Identifier Binding Attacks and Defenses in Software-Defined Networks

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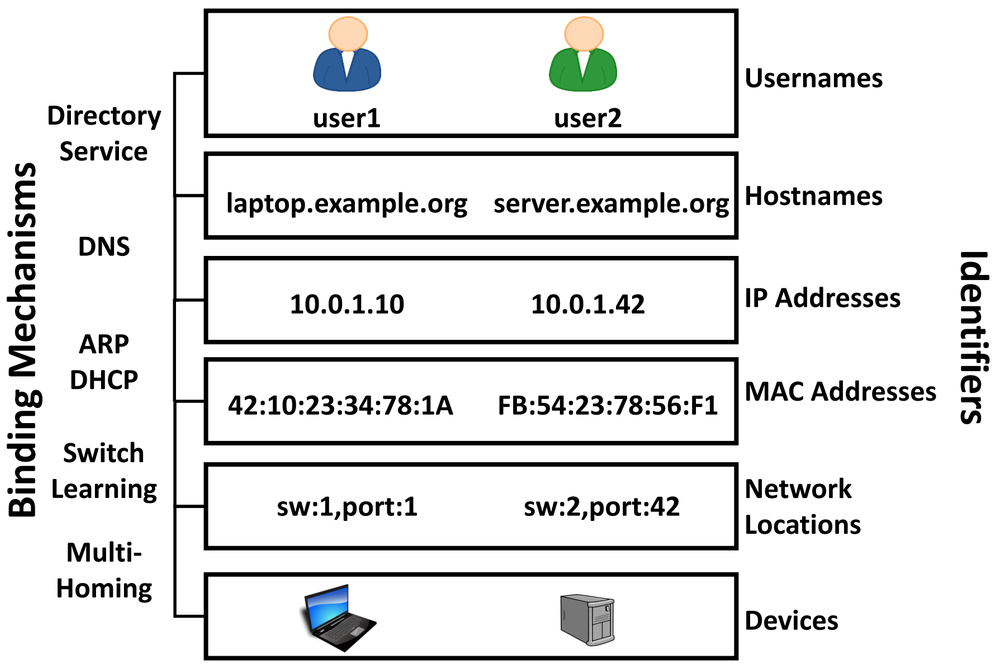
Network Identifiers and Their Bindings

- Network Identifier: An Identifier for a device used at some layer of the network stack
- Used for forwarding, access control, and authorization
- Bound from higher layers to lower layers to actually send traffic



Bindings are done by insecure protocols

- No authentication
- Simple broadcast queries
- No cross-layer checks
- No additional checks on binding updates
- Mutable Identifiers

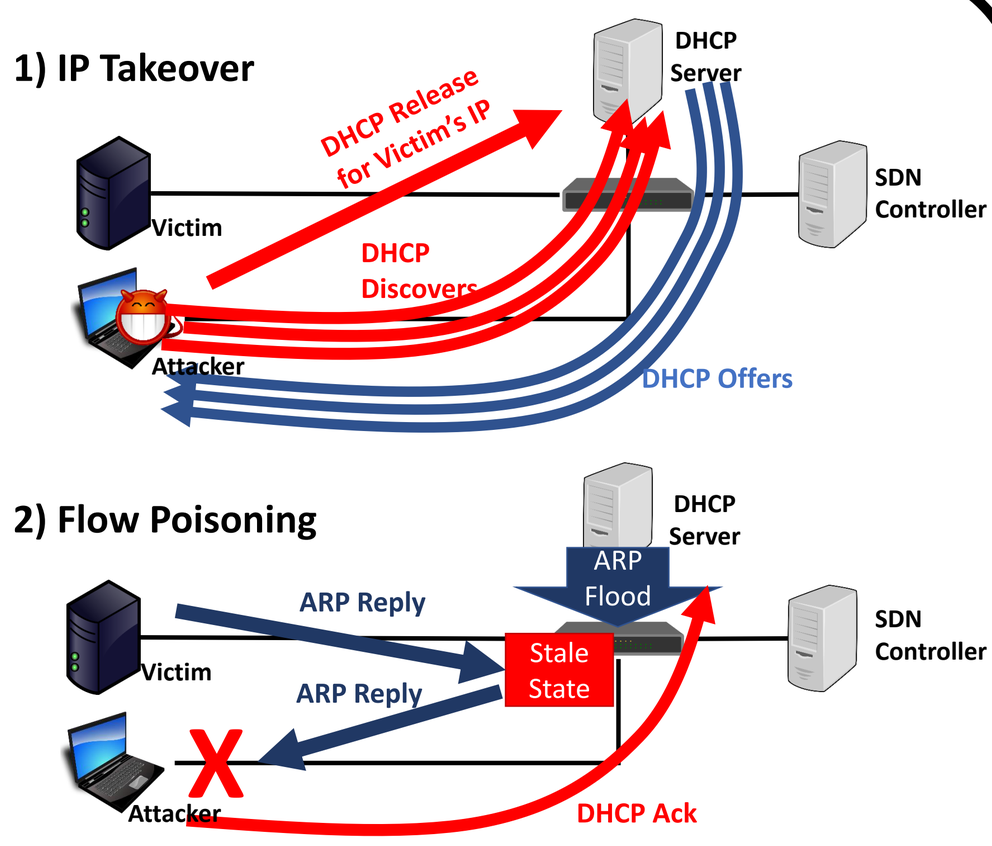
Persona Hijacking Attack

- Novel and extremely powerful identifier binding attack
- Achieves takeover of the victim's IP address and DNS name
- Persists for hours or days
- Attacker becomes the *owner-of-record* for the victim's IP address

Vulnerable Controllers

Controller	Experimentally Vulnerable	Probably Vulnerable*	Not Vulnerable
ONOS	X		
Ryu	X		
POX		X	
Floodlight		X	

* Based on Source Code Analysis



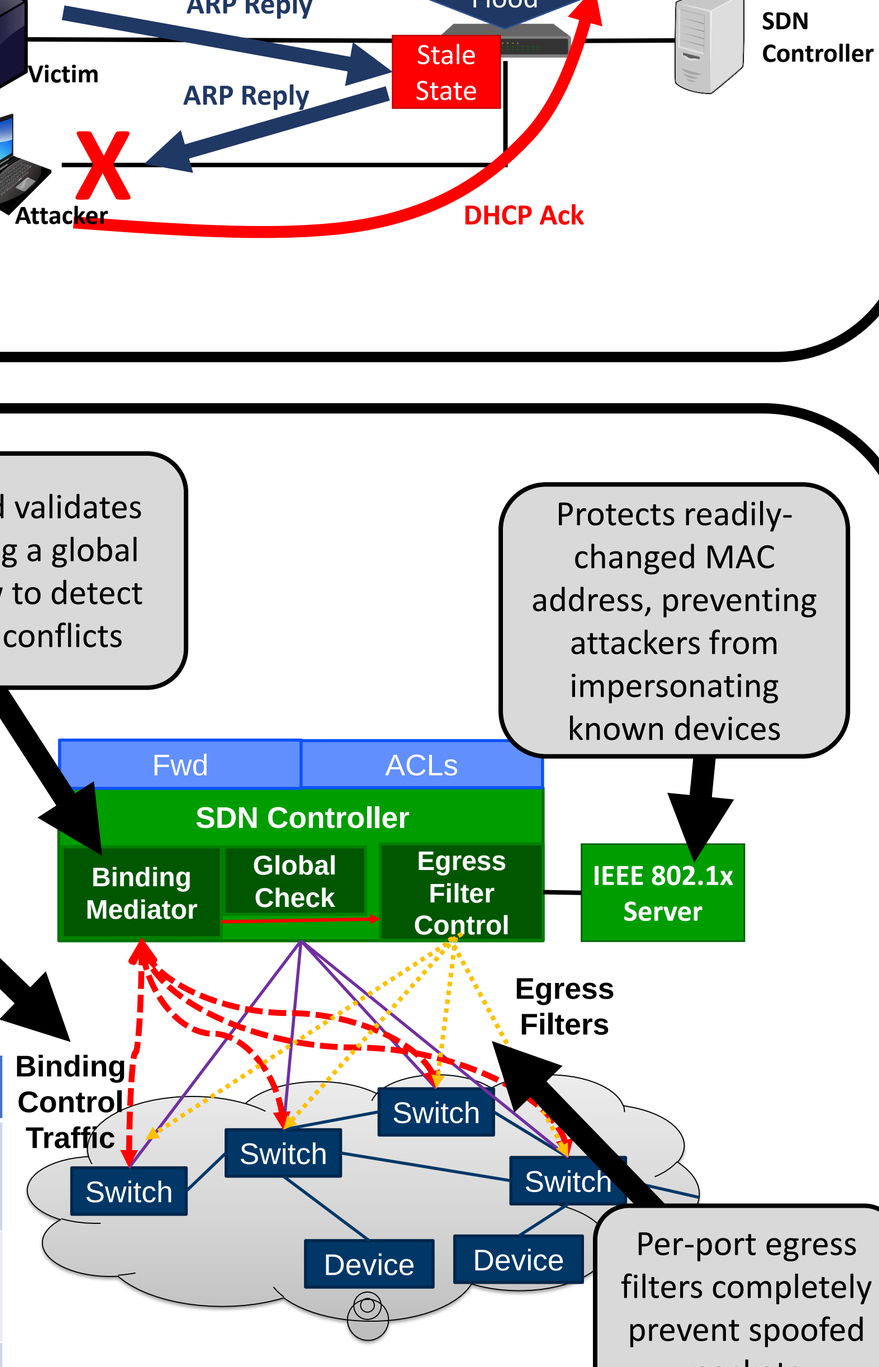
SecureBinder

- SDN-based defense to completely prevent identifier binding attacks
- Mediates identifier bindings
- Provides a root-of-trust for network identifiers

Mediates and validates bindings using a global network view to detect and resolve conflicts

Protects readily-changed MAC address, preventing attackers from impersonating known devices

Isolates identifier binding control traffic from the data-plane



Per-port egress filters completely prevent spoofed packets

Evaluation

Security

Attack	ONOS	SecureBinder
Persona Hijacking	X	✓
Host Location Hijacking	X	✓
ARP Spoofing	X	✓

Performance

		SecureBinder
Host Join Latency	505ms	3505ms (+3sec)
New Flow Latency	8ms	6ms (-2ms)
Pkt_ins (Load)	131	193 (+47%)

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