A Software Defined Approach to Unified IPv6 Transition
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IPv6: Status Quo and Challenges

• Current state of IPv6 transition
  • *Many* solutions and *multiple* scenarios co-exist, e.g. 4-6-4, 6-6-4, etc.
  • *Slow* transition

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Diagram showing various IPv6 transition scenarios:
- IPv4-Only Network
- Dual Stack Network
- IPv6 Only
- Dual Stack Network
- 6+4
- IPv6-Only

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- NAT
- PE
- CE

IPv4-Only Users
Dual-Stack Users
IPv6-Only Users
Motivation & Rationale

• Design a *low-cost, unified* approach to IPv6 transition
  
  • Low-cost: a virtual CPEs(e.g. vRGW) or a SDN enabled CPE can cover different scenarios of IPv6 transition. carriers do **NOT** have to upgrade/manage CPEs to support a specific IPv6 transition scheme
  
  • Unified: the design should be compatible (or accommodate) existing and future IPv6 transition schemes

• Users / applications should be able to decide for themselves *when and how* to start the IPv6 transition
SD-IPv6: A Low-Cost, Unified Approach to IPv6 Transition

• Leverage the SDN capability to
  • **Decouple** network equipment (i.e., data plane) and *operating* specific IPv6 transition schemes (i.e., control plane)
    – By leveraging SDN’s separation of control / data plane
  • **Decouple** network equipment and *implementation* of specific IPv6 transition schemes
    – by leveraging SDN’s NBI to efficiently implement IPv6 apps
  • **Decouple** network equipment and *deployment* of specific IPv6 transition schemes
    – As a result of the above two enablers
SD-IPv6: Architecture

- Network equipment is SDN compatible
- IPv6 schemes are implemented as SDN apps
  - SDN apps communicate with SDN controller via NBI
SD-IPv6: Data / Control Flow
Evaluations I: Lab Experiments

• Experiment setup
  • Use flow generators to generate a varying number of flows
  • Use commodity hardware

• Result
  • SD-IPv6 can handle a reasonably large number of flows with very high cost-performance efficiency
Evaluations II: Live Experiments

Provide live Internet access for 270+ participants of ETSI Network Function Virtualization 2\textsuperscript{nd} meeting on April 22–23, 2013
We have deployed an SDN-IPv6 trial in an enterprise campus in Santa Clara. The following drawing is the network diagram.
Deployments II: Shenzhen

Legacy network region (IPv4 only)

Experiment network region (IPv6 only)

IPv4
IPv6

SDN - Enabled

Controller

Applications

Plug-in

Provide protocol-independent data model & programmatic interface for new applications/technologies creation
IPv6 transition App, called “SDN IPv6” and available for download at http://www.huawei.com/enmobile/app/ and Google Play, and also at Apple Store soon.

Visitors can watch the configuration of SDN-IPv6 deployed in Santa Clara via the App. Administrator can modify the configuration of SDN-IPv6 via the App.
Provide live Internet access for 800+ participants of SDN-IPv6 Internet Access for the Global Open Networking and SDN Conference 2013 in Beijing on Aug 29-30, 2013

The following metrics and tools are summary from this live experiments.
SDN IPv6 Deployment

Metrics & Tools (1)

Monitoring for SDN IPv6

Graph showing percentage of flow set-up time with less than 0.7 ms.
SDN IPv6 Deployment
Metrics & Tools (2)

Packet Latency in Data Plane

Percentage RTT < 4ms (host <-> border router)

Percentage RTT<4ms
SDN IPv6 Deployment
Metrics & Tools (3)

Flow Injection Rate

CPU Usage
SDN IPv6 Deployment
Metrics & Tools (4)

Active Flow

Total Traffic Volume
IRTF/IETF/BnB

SDN RG is a platform for exhibition of this approach

Protocol work needs to be done in IETF

You can experience it in Bits-N-Bites

Technology & Networking Social
IETF 88 Meeting - Vancouver, BC, Canada
Hyatt Regency Vancouver
Date: November 7, 2013
Time: 19:00-21:00
Location: Regency Ballroom D,E,F
Summary

• We provide a software defined approach to IPv6 transition
  • Low cost
  • High performance
  • Unifying existing IPv6 schemes
  • Extensible: easy to add / implement new IPv6 schemes
  • Easy to implement, deploy and operate

For more details, please refer to our ACM SIGCOMM 2013 poster titled “A Software Defined Approach to Unified IPv6 Transition”.
Questions