Deploying LISP in a Campus Network

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Summary

1. Overview of Software-Defined Access (SDA)
2. LISP use-cases in SDA
3. Architecture and Design
4. Evaluation
Introduction: SDA

- SDN-based solution for Campus and Access Networks
- VXLAN data plane
- LISP control plane
- Unified Wired + Wireless
- Endpoint Mobility
- L3 Segmentation:  
  - VXLAN VNI
  - Group-based policies
- L2 stretching
LISP use-cases in SDA

- L2/L3 EID Mobility
- Reduce and distribute data plane state
- Minimize CAPEX via providing routes on-demand
  - Less data plane entries $\rightarrow$ Smaller FIB $\rightarrow$ Less memory $\rightarrow$ Reduced cost
- Incremental deployment
  - Keep existing underlay, with standard OSPF or IS-IS
Architecture & Design
Architecture

- LISP control plane
- VXLAN data plane
- EIDs are individual hosts
- Three mappings per endpoint: IPv4, IPv6, and MAC to RLOC
- Plus MAC EID to IP EID
Architecture - Wireless

- WLAN controller connected to Map Server
- Updates location based on new authentications
Architecture - Wireless

- WLAN controller connected to Map Server
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- ‘Regular’ underlay VXLAN tunnels
- xTR – AP VXLAN tunnels – multiplex several APs, not in MS
Design – Mobility (I)

- Static VXLAN tunnel between AP and xTR
  - Multiple APs per xTR
  - Store (AP IP → xTR RLOC) mappings
- WLAN controller detects host movement
  - Map Request: AP C? → xTR B
- Registers new location
  - EID Host → xTR B
Design – Mobility (II)

- xTR B receives Map Notify and updates local state → EID Host behind AP C
- Additional mechanisms to improve mobility:
  - Away entry (to not drop packets)
  - SMR (to notify outdated remote xTR)
Design – Mobility (and III)

• SMR
  (1) If receive traffic for EID no longer in xTR
  (2) Send SMR to xTR
  (4) xTR updates map cache

• Away entry
  • Remember EIDs no longer in xTR
  • Forward traffic to new xTR (3)
Design – Avoid resolution delay (aka No First Packet Drop)

- Add default route in xTRs
- Points to PxTR (aka Border)
- Proxy has Pub/Sub functionality
- Forwards traffic on behalf of xTR
- Until more specific map cache is installed in the xTR
Design – Scalable L2 stretching

• Use cases:
  • Convert ARP broadcast to unicast
  • L2 protocols (eg. Apple Bonjour)
  • Legacy IoT devices (that do not use IP)
• Src. xTR encaps L2 frames to dst. xTR on VXLAN
• Resolve in Map Server missing info:
  • Use inner dst. MAC to locate dst. RLOC
  • For ARP: use MAC to EID mapping
• Forward ARP requests (instead of creating them) for coherence with IPv6 NDP
Evaluation
Data Plane State Reduction

• Count map cache entries in
  • PxTR
  • xTRs

• PxTR has all MS data due to Pub/Sub → fraction of mappings in xTRs

• Two different deployments:
  • Depl. A 150 hosts
  • Depl. B 450 hosts
  • Routers:
    • 1-2 PxTR
    • 7-6 xTR
    • 120 AP (20 per xTR)
Data Plane State Reduction

![Graph showing FIB entries over days with proxy and xTRs lines]

A

B

16
Data Plane State Reduction

A

B

50% reduction

80% reduction

proxy
xTRs

0

20

40

60

80

100

120

140

160

Mon Tue Wed Thu Fri Sat Sun

Day

FIB entries

proxy
xTRs

0

20

40

60

80

100

120

140

160

180

Mon Tue Wed Thu Fri Sat Sun

Day

FIB entries

80% reduction

50% reduction

proxy
xTRs

0

100

200

300

400

500

600

Mon Tue Wed Thu Fri Sat Sun

Day

FIB entries

proxy
xTRs

0

100

200

300

400

500

600

Mon Tue Wed Thu Fri Sat Sun

Day

FIB entries
Data Plane State Reduction

A

B

Always connected devices

24h map cache TTL

Pub/Sub follows day/night routine
Handover Delay

- Massive mobility events
  - Eg. warehouse with mobile robots
- Calculate handover delay
- Lab setup
- 3 physical routers
- 198 emulated xTR
- Simulate handovers with a traffic generator

Diagram:
- Traffic Generator
  - BGP / LISP
  - PxTR or Route Reflector
  - 800 moves/s
  - External traffic
  - 198x Emulated
Handover Delay

• Compare LISP and BGP control planes
• Difference of aprox. one order of magnitude
• Notify only affected routers vs. all of them
• Less variability
Conclusions

• Example of a LISP deployment in an enterprise setting
• Reduced data plane state
• Distributed mobility data plane, with centralized control
• Versus classical WLAN controllers:
  • Improved routing (no triangular routing)
  • More scalable
• Reduce mobility handover
Thanks for listening!

You can find the paper at: