Deploying LISP in Enterprise Networks

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Based on the paper:

SD-Access: Practical Experiences in Designing and Deploying Software Defined Enterprise Networks.
ACM CoNEXT '20, December, 2020,
https://arxiv.org/abs/2010.15236

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 polices
- L2 stretching

https://www.nordu.net/article/infoshare-campus-network-service

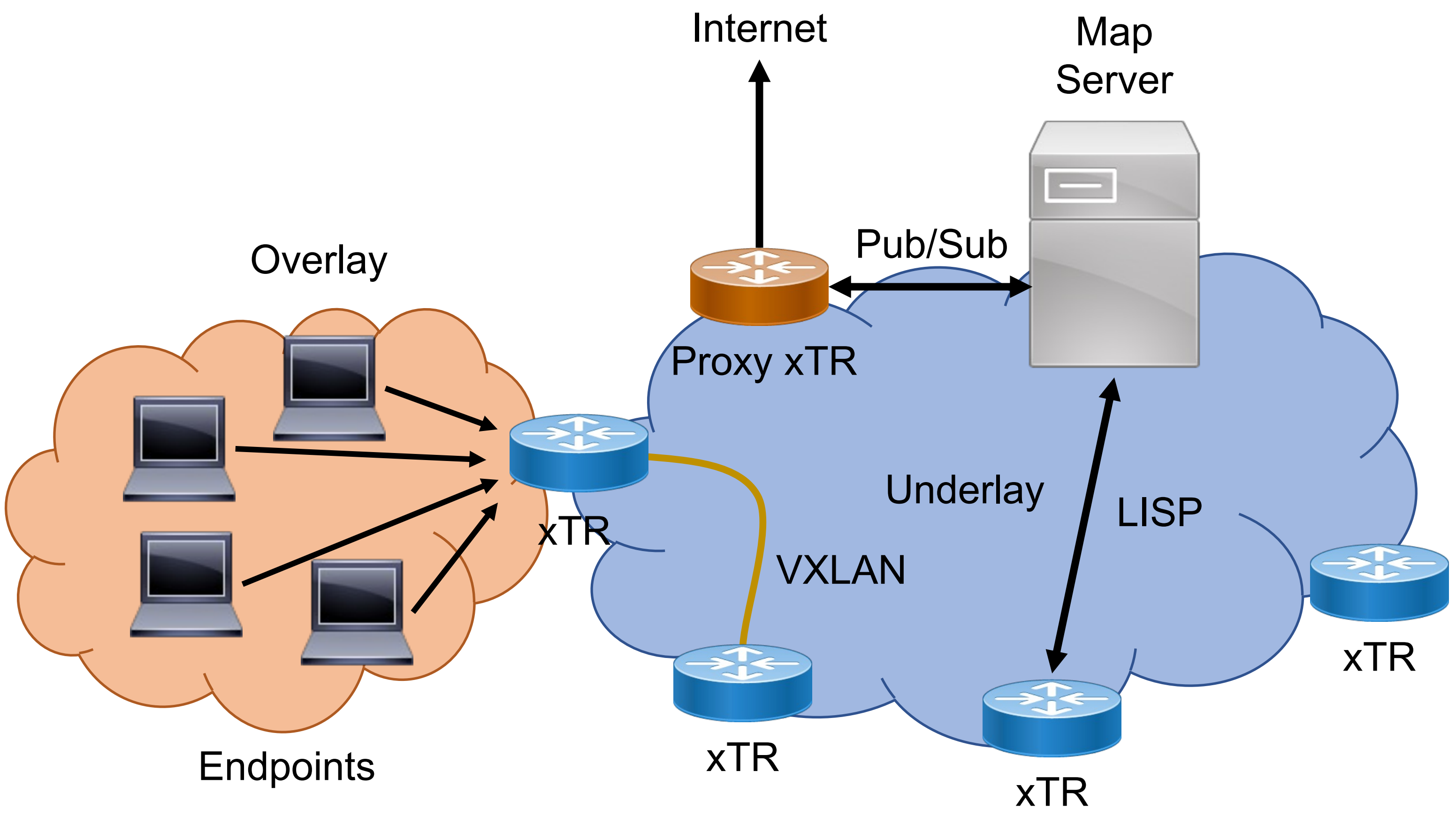
LISP use-cases in SDA

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

Architecture & Design

Architecture

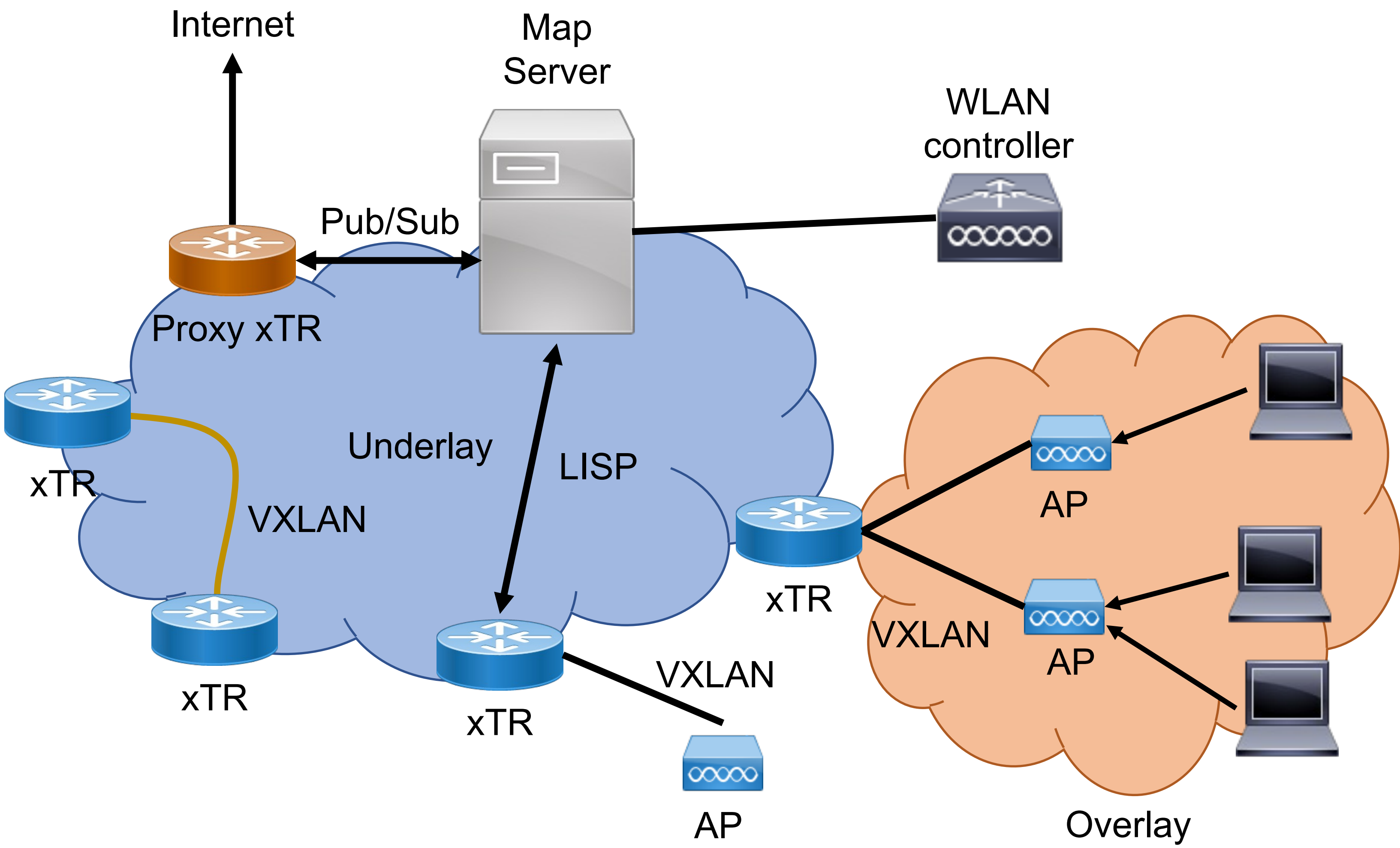
- LISP control plane
- VXLAN data plane
- EIDs are individual hosts
- Connected to xTR (LISP router)
- Proxy xTR for external connectivity (border router)



	EID – Overlay	RLOC - Underlay
Per-device entries in the Map Server	IPv4 addr.	xTR RLOC
	IPv6 addr.	xTR RLOC
	MAC addr.	xTR RLOC
	MAC addr.	IPv4 addr.

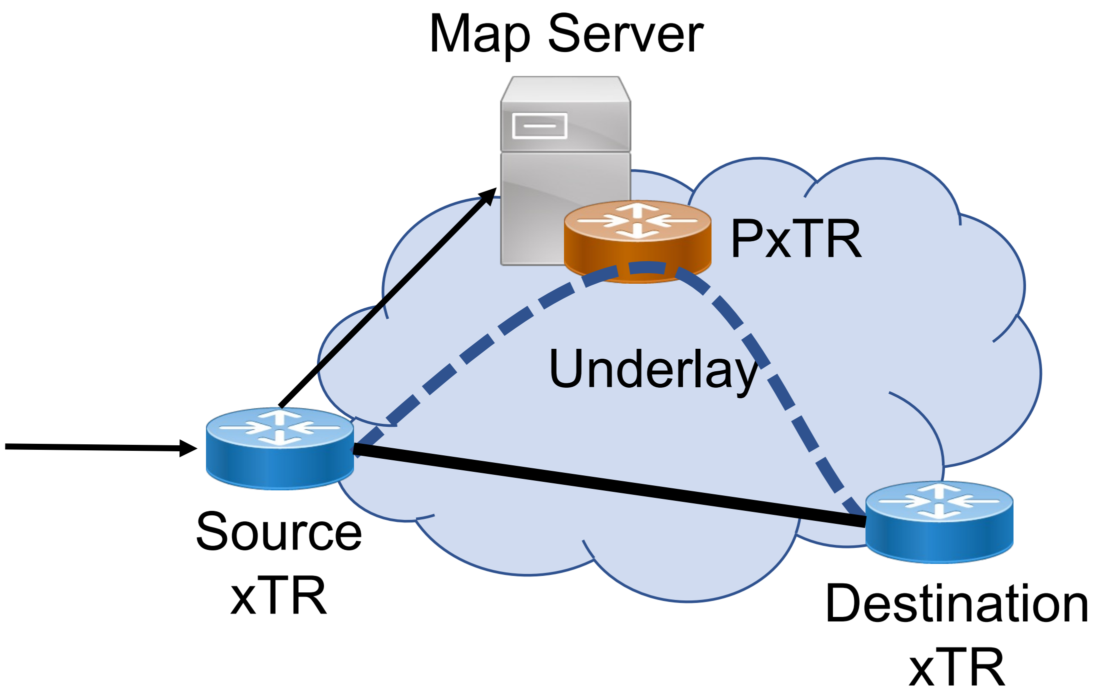
Architecture - Wireless

- WLAN controller connected to Map Server
- Controller updates endpoint location based on new device authentications



Design – Avoid resolution delay (aka No First Packet Drop)

- Add default route in LISP routers (xTR)
- Points to border router (PxTR)
- Proxy is synchronized with Map Server
- Forwards traffic on behalf of LISP routers
- Until more specific route is installed in the LISP routers



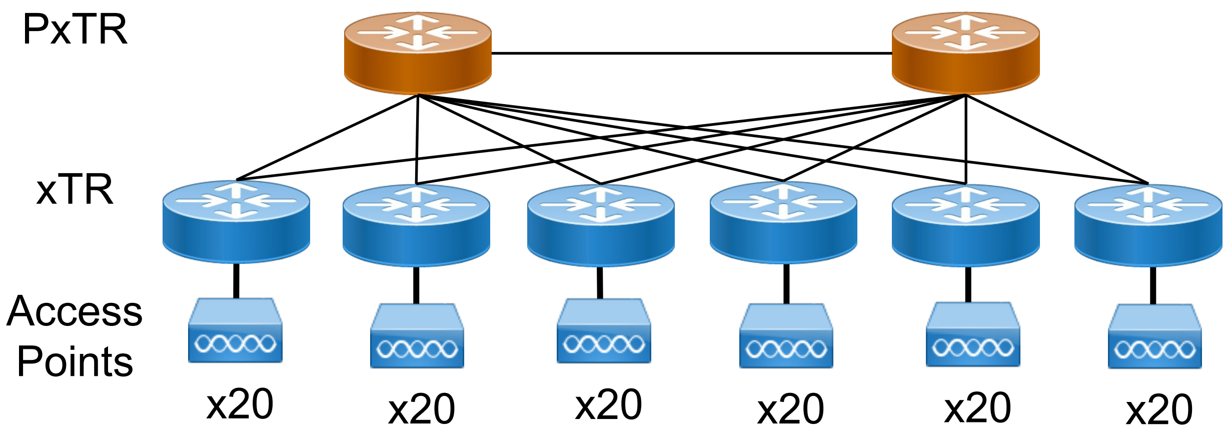
Design – Scalable L2 stretching

- Use cases:
  - Convert ARP broadcast to unicast
  - L2 protocols (eg. Apple Bonjour)
  - Legacy IoT devices (that do not use IP)
- Src. router encaps L2 frames to dst. router 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

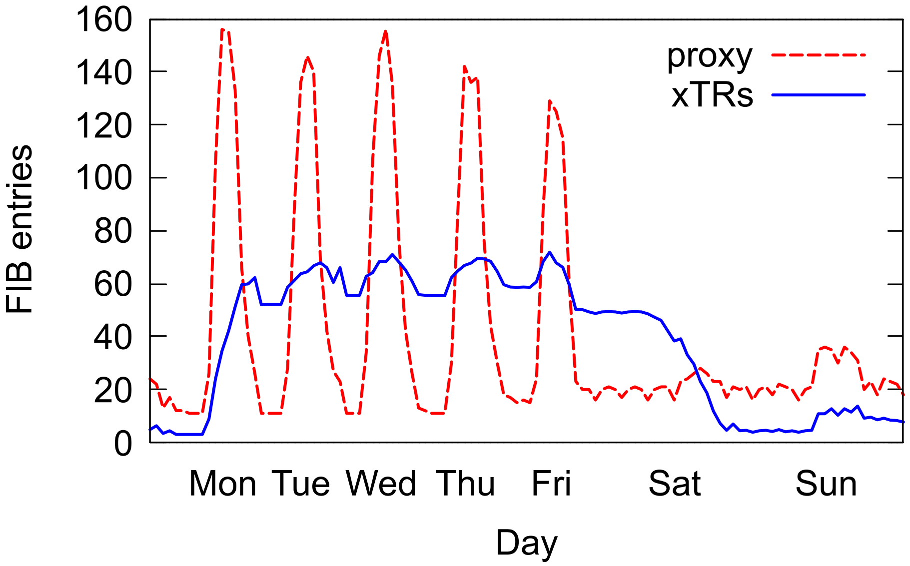
Data Plane State Reduction

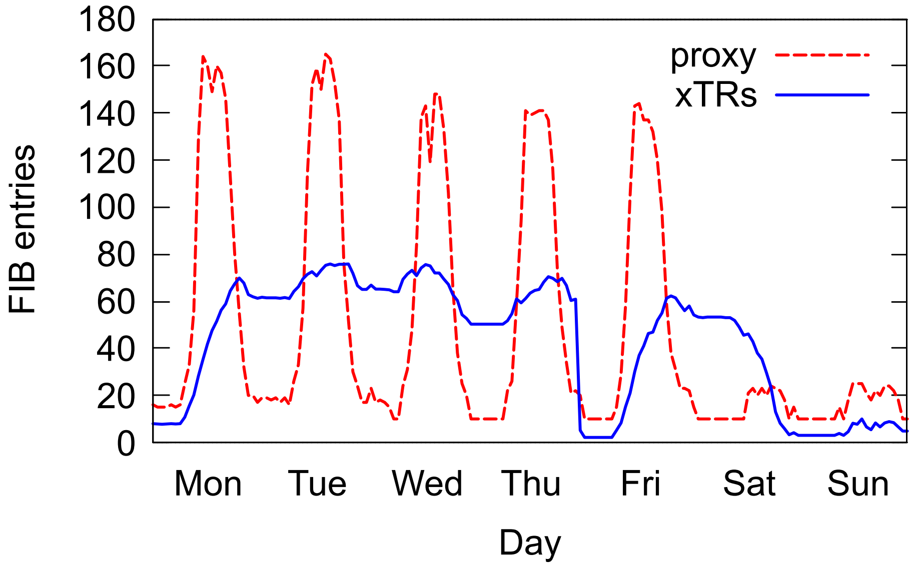
- Count map cache entries in
  - PxTR (all routes)
  - xTRs (on-demand routes)
- PxTR has all MS data → fraction of mappings in xTRs
- Two different deployments:
  - Depl. A 150 hosts
  - Depl. B 450 hosts
  - Routers:
    - 1-2 PxTR
    - 7-6 xTR
    - 120 AP (20 per xTR)



Data Plane State Reduction

A





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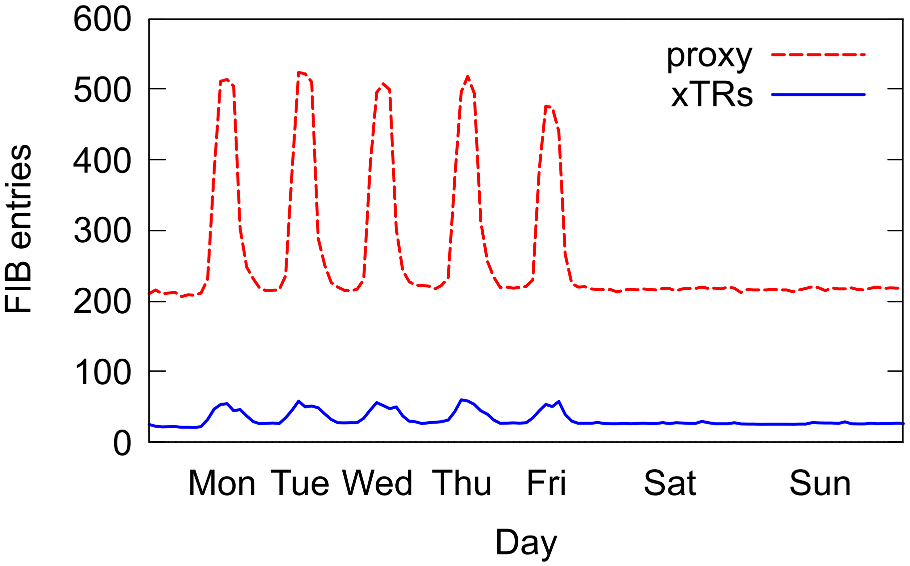

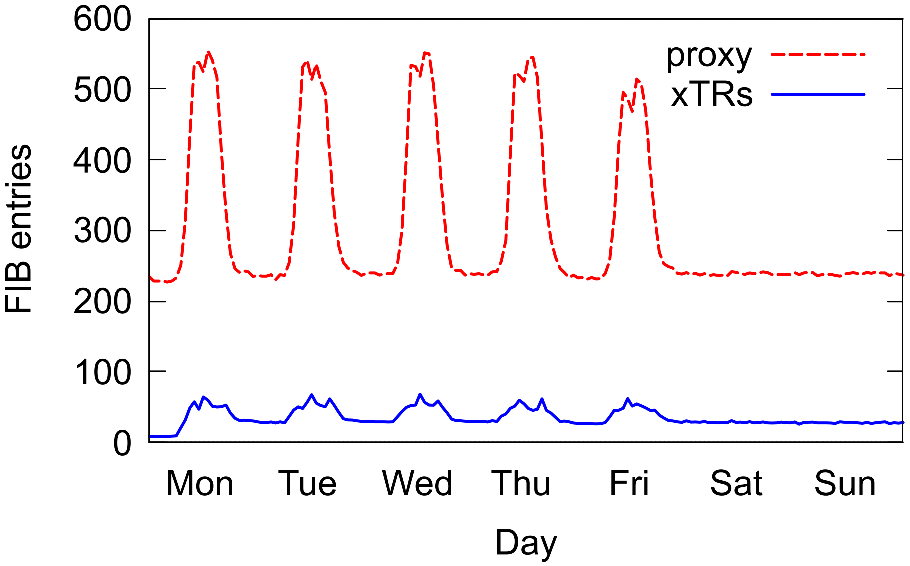

Data Plane State Reduction

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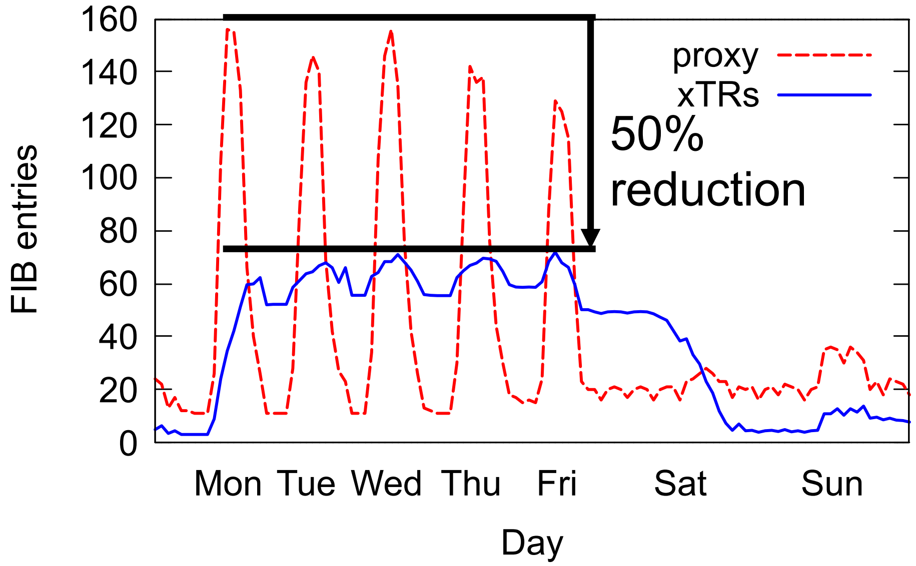

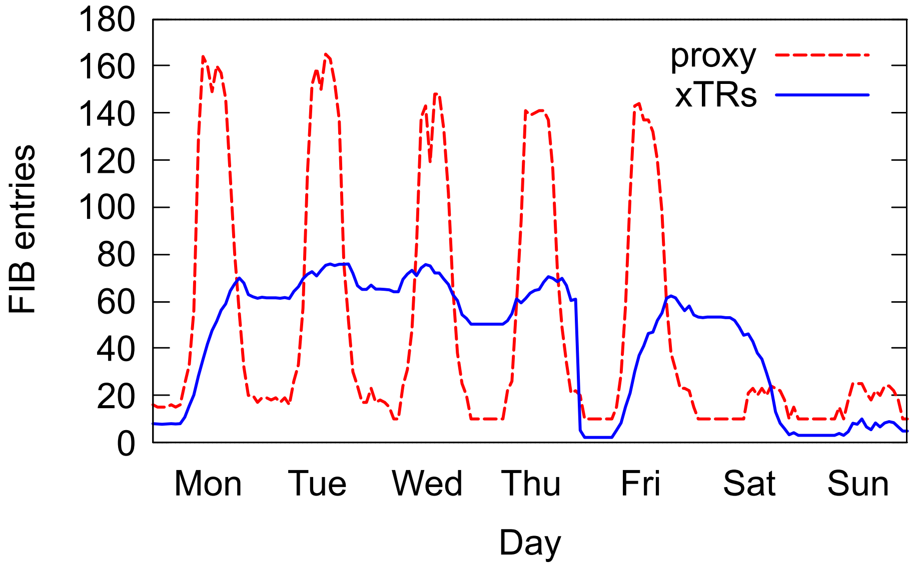

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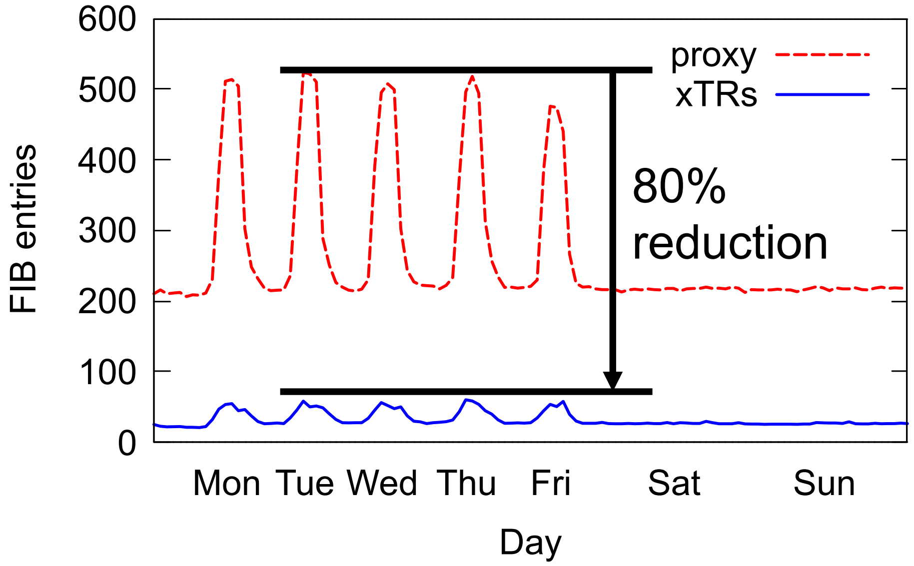
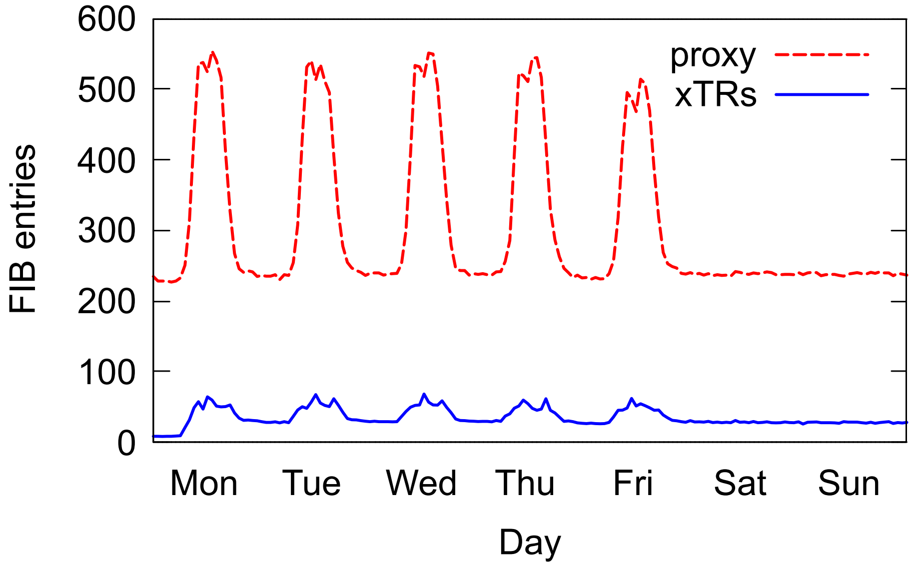
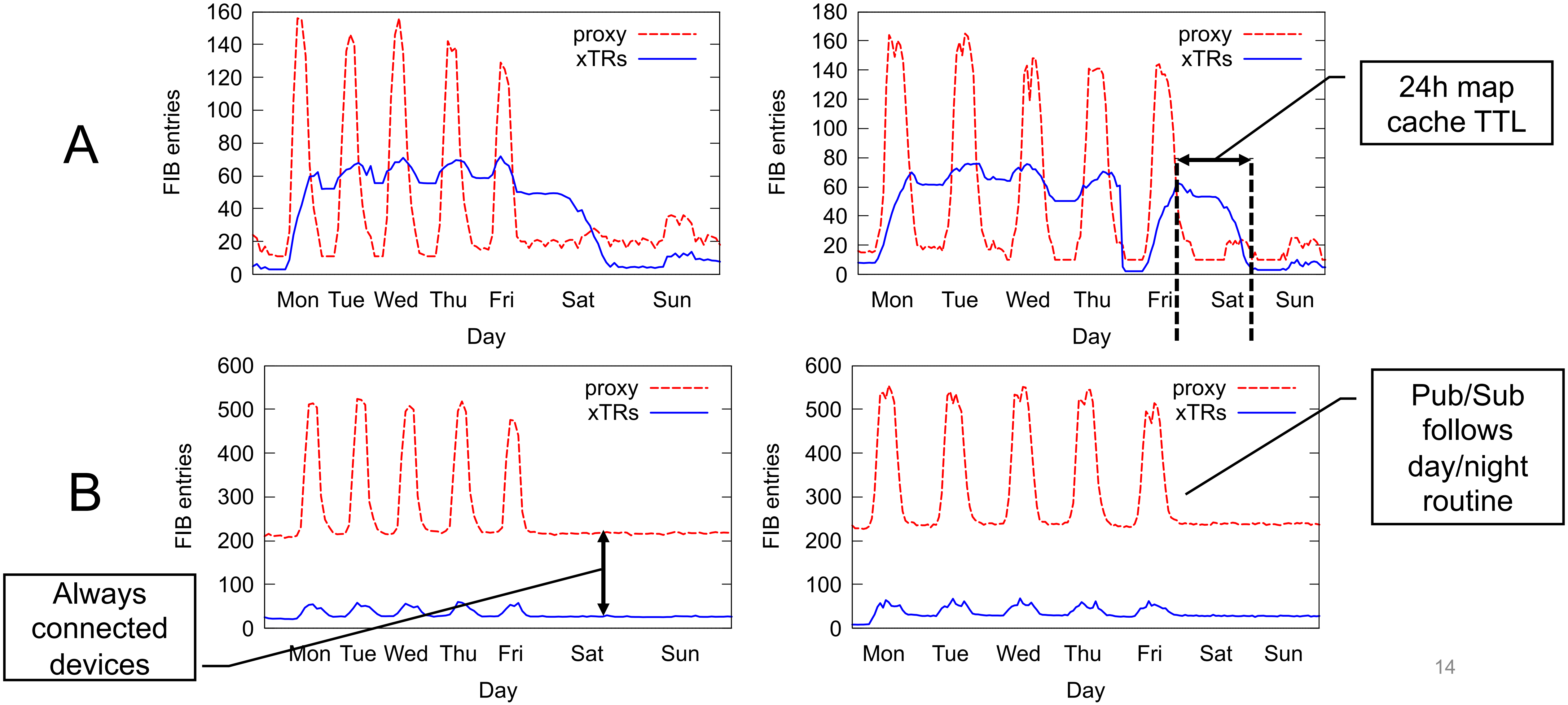


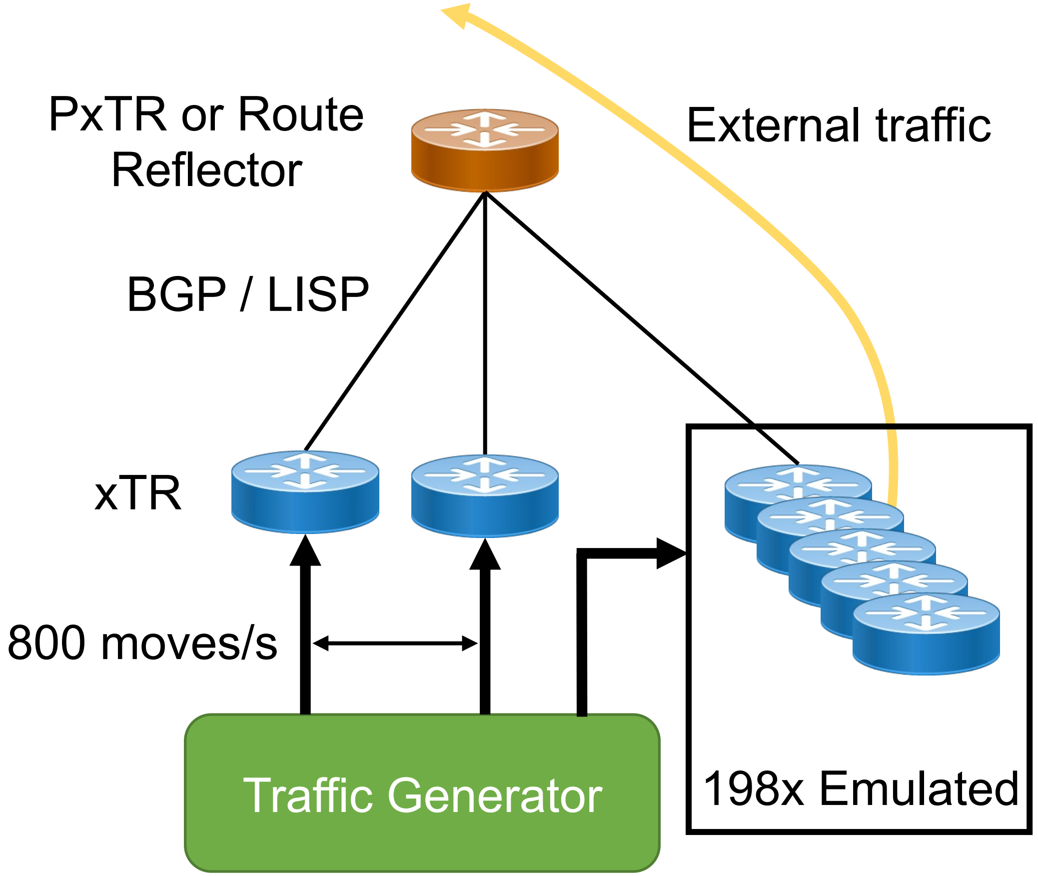


Data Plane State Reduction



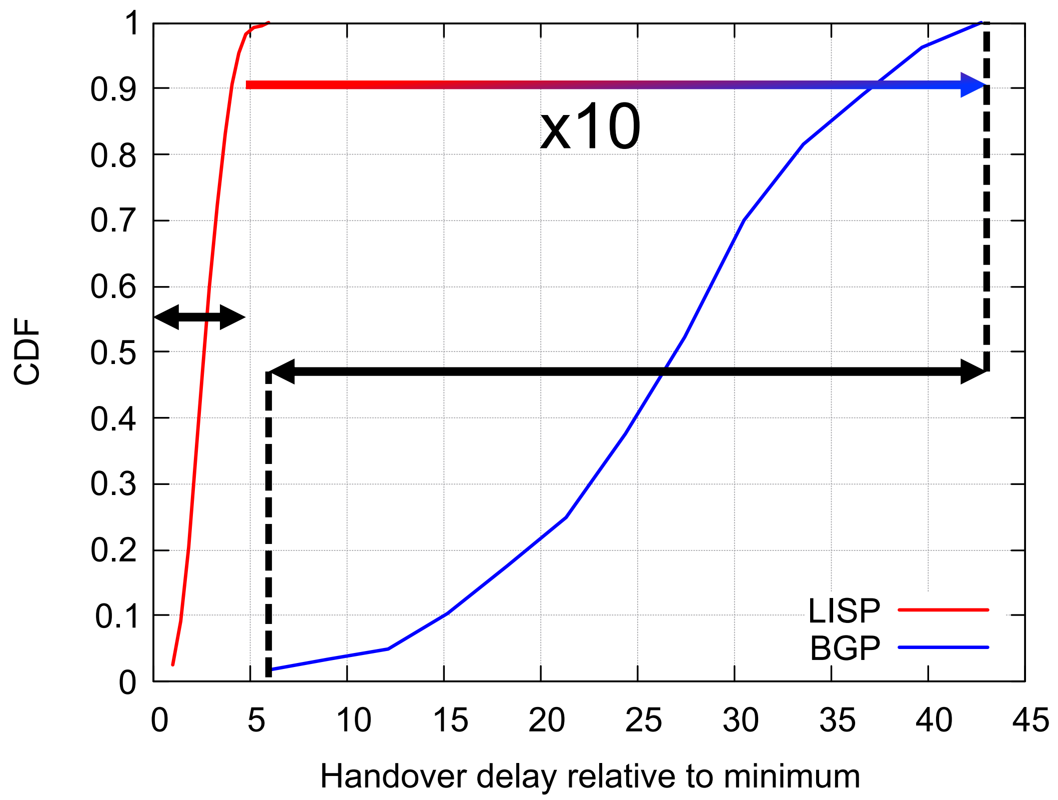
Handover Delay

- 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



Handover Delay

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



Conclusions

- Example of a LISP deployment in an enterprise environment
- 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

https://www.nordu.net/article/infoshare-campus-network-service

Thanks for listening!

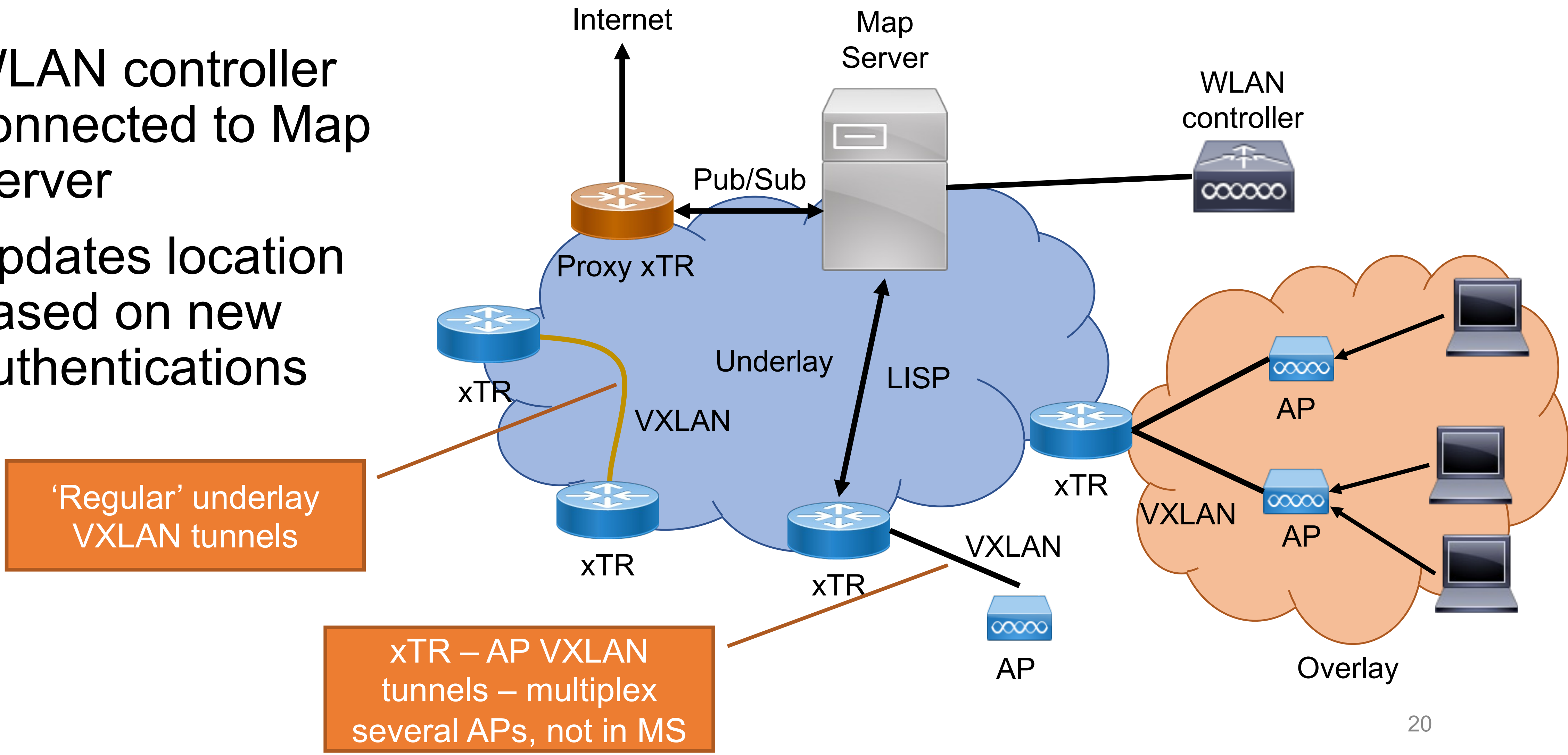
You can find the paper at:

https://arxiv.org/abs/2010.15236

Backup

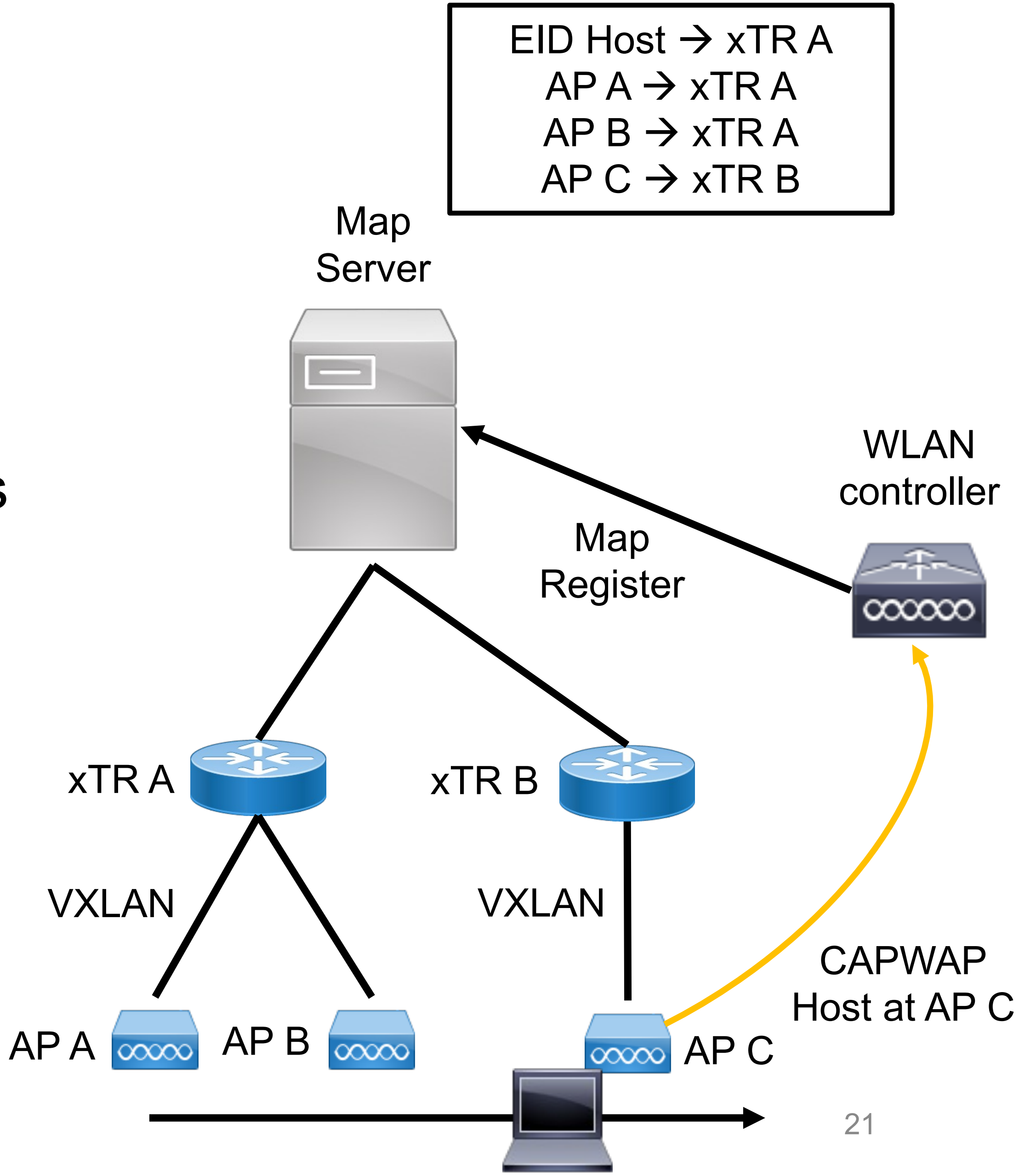
Architecture - Wireless

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



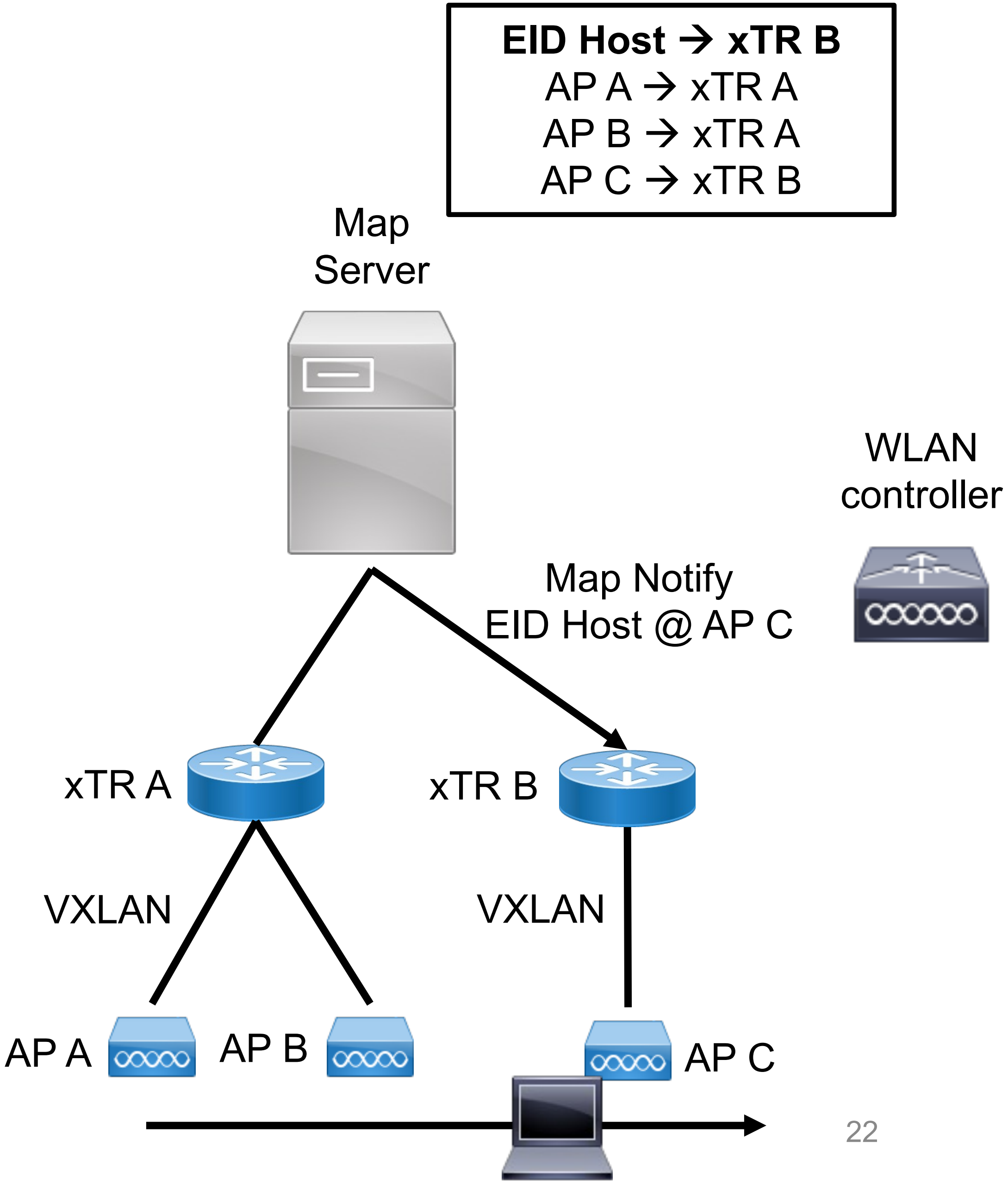
Design – Mobility (I)

- 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)