





IBM Research GmbH Zurich Research Laboratory







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Bringing SDN to the inter-domain



Source: http://www.internetexchangemap.com/

Bringing SDN to the inter-domain

Internet eXchange Points: an opportunity ripe for impact

- Convergence points for a large number of ASes
- More than 600, and growing at 10-20%/year and traffic at 50-100%/year
- Innovation hotspot: hundreds of members, multi-Tbps traffic, 100 Gbps ports
- SDN deployment even at single IXP can benefit tens to hundreds of providers
 - Without providers deploying new equipment!



Source: DE-CIX statistics

What are the issues at the interdomain level?

Static

Contracts are slow to setup; long timeframes



Constrained

Destination-based forwarding decisions are not enough



Indirect control over packet forwarding

(Indirect mechanisms to influence path selection)

Only basic packet forwarding

(Difficult to introduce new in-network services)

Myopic

Limited visibility leads to suboptimal paths (or hard to troubleshoot interactions)

Can only influence immediate neighbors

(No ability to affect path selection remotely)



Enter Software-Defined Networking

Match packets on multiple header fields

(Not just destination IP address)

Control entire networks with one program

(Not just immediate neighbors)

Direct control over packet handling

(Not indirectly via routing protocol arcana)

Perform a variety of actions on packets

(Beyond basic packet forwarding)

What can SDN do at the inter-domain level?

Improve the IXP fabric

SDN Use Cases for IXP Operators

Advantages

Simplified Management

Fine-Grained Monitoring

New Services

- Principle, automated network management
- Fine-grained filtering broadcast and unwanted traffic
- Fine-grained monitor capabilities
- Adaptive load balancing on the fabric
- Easier to innovate and build new applications with SDN
- Steering traffic through (virtual) network functions

Enable novel services for IXP members

SDN Use Cases for IXP Members

Advantages

Improved Security

Better Traffic Engineering

Advanced Peering

- Blocking DDoS attacks and filtering unwanted traffic
- Advanced traffic blackholing based on arbitrary fields
- Split incoming traffic over multiple peering links
- Split outbound traffic based on congestion of destination port
- Application-specific peering
- Dynamic non-peering traffic filtering

Use Case: Block DDoS Attacks



How can we achieve this?

The ENDEAVOUR approach

ENDEAVOUR Architecture



SDX/ENDEAVOUR IXP Fabric



Next step:

EARL: SDN-Enabled Measurements foR AIL

EARL: SDN-Enabled Measurements foR AlL

EPSRC-funded project (EP/P025374/1):

- Duration: 3 years from Jan. 2018
- Partners: QMUL, Univ. Cambridge, LINX, GEANT, Corsa, Cisco, ESN

Goals:

- Build a SDN-based scalable software+hardware monitoring infrastructure
- Enable reactive traffic engineering based on SDN
- EARLnet: an operational, research-centered, Autonomous System (AS) directly connected to our partners (additional peerings welcome!)