ALTO and Software Defined Networking (SDN)

draft-xie-alto-sdn-extension-use-cases

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Background

• SDN is based on
  – A radical separation of control and data planes
  – Open interfaces between the elements implementing them
• SDN allows higher flexibility in managing the network
  – Override L2/L3 protocols if necessary
  – Additional input to the control plane
• SDN has started to be deployed in many networks
  – Production datacenters (including WAN interconnection)
  – Mature trials in carriers
• SDN deployment could include
  – Infrastructure comprised of SDN domains
  – End-to-end applications aware/unaware of SDN
  – Application modules residing inside SDN controllers
SDN Partitioning

• SDN partitioning is inevitable
  – A large network is likely to be divided into multiple SDN domains
  – Each SDN domain has its own controller, managing the SDN-compatible devices in the domain

• Reasons for SDN partitioning
  – Scalability
    • The number of devices a controller can manage is limited
  – Manageability
  – Privacy
    • Some sub-networks (e.g., data center networks) are dedicated to certain customers, special privacy policies may be necessary for such sub-networks
  – Deployment
    • Incremental deployment (i.e., only a part of a large network is SDN compatible) is desirable and sometimes necessary

• Partitioning is already a common practice
  – FlowVisor-enabled slices

See, e.g., draft-yin-sdn-sdni-00 (http://tools.ietf.org/html/draft-yin-sdn-sdni-00)
Benefits & Challenges

• Benefits
  – SDN controllers could become the main source of network information for ALTO

• Challenges
  – Architecture for co-existing ALTO & SDN should be carefully designed
  – Interactions between ALTO & SDN are complex
  – SDN domain-specific privacy policies should be accommodated by ALTO
ALTO-SDN Architectures

The Horizontal Architecture

- Not well suited for partitioned environments
  - ALTO lacks support for communications among ALTO servers
  - Redundant & Inefficient
  - Possible violation of Privacy
  - Information obtained by ALTO directly is likely outdated due to its scale and granularity
  - ALTO decisions are local, while applications and network management typically require global ALTO decisions

The Vertical Architecture

- Better suited for partitioned environments
  - Efficient & scalable
  - Preserve domain-specific privacy
  - Allow incremental deployment
  - Allow independent evolution
  - Success of ALTO (SDN) does not depend on SDN (ALTO)
  - ALTO: coarse-grain information, SDN controller: fine-grain information
The Upward Flow

- SDN controllers export network information to ALTO server
  - Information exporting is subject to domain-specific policies, e.g., privacy policy, aggregation/filtering policy
- ALTO server build cost maps based on such information
  - Inter-domain & intra-domain cost maps
- Outside current specifications
  - But we believe it should be considered in extensions
The Downward Flow

• SDN controllers use ALTO maps as a key source to take their decisions
  – Under application requests
  – Coordinated with controllers in other domains
• Require extensions to the current protocol
  – Data
  – Session control
  – Security

• Use cases
  – On-demand bandwidth
  – CDN
    • Classical CDN
    • Information-Centric CDN (refer to the draft)
Use Case: On-Demand Bandwidth

ALTO Server

Cost map

request

SDNI request

Intra-domain path setup
Use Case: CDN

- **U (Client)**
  - "go to A"

- **ALTO Server**
  - "pick B instead of A"

- **SDNI request**

- **Equivalent class**
  - A
  - B
  - C
Summary

• SDN introduces new benefits as well as challenges to ALTO
  – Domain-specific policy
  – Granularity and scale of information collection and share
  – Delegation of domain-specific decision making and execution
• ALTO must co-exist with multiple SDN domains
  – Coordination and joint optimization become more challenging
• ALTO-SDN architecture should be carefully designed in order to avoid overhauling at later times
  – Vertical architecture is better suited to multi-domain than the horizontal one
  – ALTO-SDN interactions must include upward and downward information flow
• Several interesting use cases in sight
  – Connected with already proposed challenges

PoC demonstration during the Bits-and-Bites on Thursday