scalable Routing

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

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

3. **topological addressing**: assign addresses in contiguous blocks to make advertisements smaller
problem: ASes also need a means to implement policy
Common AS Relationships

**customer/provider ("transit")**
customer pays provider for transit

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

*as long as the amount of traffic in each direction is roughly equal*
Export Policies

goal: make money

customer/provider ("transit")

providers tell everyone about themselves their customers, and tell their customers about everyone

peers

peers tell each other about their customers
Import Policies

goal: make money

customer > peer > provider

(and then a variety of other attributes when this rule isn’t sufficient)
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)
does BGP scale?
• 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.