SDX: A Software-Defined Internet Exchange

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SDN Has Landed

• SDN has reshaped many types of networks already
  – Data Centers
  – Others, to some extent: Campus, Enterprise, Home, Cellular

• What about interdomain routing, the protocol which has received so much attention for being so “broken”?
What’s Wrong with BGP?

• Security
  – BGP does not prevent an AS from making arbitrary announcements
  – The forwarding path might not match the AS path

• Policy
  – Policies are too coarse-grained
  – Contracts result in market inefficiencies

• Stability
  – Even with stable inputs, BGP might not converge
  – BGP can even oscillate within a single AS
How SDN Can Help

• Benefits already known for single domains

• Programmability for more flexible route selection

• Now: New twists on some currently intractable issues in interdomain routing:
  – Policy
  – Economics/Business
  – Security
New Functions

• Time-of-day routing
• Domain-based routing
• Dynamic peering ratio maintenance
• Application-specific peering
• Route preference based on external inputs (e.g., reputation)
New Policies

• Security
  – Automatically prefer routes that have a higher reputation score (e.g., from hijack alert systems)
  – Incorporate checks for consistent route advertisement at peering points

• Economics
  – Hold an auction for transit or peering
  – More efficient pricing tiers, as opposed to “blended rate” pricing

• Performance
  – “Remote control” peering: Content provider can affect route selection along the path, closer to access network/customer
A Preliminary SDX: One Switch, One Controller

• **Step 1:** Controller at exchange receives
  – BGP routes from all ASes at the exchange
  – Auxiliary information
    • Pricing
    • Alerts for prefixes that may be subject to hijack (and alleged perpetrators)

• **Step 2:** Participant at exchange runs a function that executes at the controller to select route
Other Designs and Extensions

• Every AS runs their own controller
  – Inter-controller protocol is responsible for exchanging routes, negotiating route selection

• Advantages
  – No need for BGP to exchange routes (or at all)
  – No need to have a single “trusted” controller

• Requires an additional step of designing the inter-controller protocol (potentially more complexity)
Challenges

• **Scaling:** Switch may need to perform per-AS forwarding, which causes state explosion in the FIB.

• **Isolation:** How to ensure that each AS can apply route selection independently?

• **Incremental deployment:** What happens when some exchanges are BGP, others SDX?

• **Distributed computation:** How to perform route computation across multiple exchange points?

• **Programming models:** Who is the programmer? (the ISP at the IXP, the content provider, etc.) What is the evaluation environment at the controller?
Status and Next Steps

• Research
  – Understanding and discovering use cases
  – Designing an architecture that supports these use cases

• Deployment at SNAP
  (need more participating ASes)