Towards Programmable Enterprise WLANs with Odin

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Motivation
Enterprise WLANs
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Centralised management

Wireless Mgmnt. System

WLAN Controller
Enterprise WLANs

mobility management, load balancing, policy enforcement, AAA.

Wireless Mgmnt. System

Services

WLAN Controller
Vendor Solutions?
Vendor Solutions?

Vendor lock-in, inflexibility

[Diagram showing wireless management system, services, and WLAN controller]
Network "apps" for Enterprise WLANs?
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Objective

Enterprise WLAN services as network "apps"
Requirements

1. Do not modify 802.11 clients
   (Clients = 802.11 STA in Infrst. mode, compatibility with WPA2 Enterprise)

2. Simplified programming model
Light Virtual Access Points (LVAPs)
802.11 Association

{mac_addr (client), bssid (ap-1)}
802.11 Association

Roaming client?
802.11 Association

Roaming client?

\{\text{mac\_addr (client)}, \text{bssid (ap-2)}\}
802.11 Association

Roaming client?
Avoiding handoff delay?
Control on client's association?
802.11 Association

Two physical devices

AP-1

AP-2

Client
s / physical-AP / LVAP

{mac_addr (client), bssid (ap-virtual)}
s / physical-AP / LVAP

\{mac_addr \text{(client)}, \text{bssid \text{ap-virtual)}\}\}
s / physical-AP / LVAP

Unique virtual AP per client
LVAP =>

LVAP Migration == Handoff
(+) No protocol messages triggered

Fixed link between client and n/w
Using LVAPs for writing n/w apps with Odin
Odin Application Example
Odin Application Example
Odin Application Example

Mobility Manager

lvap_handoff()

Odin

lvap_add()

lvap_remove()
Odin Application Example

Mobility Manager

Odin
More examples

Re-association based Load Balancing

Offloading clients for energy saving
Evaluation

Are LVAPs feasible?
LVAP Handoff Experiment

- APs in 5Ghz channel, open authentication
- Client does HTTP download
- Perform a single handoff in regular 802.11 and Odin settings
- Observe throughput drop
LVAP Handoff Experiment

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Regular 802.11

Throughput versus time for normal handoff experiment (wget)

Throughput (Mbit/sec)

Time (seconds)
LVAP-handoff (Odin)

Throughput versus time for Odin handoff experiment (wget)
LVAP-handoff Benchmark Experiment

- Same setup as previous experiment with Odin
- Perform handoffs continuously every 'T' seconds, for 20 seconds.
- Observe throughput drop
LVAP-handoff Benchmark Experiment

Throughput results with benchmark experiment

Throughput with Odin

Throughput (Mbit/sec)

Interval between two Odin handoffs (seconds)
Summary

Odin takes a step towards programmable Enterprise WLANs

LVAP abstraction makes it easier to express some n/w services as n/w applications.
On-going work

Authentication

Larger deployment

Performance optimisations

More applications
Thanks!

(Demo on Wednesday (15th)!)
LVAP

{client_mac_addr,
 client_ip_addr,
 lvap_bssid,
 lvap_ssid}

Downlink (data)

wifi_header.src_addr = map.get(dst_mac).lvap_bssid
LVAP: Driver Hack

bssid_mask = 0xfffffffffffff

foreach bssid in BSSID_SET do

    bssid_mask = bssid_mask & !(hw_mac_addr ⊕ bssid)

end

if (frame.dst_mac_addr & bssid_mask)
    == (bssid_mask & hw_mac_addr) then

    //accept frame

end
Proactive Application
(Load Balancer Example)

```plaintext
run ()

    while (1)
        // query all APs for load
        // LVAP-Handoff clients to even load
        sleep(60);
```
Towards SDN

Open Interfaces

"Network Applications"