Software Defined
Internet Exchange Points

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Partners in Crime: 
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“Can Software Defined Networks simplify network operations for inter-domain routing?”
Operator for AS B wants to control the inbound traffic for its two edge routers.
Selective Announcements for Inbound TE

Add preferred destination IP prefixes for each router

Atlanta
130.267.0.0/16
130.267.0.0/17

Washington
130.267.0.0/16
130.267.128.0/17

[BGP Traffic Engg, APRICOT'13]
Other Approaches for Inbound TE

• AS_Path Prepending

• MEDs

• Community tagging

...

...
Problems with Current Approaches

• Inflexible
  – Limited to destination IP prefixes only

• Complex
  – Configuration intensive

• Unpredictable
  – No guarantee that the remote party will comply
  – Networks constantly change
Inbound TE using Software Defined Networks

AS B writes simple Open Flow (OF) rules for its inbound traffic at IXP.

If (dstip=ipB1) \(\rightarrow\) fwd(1)
Inbound TE using Software Defined Networks

Not limited to destination IP prefixes

SDN Controller

If \((\text{srcip} = \text{ipC})\)  fwd(1)
If \((\text{dstport} = 80)\)  fwd(2)
Outline

• Motivation

• SDX: Software Defined Exchange Points

• SDX’s Features

• Current Status
Why Software Defined Internet Exchange Points?

• SDN widely used in various campus networks, datacenters

• Why we don’t have SDN for inter-domain routing?
  – Deployment Cost

• Start with Software Defined IXPs (SDX)
  – Structural Advantage
SDX: Challenges

What happens when all participants write policies at SDX?

If (dstip=ipB) → fwd(1)
If (dstip=ipB) → drop
Managing Multiple Participants

• Challenges
  – Minimize complexity
  – Avoid potential conflicts
  – Ensure security

• Solutions
  – Virtual SDX Abstraction
  – Sandbox
Virtual SDX Abstraction

Each AS has its own view of the SDX

AS A’s view of SDX

SDX Controller

AS A
Sandbox

Individual AS policies

AS A

Sandbox A

AS B

Sandbox B

AS C

Sandbox C

SDX Controller

Composite Flow-rules
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Uses Auxiliary Information

• SDX uses auxiliary information sources
  – Resource Public Key Infrastructure (RPKI)
  – Route Servers
  …

• Example
  – Application Specific Peering
  – Prevent Free-riding
Enables Task Offloading for Participants

• Enables participants to offload SDN related tasks to SDX

• Simplifies implementation of various new SDN based network operations

• Example
  – Middlebox
  – WAN Load Balancing
Offloading WAN Load Balancing Task

Network A offloads WAN load balancing task to SDX

130.267.2.0/24
DC1

130.267.3.0/24
DC2

AS A

130.267.1.0/24
SDX

AS B

AS C

Email 130.267.1.1
Video 130.267.1.2
…
Supports Remote Control

• ASes can control exchange traffic remotely

• Opportunity to process packets and control routing decisions remotely

• Example
  – Prevent selection of paths via problematic ASes
  – DDoS Squelching
Remote WAN Load Balancing

For WAN load balancing, AS A can remotely apply its load balancing policy at SDX
Outline

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• Challenges & Solutions

• SDX’s Features

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In talks with ESNet, few cloud providers and CDNs
SDN for inter-domain networking has tangible benefits!

SDX simplifies usage of SDN for inter-domain routing

Join the SDX project
noise-lab.net/projects/software-defined-networking/sdx/

• Peer with us, its simple
• Participate in SDX’s survey
• Contribute to the SDX project

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Work in Progress

• Creating interface for participants to write dynamic policies

• Integrating Route Server with SDX controller

• Adding more peers and deployment sites