A SAVI Solution for WLAN

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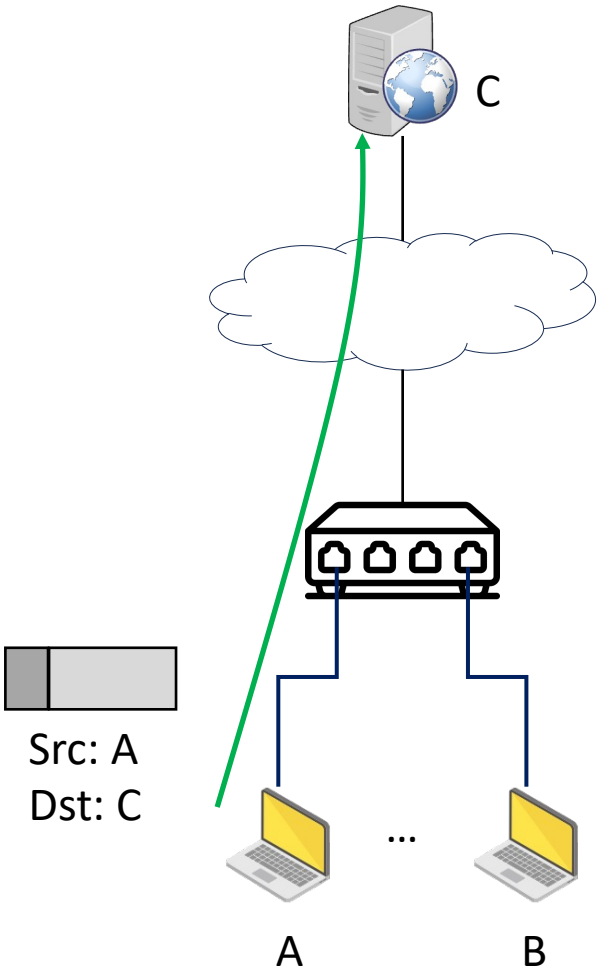
Outline

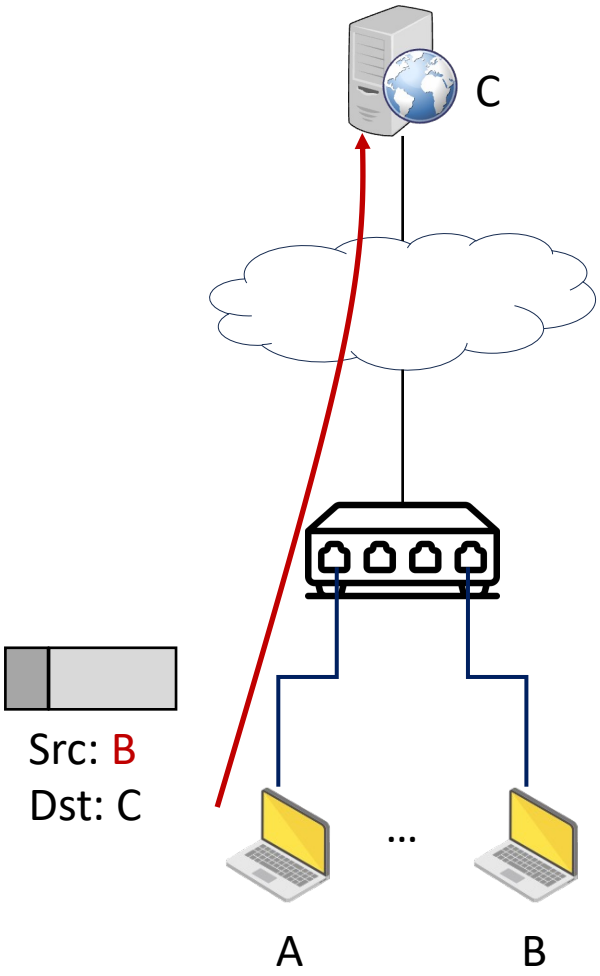
- Background
- SAVI-WLAN Solution
- Next Steps

Background

Source address spoofing



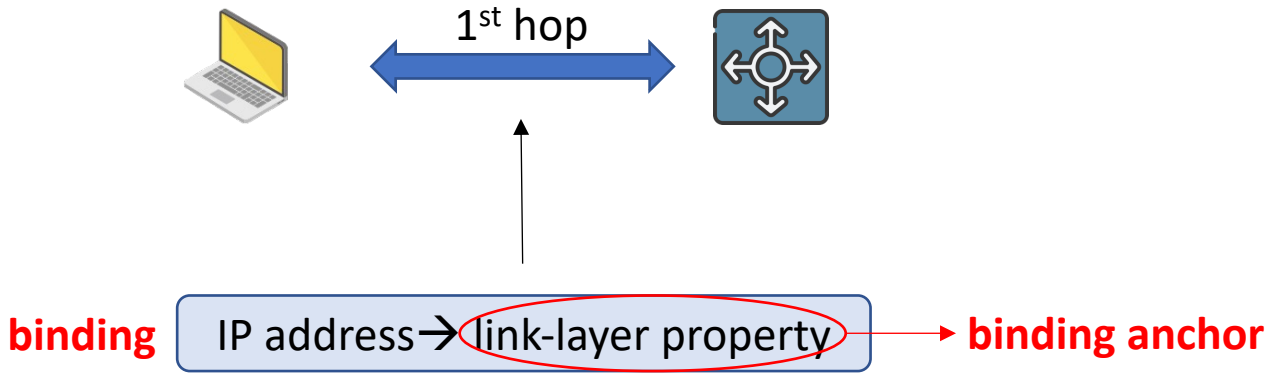
Source address spoofing



Source address validation

- Source Address Validation Improvements (savi)
- July 2008 – October 2018
- Goals
  - ensure that hosts attached to the same IP link cannot spoof each other's IP addresses without disrupting legitimate traffic

SAVI framework



1. derive legitimate IP address from on-link traffic
2. bind legitimate IP address to link-layer property
3. enforce bindings on SAVI devices

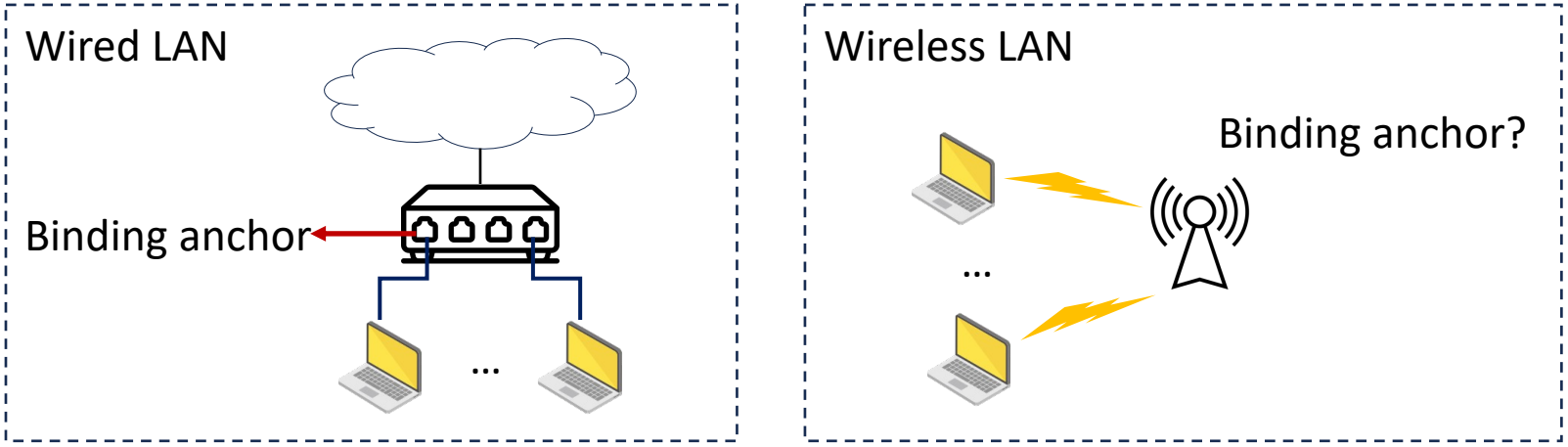
Binding anchors & existing solutions

- Various binding anchors:
  - The IEEE extended unique identifier, EUI-48 or EUI-64, of a host's interface.
  - The port on an Ethernet switch to which a host attaches.
  - The combination of a host interface's link-layer address and a customer relationship in cable modem networks.
  - …
- Existing Solutions

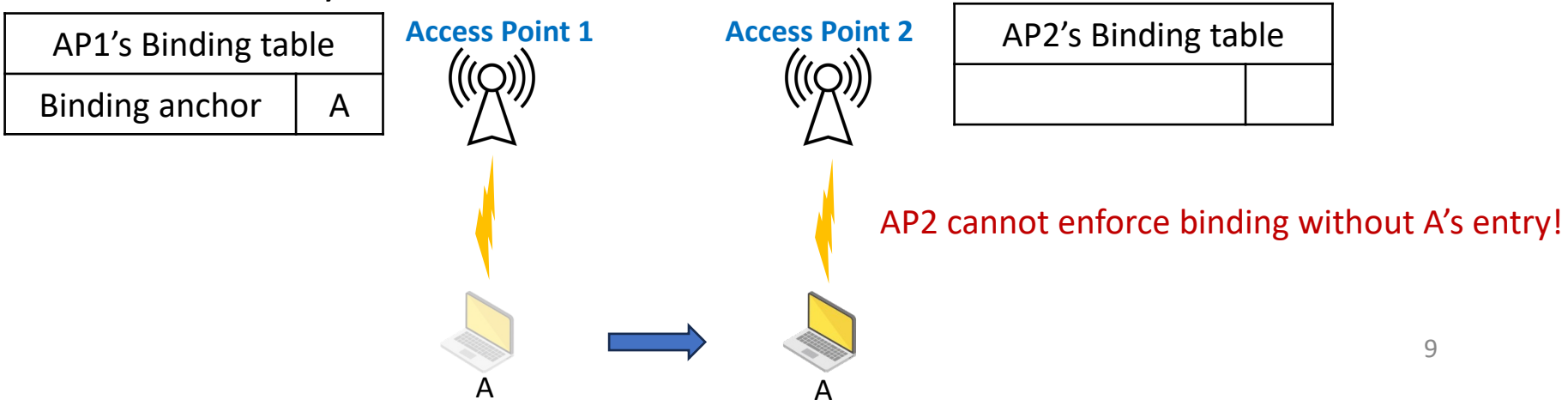
RFCs	Title	Scenarios
RFC6620	FCFS SAVI: First-Come, First-Served Source Address Validation Improvement for Locally Assigned IPv6 Addresses	SLAAC and Static
RFC7219	SEcure Neighbor Discovery (SEND) Source Address Validation Improvement (SAVI)	SEND
RFC7513	Source Address Validation Improvement (SAVI) Solution for DHCP	DHCP
RFC8074	Source Address Validation Improvement (SAVI) for Mixed Address Assignment Methods Scenario	Mixed

How about in wireless LANs?

- Lack of naturally available binding anchors in wireless LANs

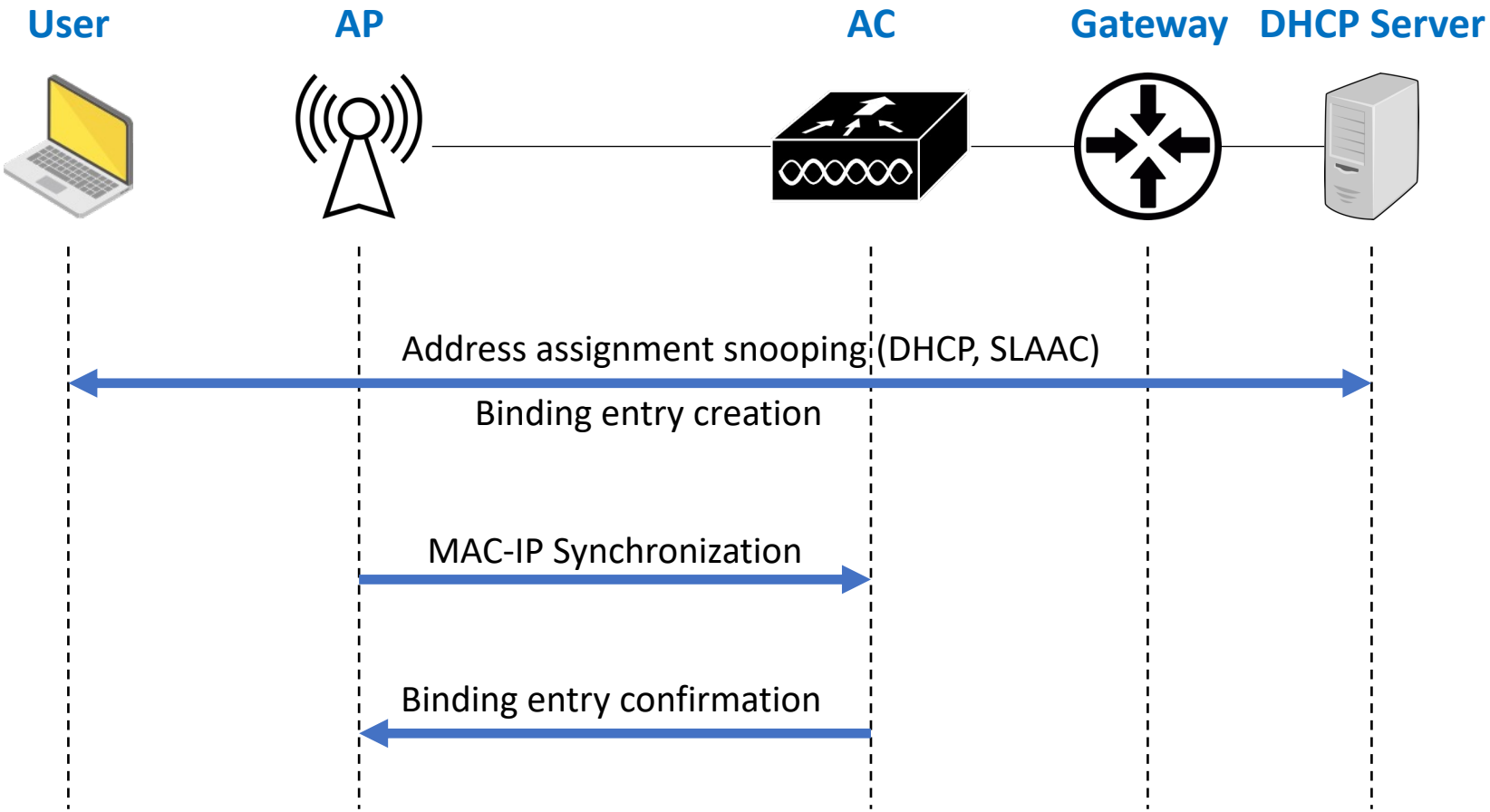


- User mobility in wireless LANs



SAVI-WLAN Solution

SAVI-WLAN overview



Binding anchor

- Binding anchor: MAC address
  - secured by 802.11i or other mechanisms

- If the MAC address is unprotected, an attacker can spoof the MAC address to pass validation successfully.

Two data structures

- IP-MAC Mapping Table
  - maps an IP address to a MAC address
  - used in the control process
- MAC-IP Mapping Table
  - maps a MAC address an IP address
  - used for filtering

IP-MAC Mapping Table		
IP1	MAC1	DHCP
IP2	MAC2	SLAAC
IP3	MAC1	SLAAC

MAC-IP Mapping Table		
MAC1	IP1	DHCP
MAC2	IP2	SLAAC

- The MAC-IP mapping table and the IP-MAC mapping table can be maintained separately on different devices.
- A synchronization mechanism must be used between these two tables to ensure the consistency of the bindings.

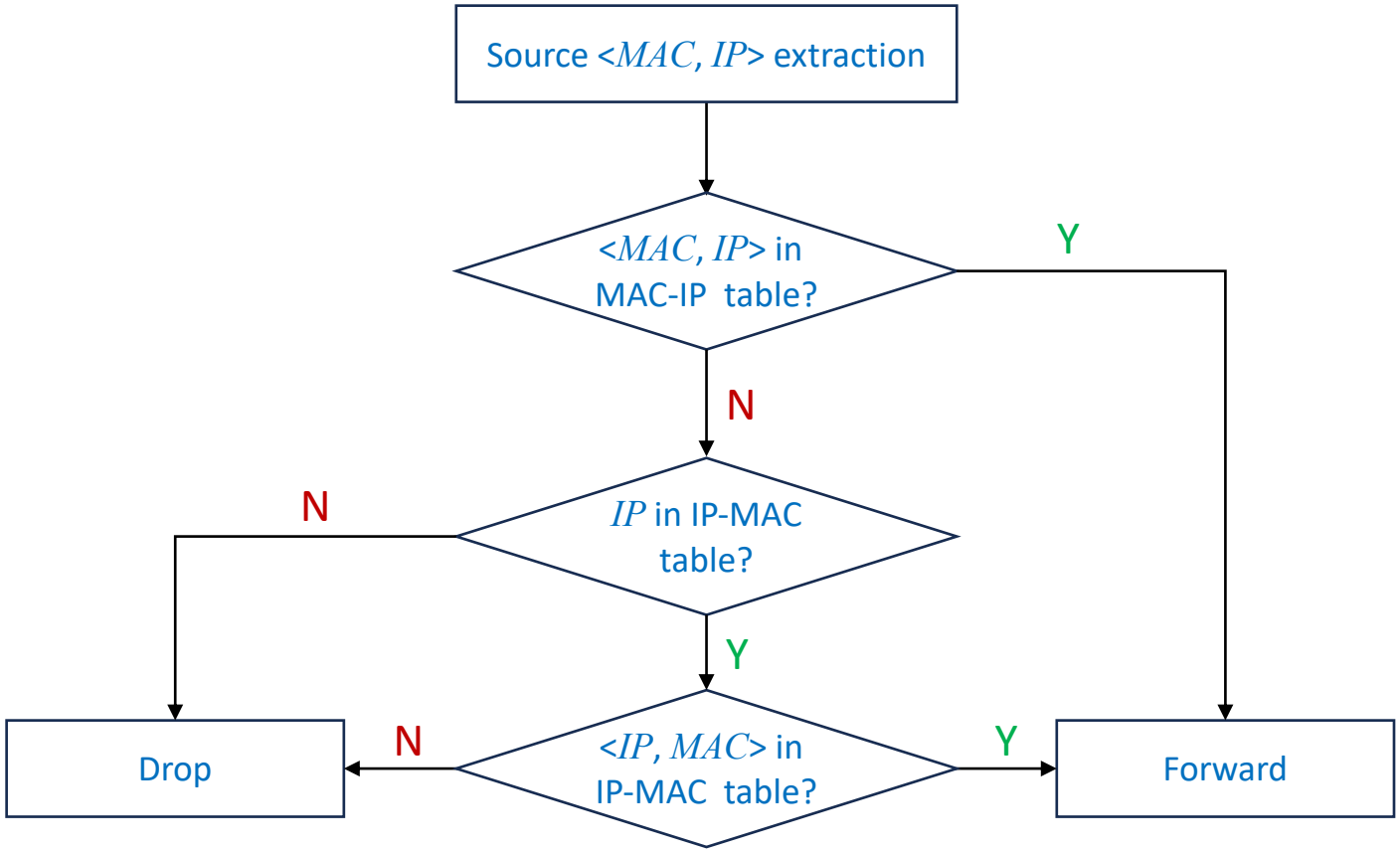
Binding creation

- Static:
  - All the static IP-MAC address pairs are configured into the IP-MAC mapping table with the mechanism enabled.
- DHCP [RFC7513]:
  - snoops on the DHCP address assignment process between the attached host and the DHCP server.
- SLAAC [RFC6620]:
  - snoops *Duplicate Address Detection* procedure or *Address Resolution* procedure between attached hosts and neighbors.

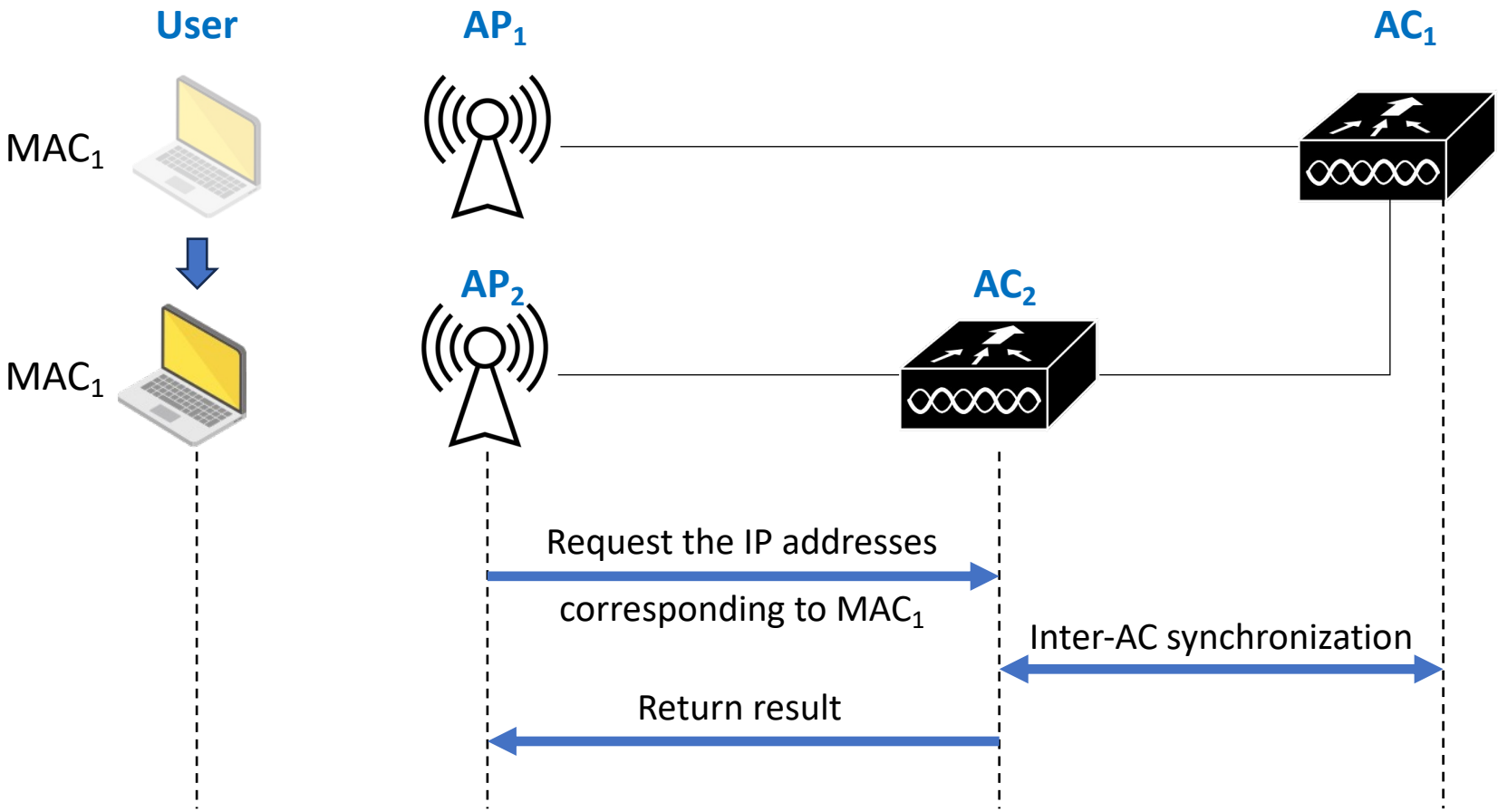
Binding clearing

1. A host leaves explicitly this access point.
   - All entries in the MAC-IP mapping table associated with this MAC address MUST be cleared.
2. A DHCP RELEASE message is received from the owner of the corresponding IP address.
   - This IP entry in the IP-MAC mapping table and the corresponding entries in the MAC-IP mapping table MUST be cleared.
3. A timeout message of the AC's client idle-time is received.
   - All entries in the MAC-IP mapping table related to the MAC address MUST be cleared.

Source address validation



Mobility Solution



The CAPWAP extension is used to synchronize binding entries between APs and ACs, while the method of synchronization between ACs can be determined independently.

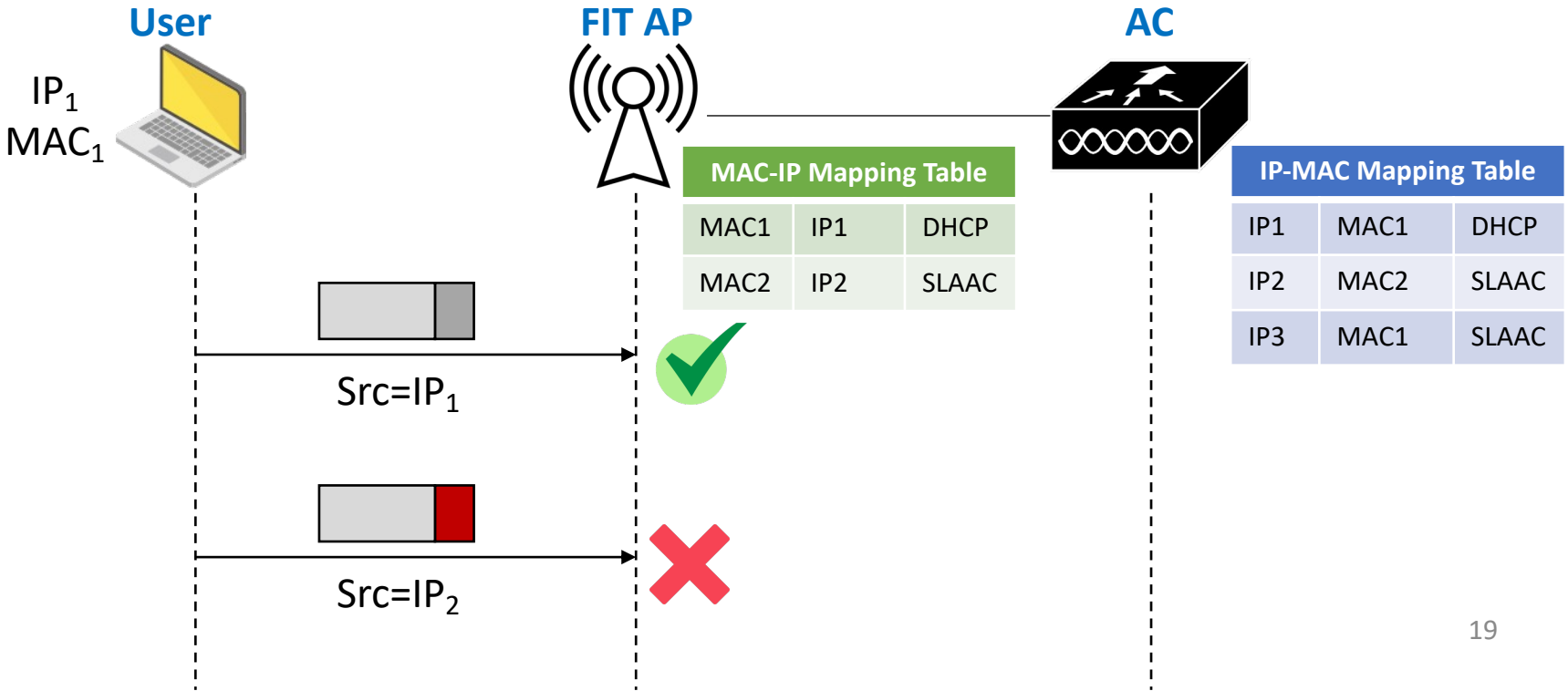
Deployment scenarios

- Scenario 1: Centralized WLAN (FIT AP + AC)

- Scenario 2: Autonomous WLAN (FAT AP)

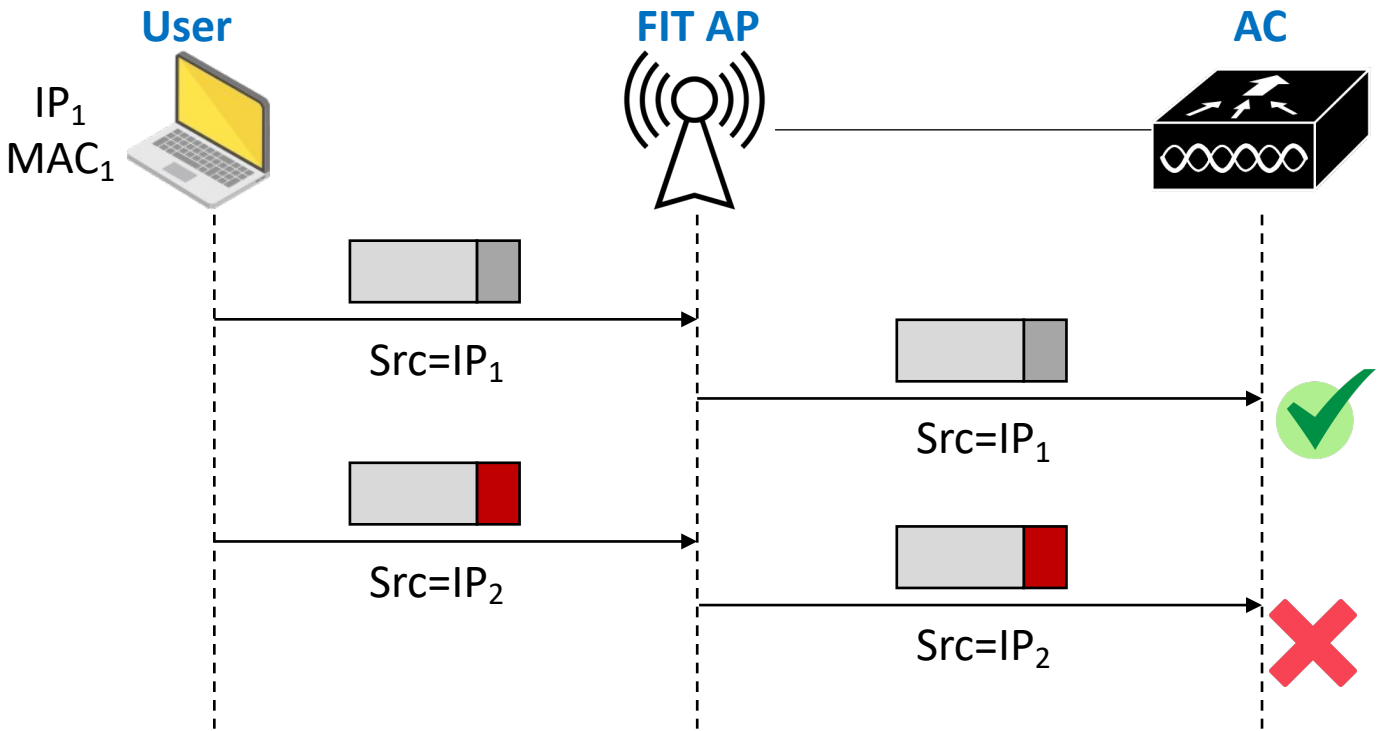
Scenario 1: Centralized WLAN

- Case 1: AP filtering
  - AC maintains IP-MAC Mapping Table
  - AP maintains MAC-IP Mapping Table and perform address snooping



Scenario 1: Centralized WLAN

- Case 2: AC filtering
  - AC maintains both MAC-IP and IP-MAC Mapping Table and performs both address snooping and packet filtering
  - All the packets must be forwarded to AC firstly

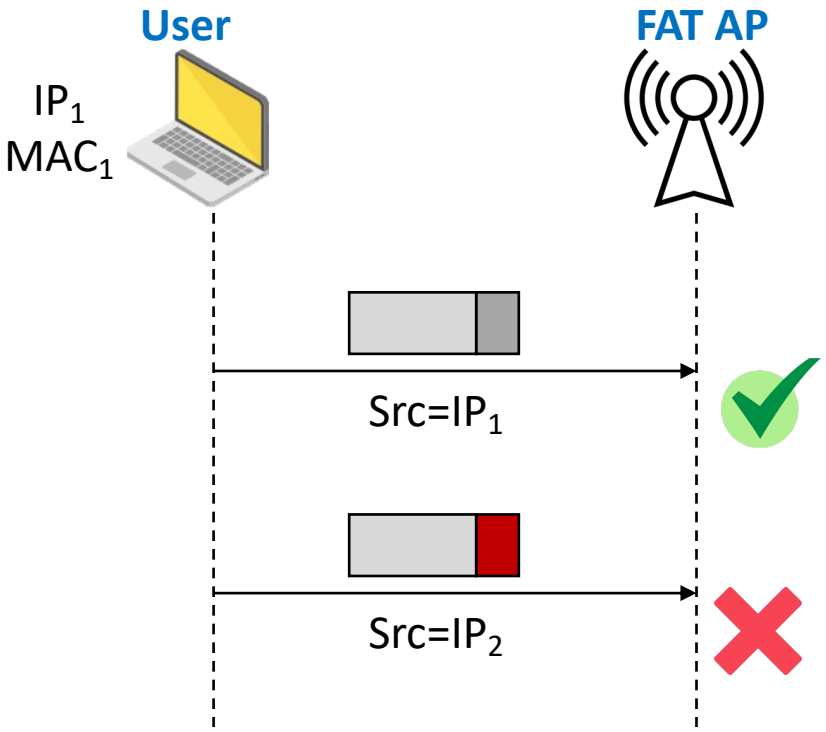


IP-MAC Mapping Table		
IP1	MAC1	DHCP
IP2	MAC2	SLAAC
IP3	MAC1	SLAAC

MAC-IP Mapping Table		
MAC1	IP1	DHCP
MAC2	IP2	SLAAC

Scenario 2: Autonomous WLAN

- AP filtering
  - FAT AP maintains both MAC-IP and IP-MAC Mapping Table and performs both address snooping and packet filtering.



IP-MAC Mapping Table		
IP1	MAC1	DHCP
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MAC-IP Mapping Table		
MAC1	IP1	DHCP
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MAC address randomization

- In WLAN, random MAC addresses are mainly used for discovering wireless networks, accessing networks and communicating.
  - **Wireless network discovery**
    - Use probe request frames to discover wireless networks. This does not affect the establishment of SAVI binding anchors.
  - **Network access and communication**
    - Random MAC addresses are used to send and receive packets.
    - In 802.11i wireless networks, the key used for communication is tied to the MAC address, and the random MAC address does not change during communication.
    - Usually, in the same wireless network, the random MAC address does not change when you re-access the wireless network to ensure roaming experience.
    - If the MAC address changes, the access needs to be rechecked.
- In summary, the anchor of SAVI binding is stable during one access, and the SAVI function will work well.

Next Steps

Next Steps

- Solicit comments and refine the draft.

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Thank You!

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