

Towards Programmable Enterprise WLANs with Odin

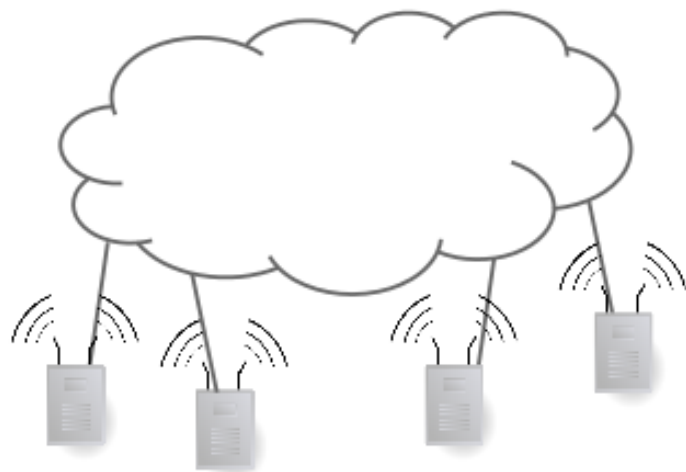
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Teresa Vazao^

*Telekom Innovation Laboratories / TU-Berlin

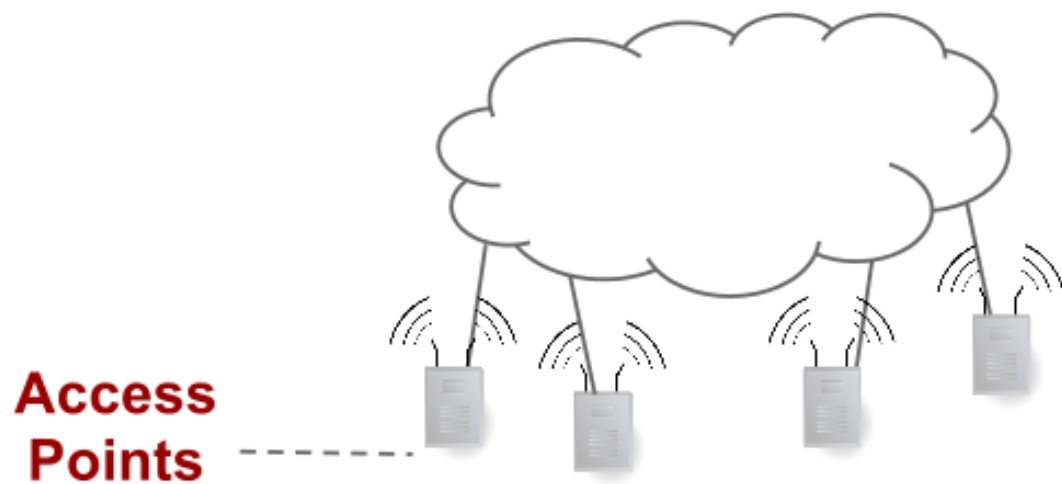
^Instituto Superior Tecnico, Lisbon

Motivation

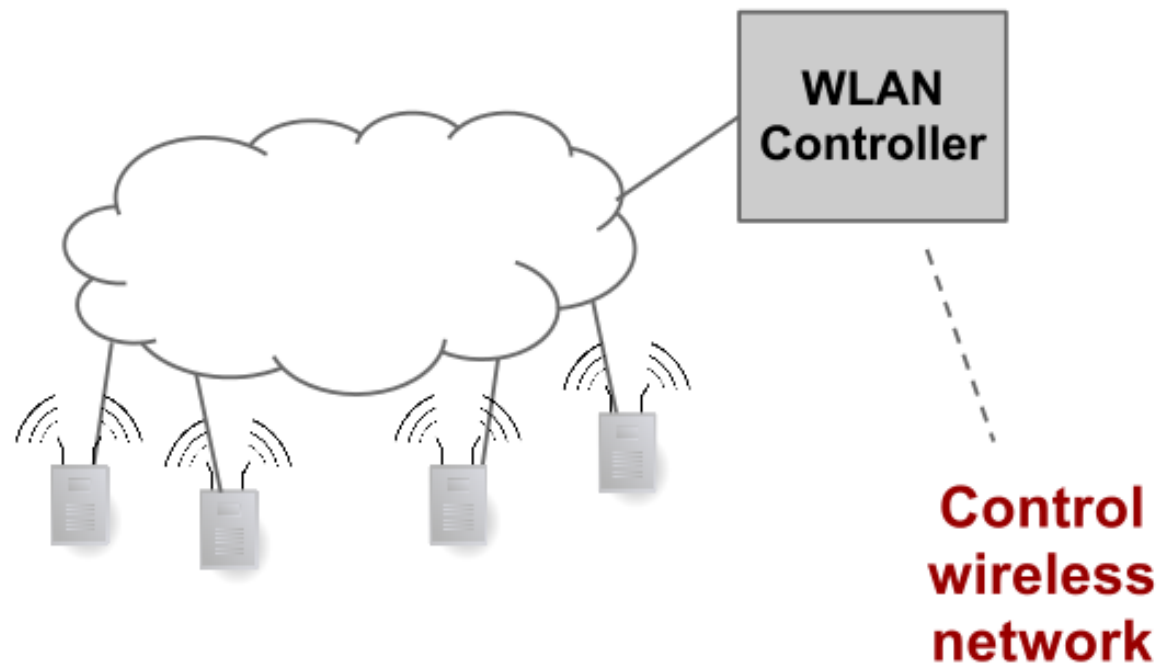
Enterprise WLANs



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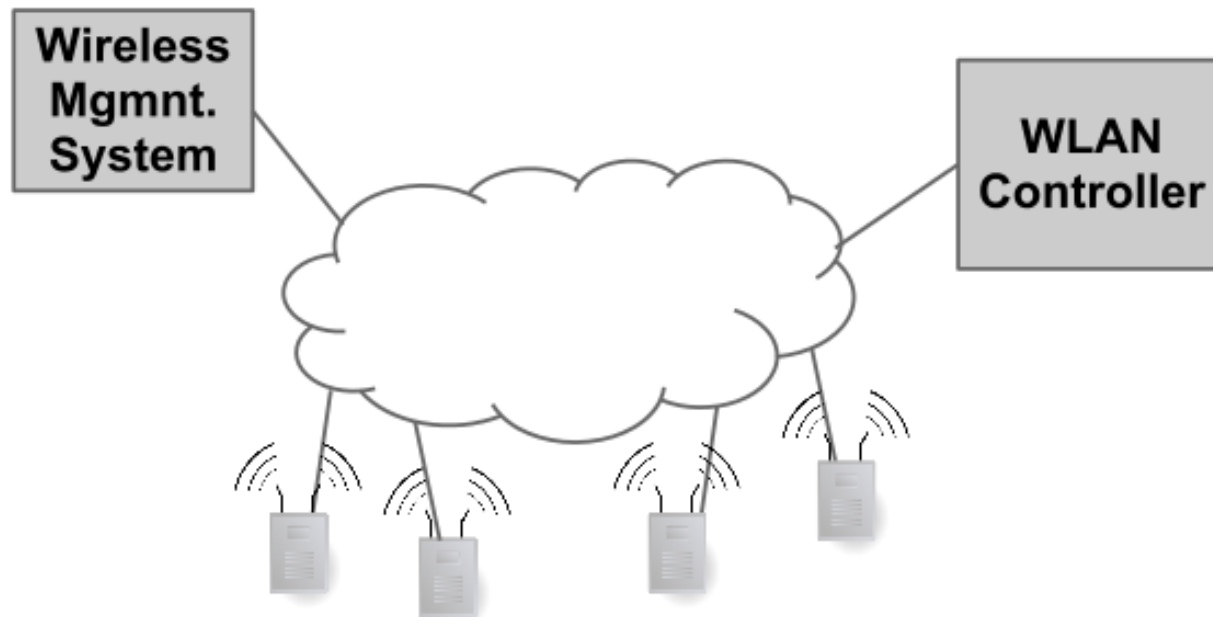


Enterprise WLANs

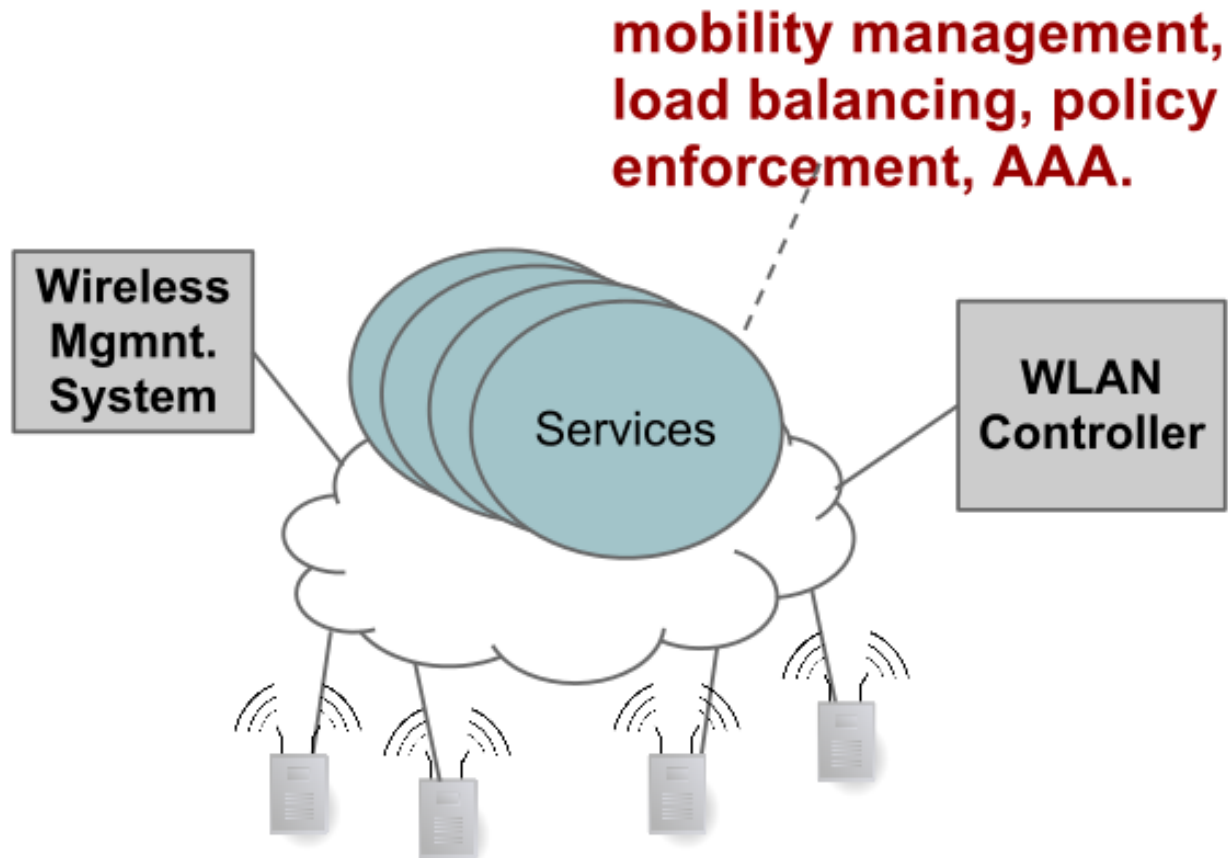


Enterprise WLANs

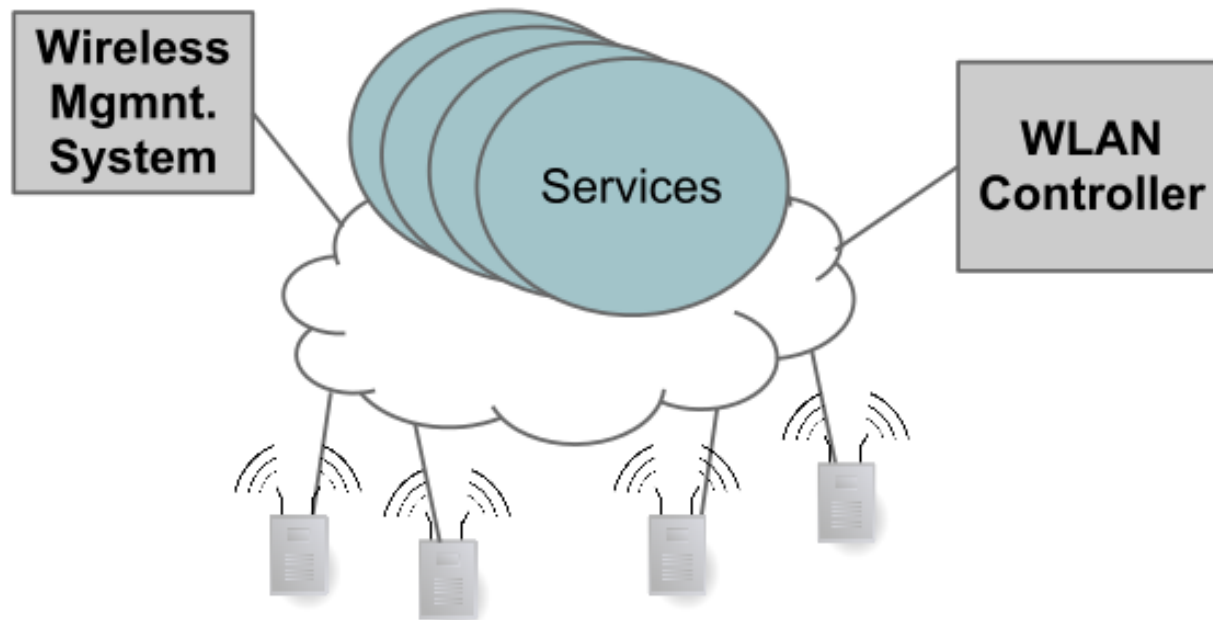
**Centralised
management**



Enterprise WLANs

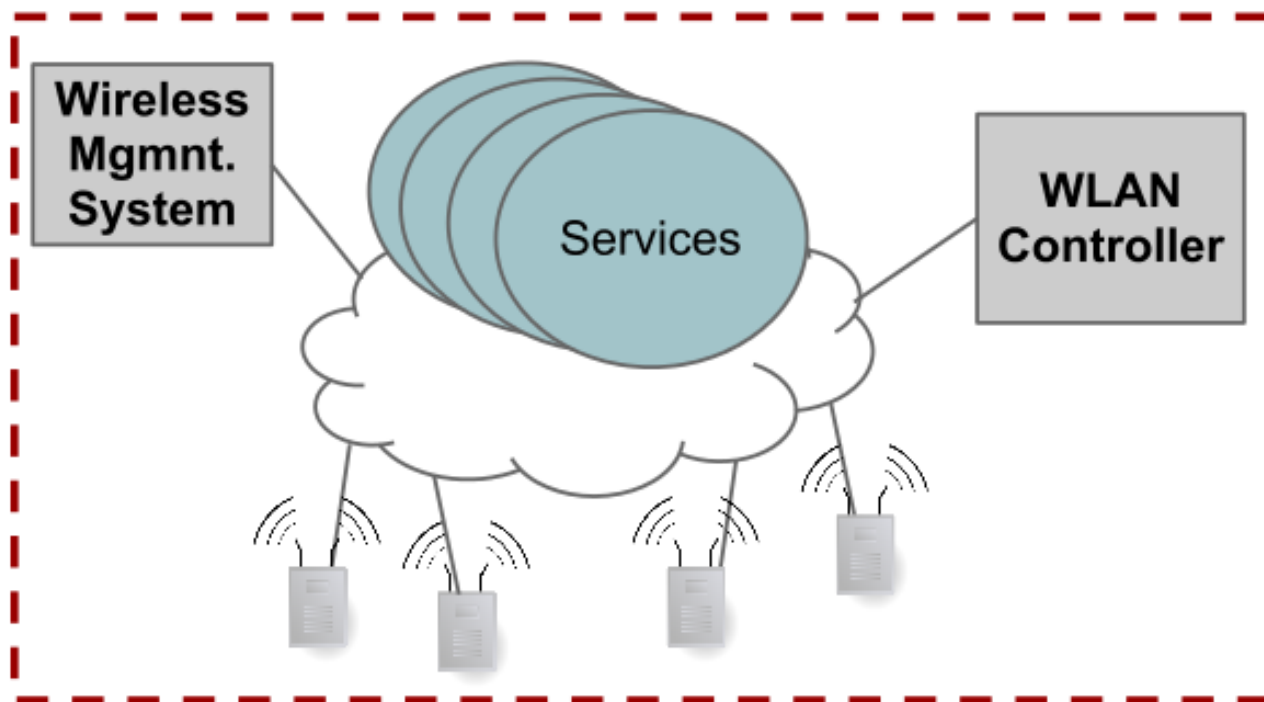


Vendor Solutions?

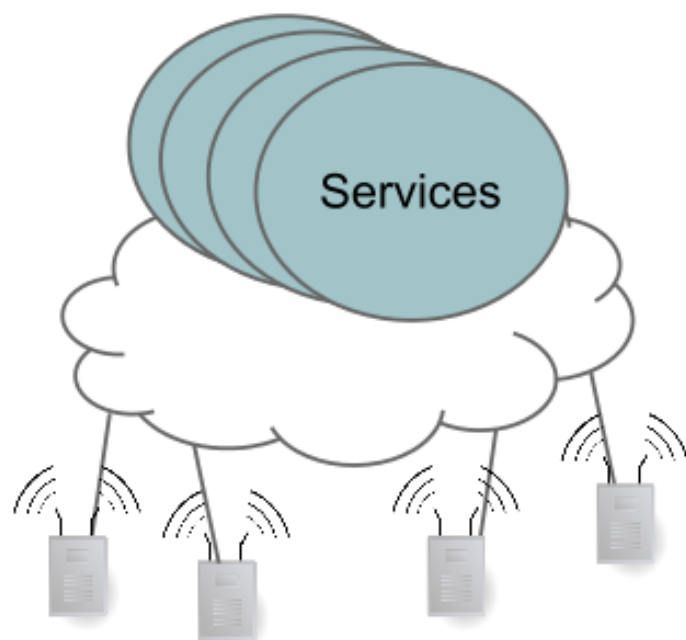


Vendor Solutions?

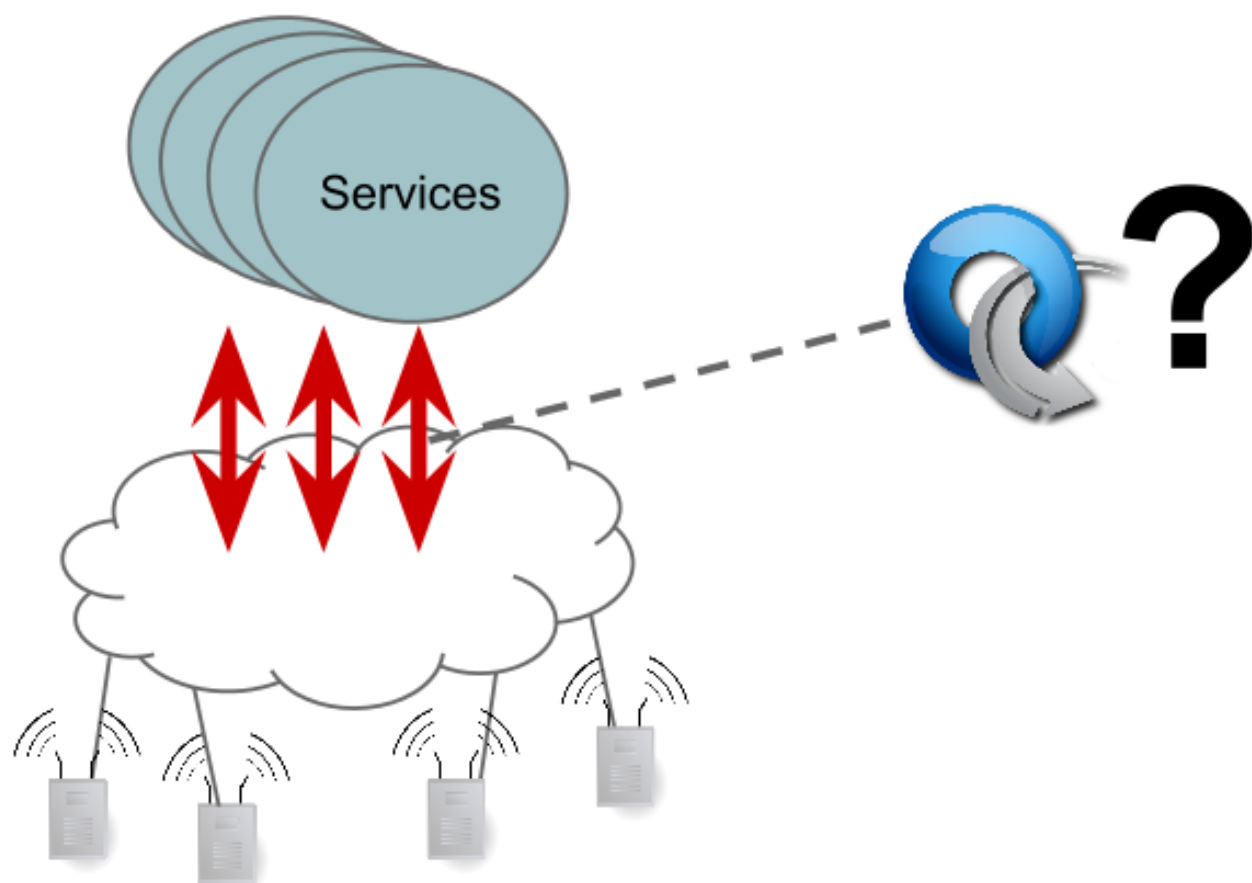
Vendor lock-in, inflexibility



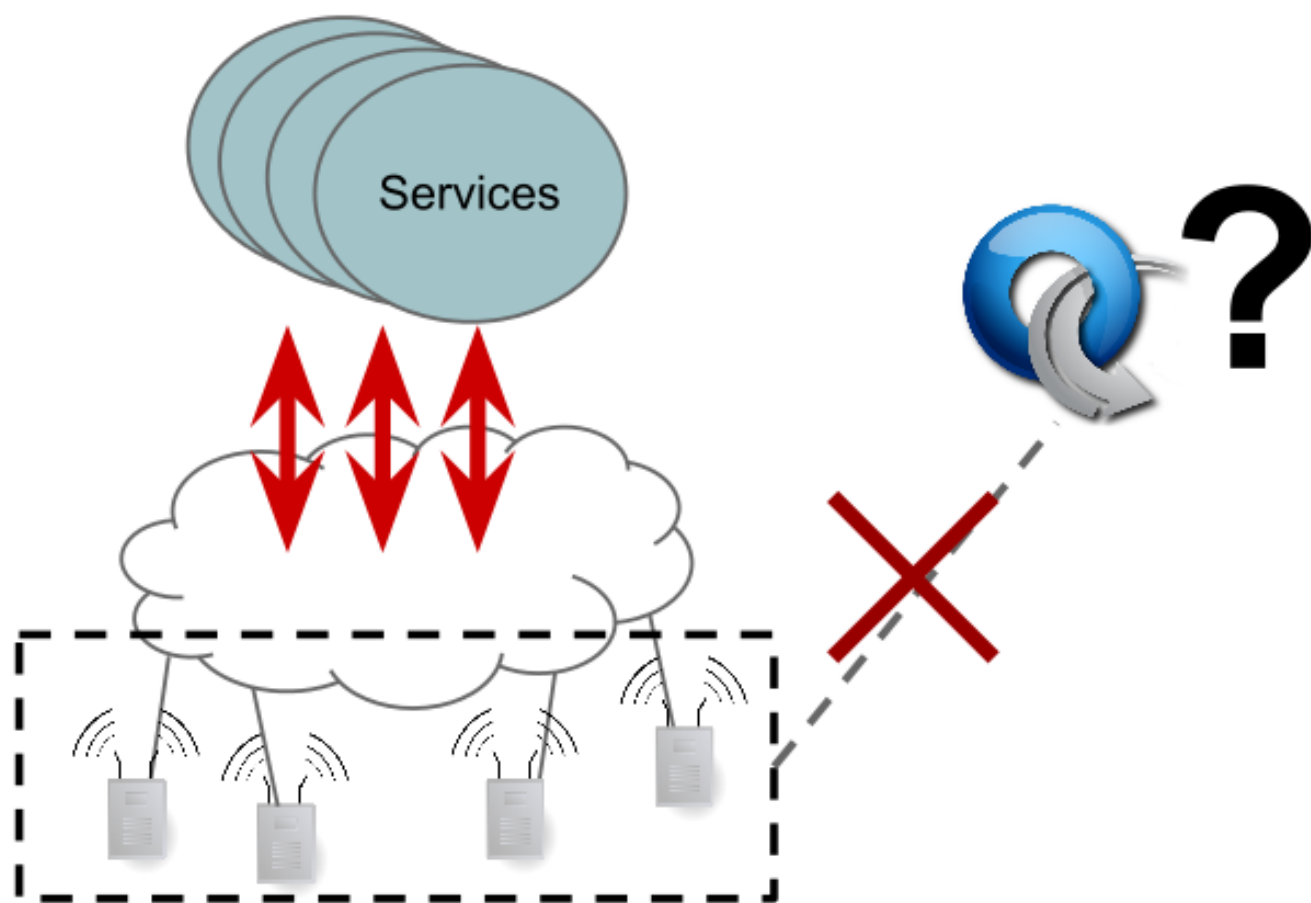
Network "apps" for Enterprise WLANs?



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Network "apps" for Enterprise WLANs?



Objective

**Enterprise WLAN services as
network "apps"**

Requirements

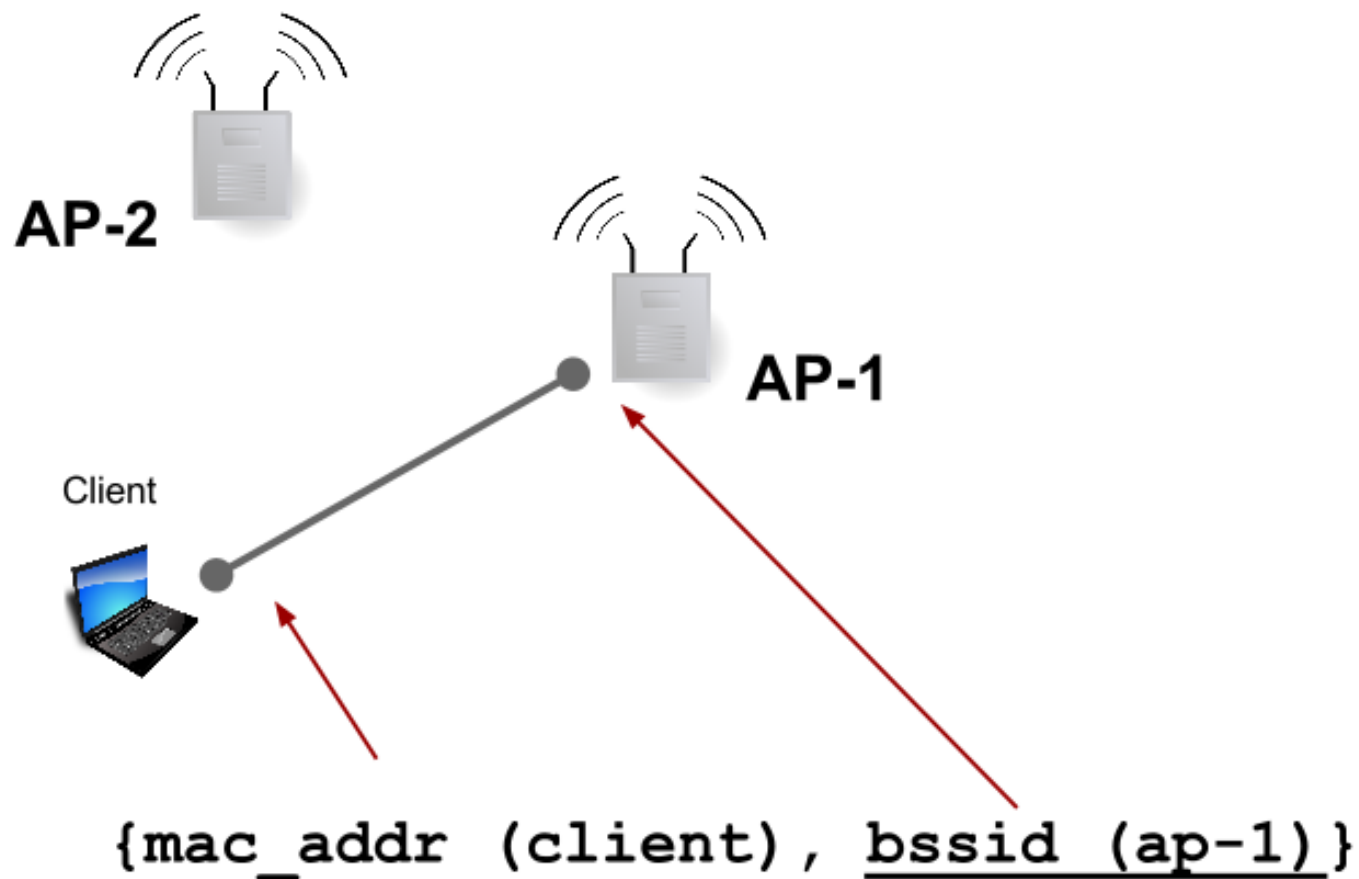
1. Do not modify 802.11 clients

(Clients = 802.11 STA in Infrst. mode, compatibility with WPA2 Enterprise)

2. Simplified programming model

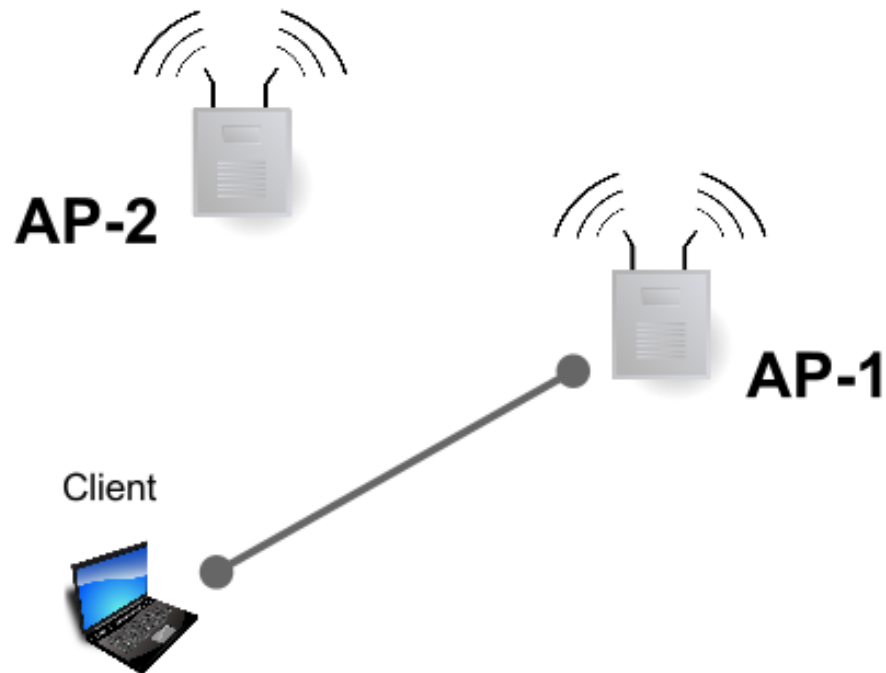
Light Virtual Access Points (LVAPs)

802.11 Association



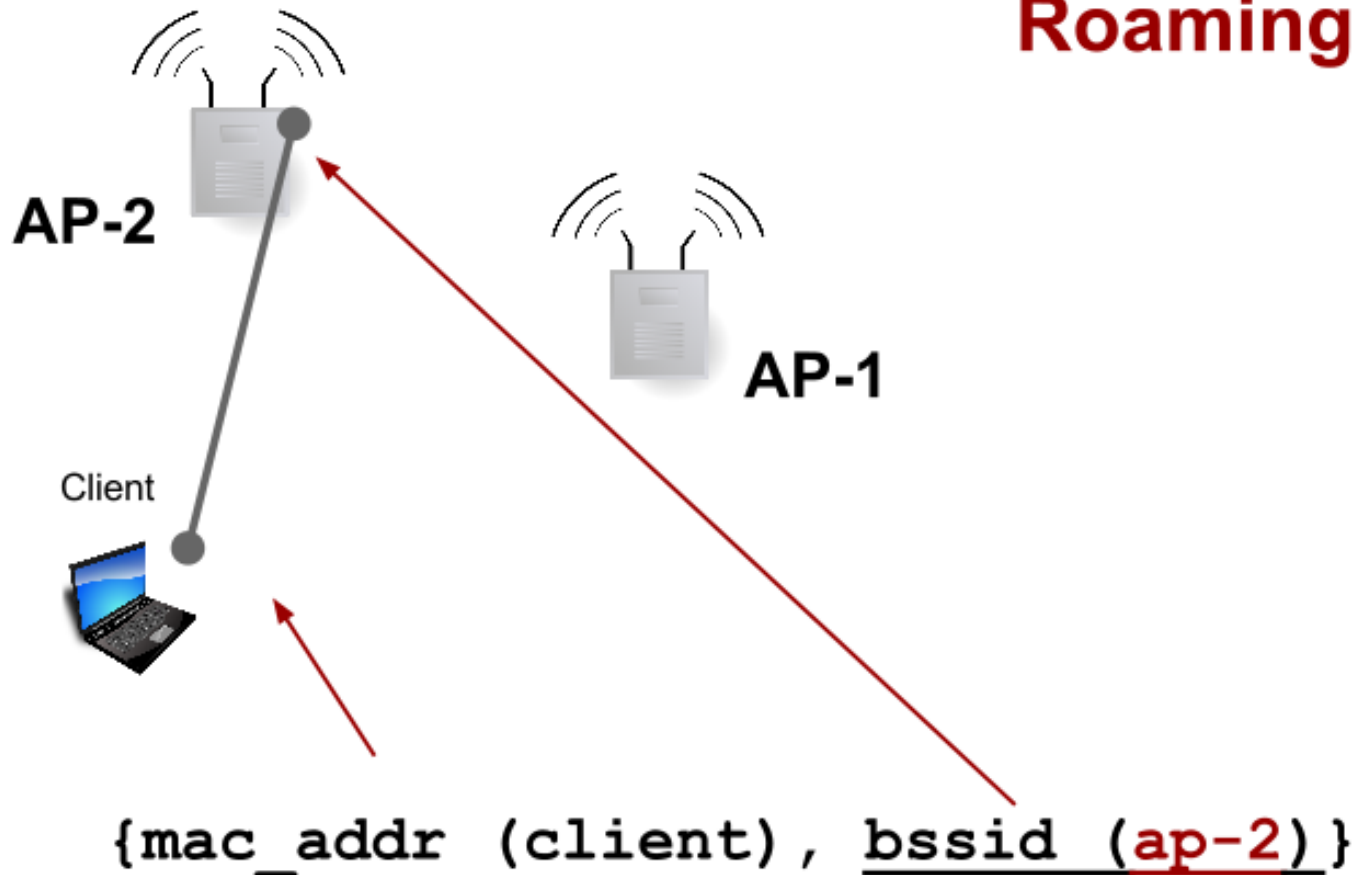
802.11 Association

Roaming client?

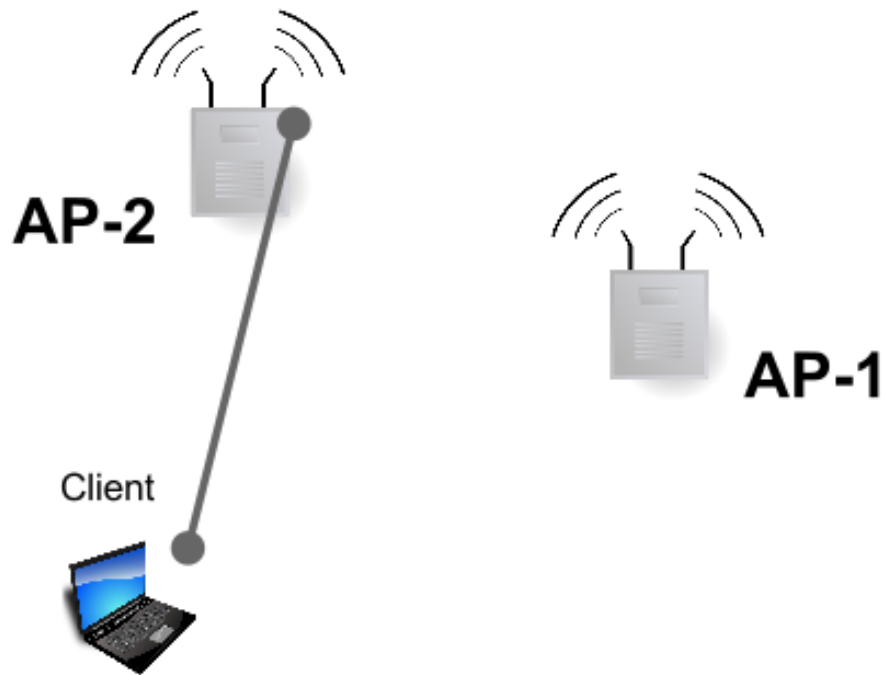


802.11 Association

Roaming client?



802.11 Association

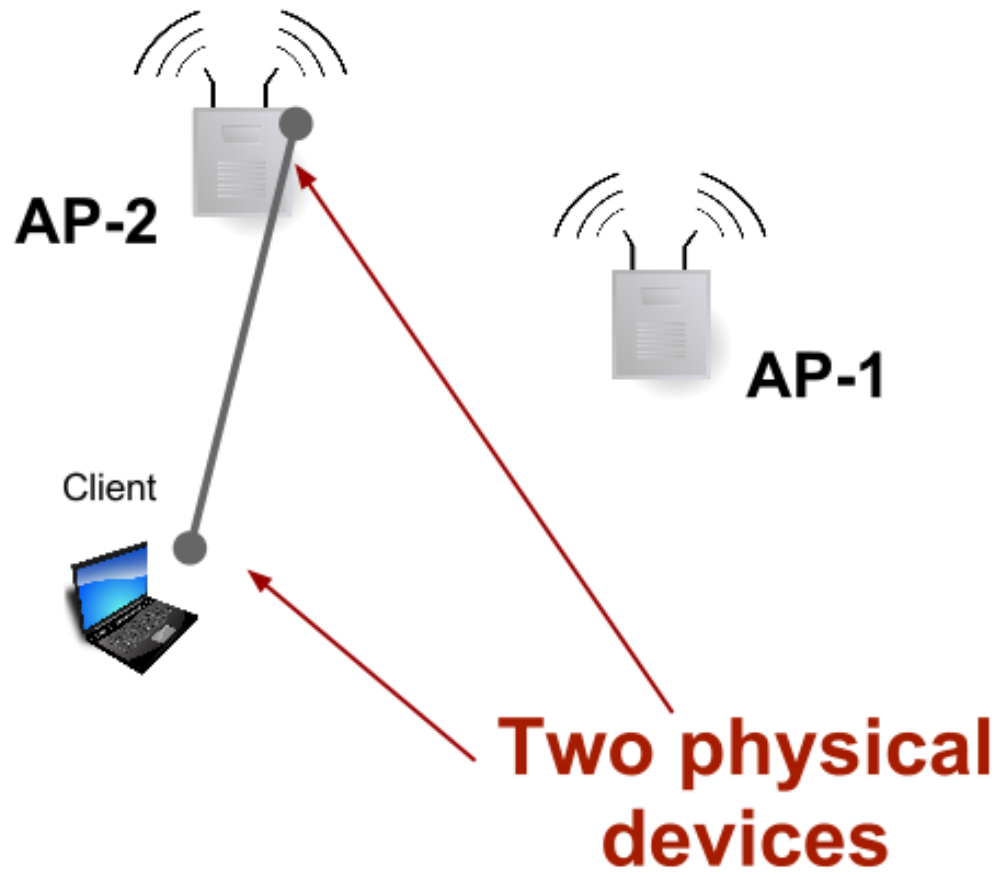


Roaming client?

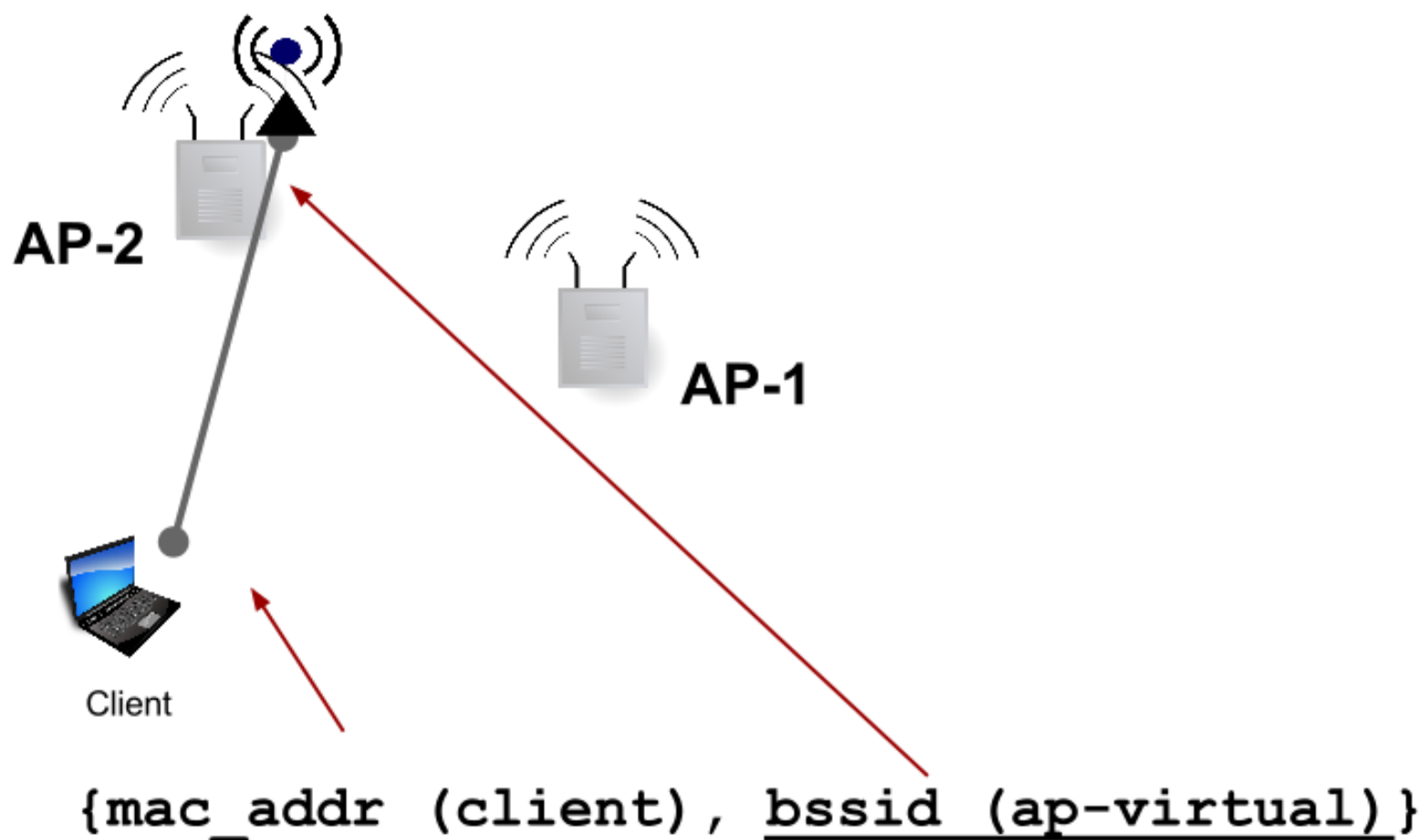
**Avoiding handoff
delay?**

**Control on
client's
association?**

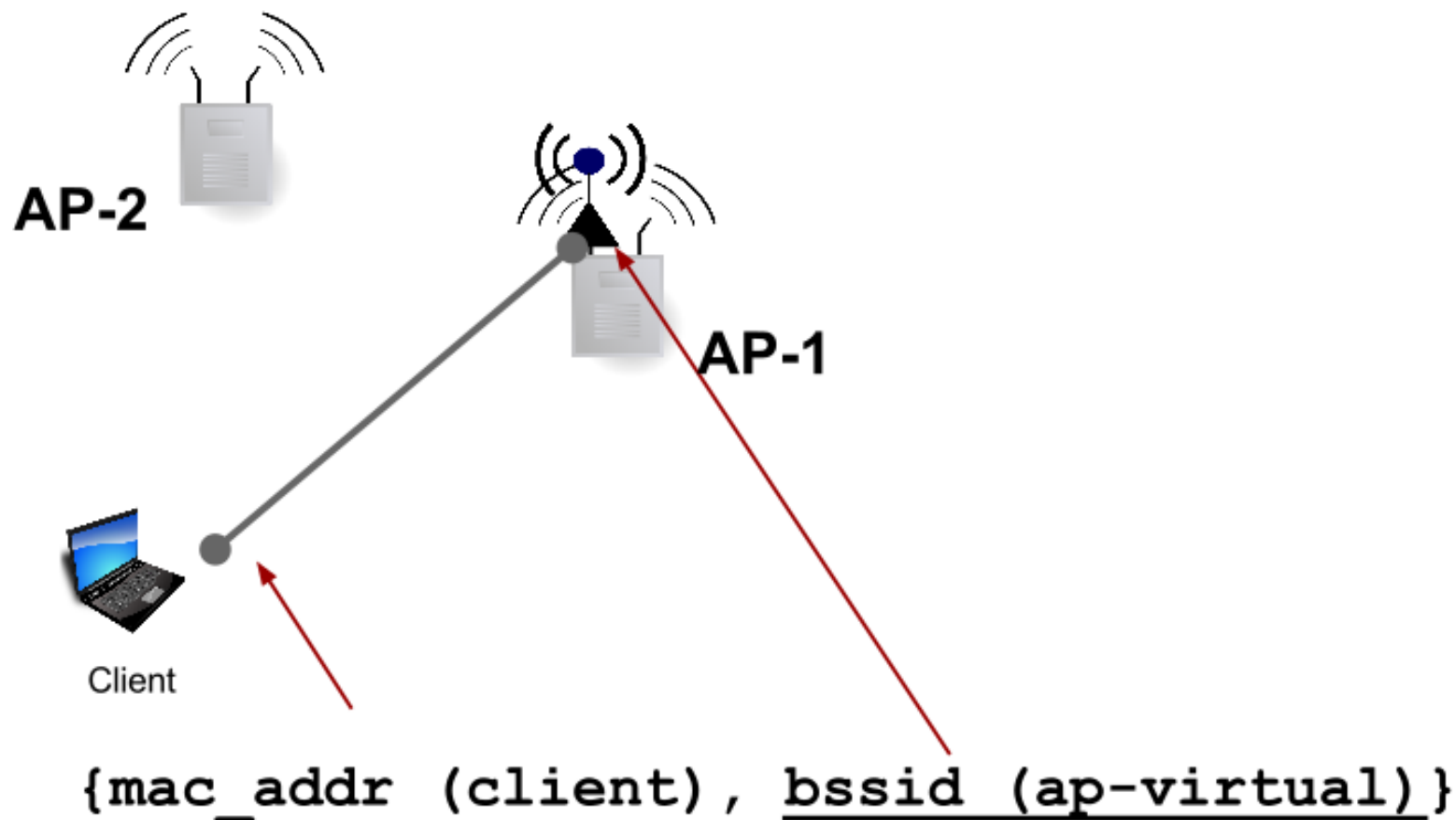
802.11 Association



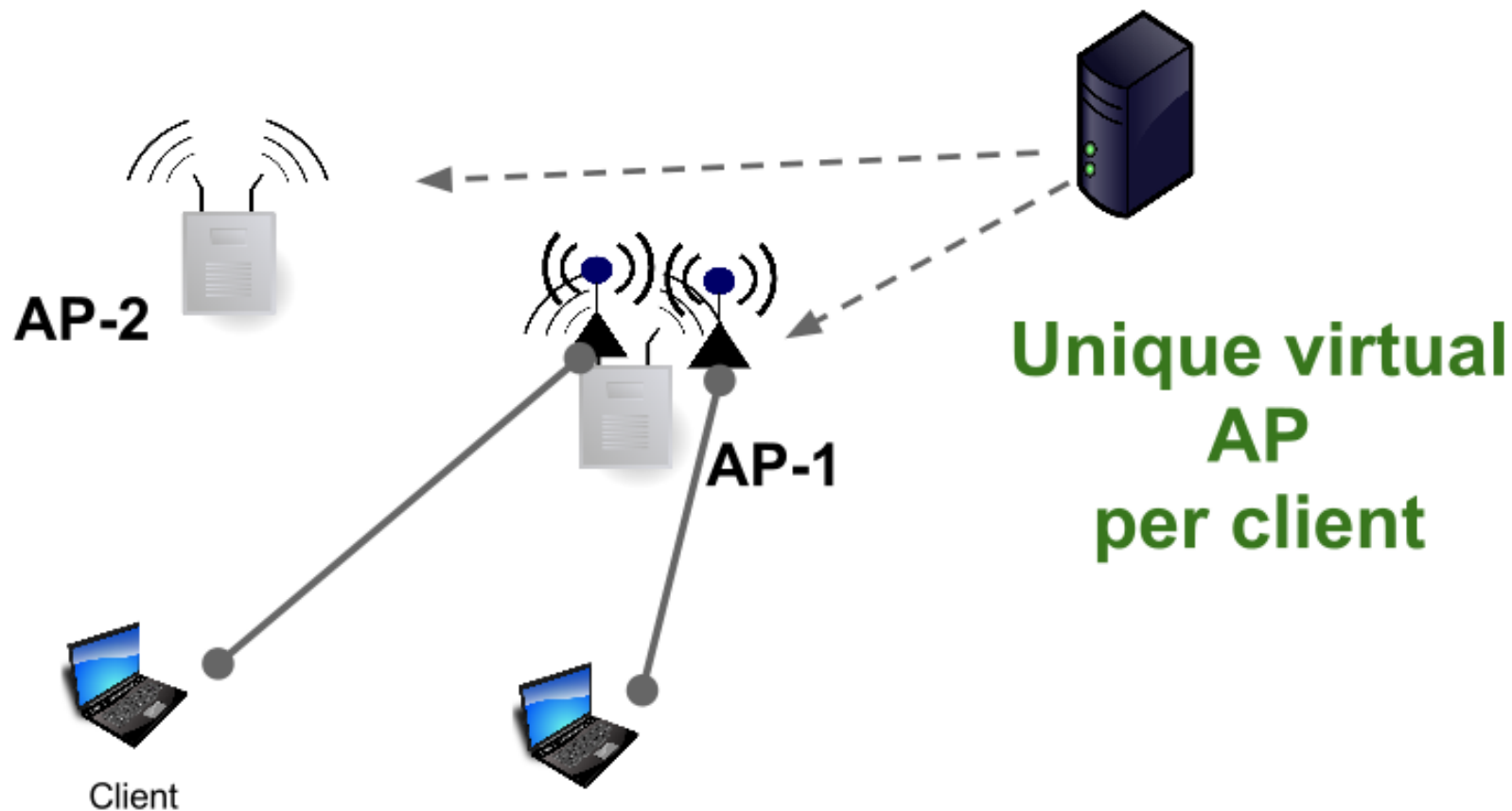
s / physical-AP / LVAP



s / physical-AP / LVAP



s / physical-AP / LVAP



LVAP =>

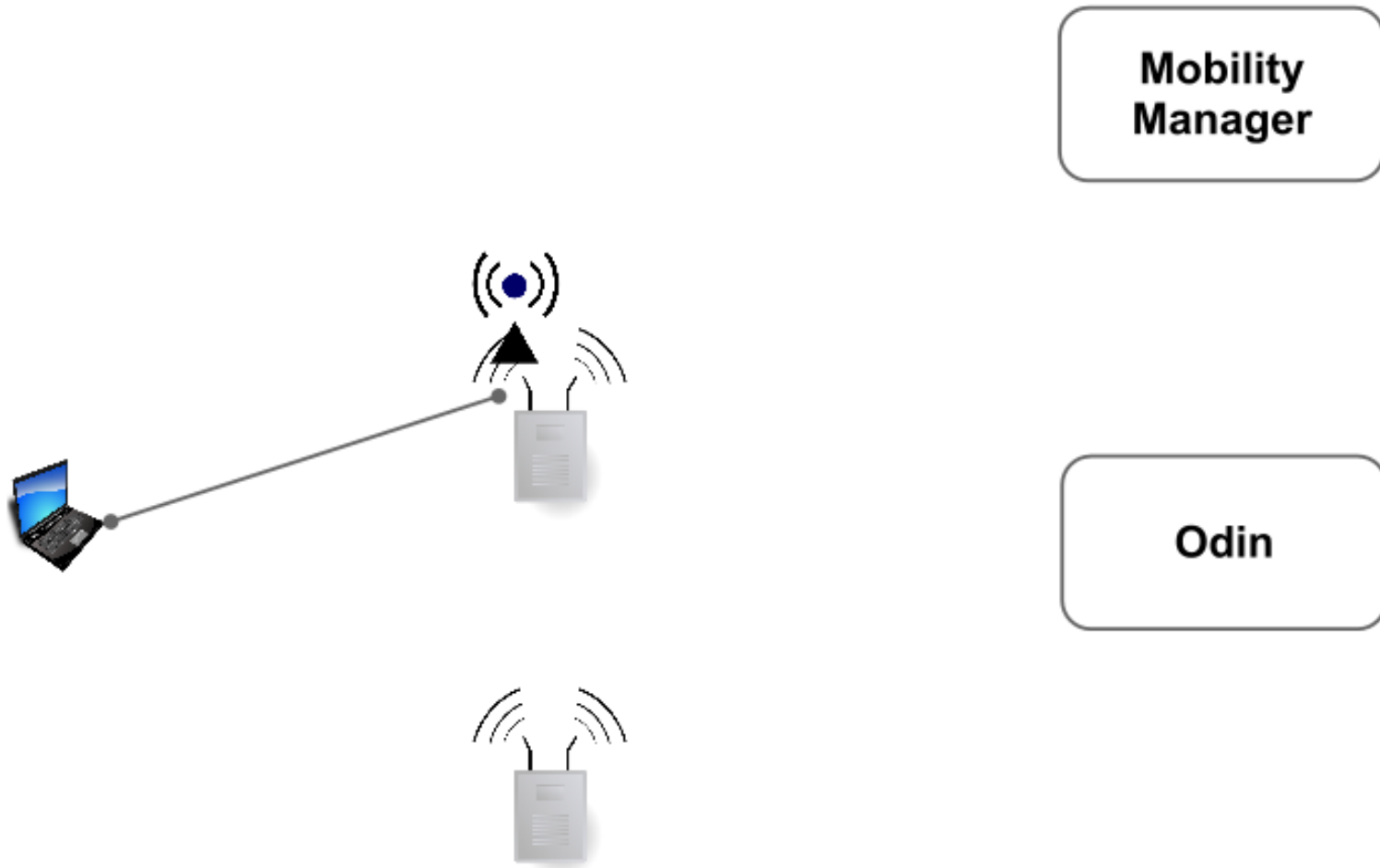
LVAP Migration == Handoff

(+) No protocol messages triggered

Fixed link between client and n/w

Using LVAPs for writing n/w apps with Odin

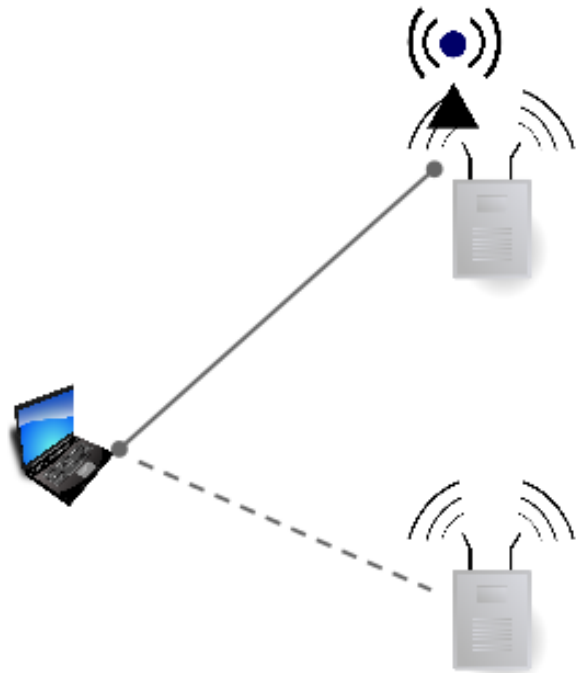
Odin Application Example



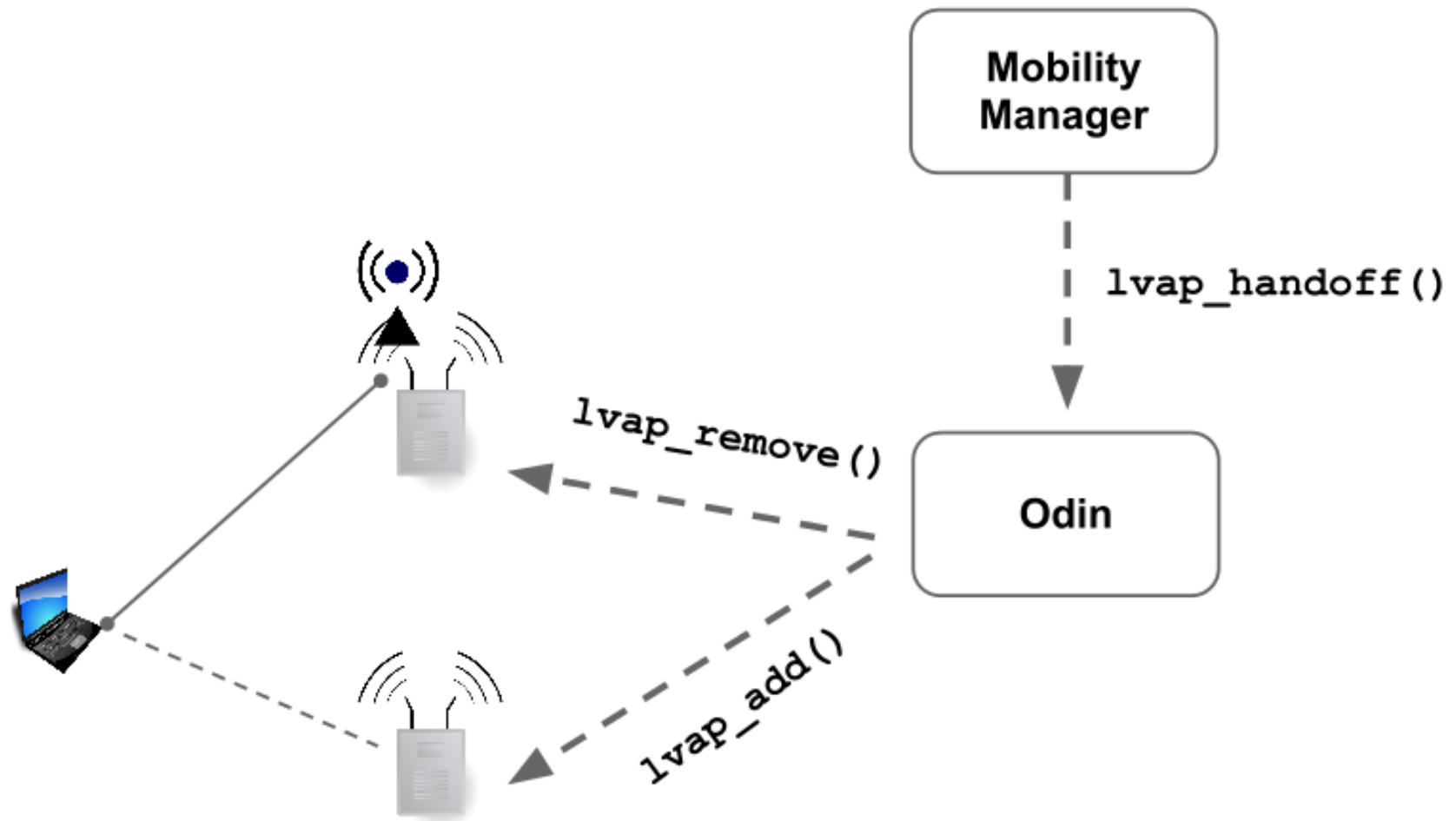
Odin Application Example

**Mobility
Manager**

Odin



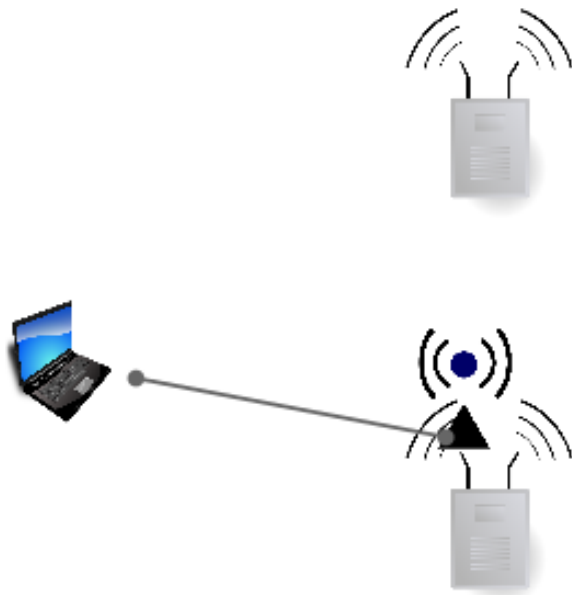
Odin Application Example



Odin Application Example

**Mobility
Manager**

Odin



More examples

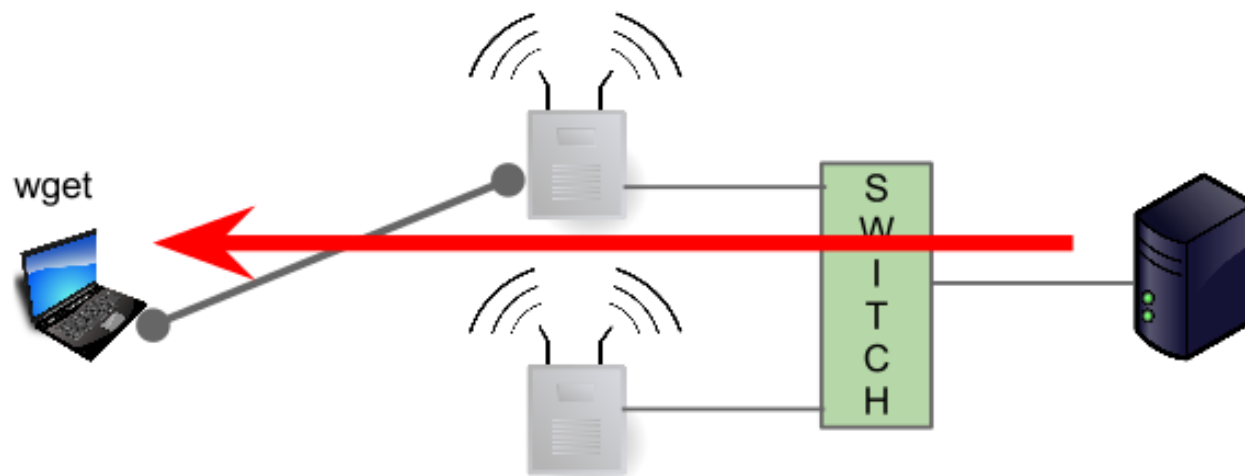
Re-association based Load Balancing

Offloading clients for energy saving

Evaluation

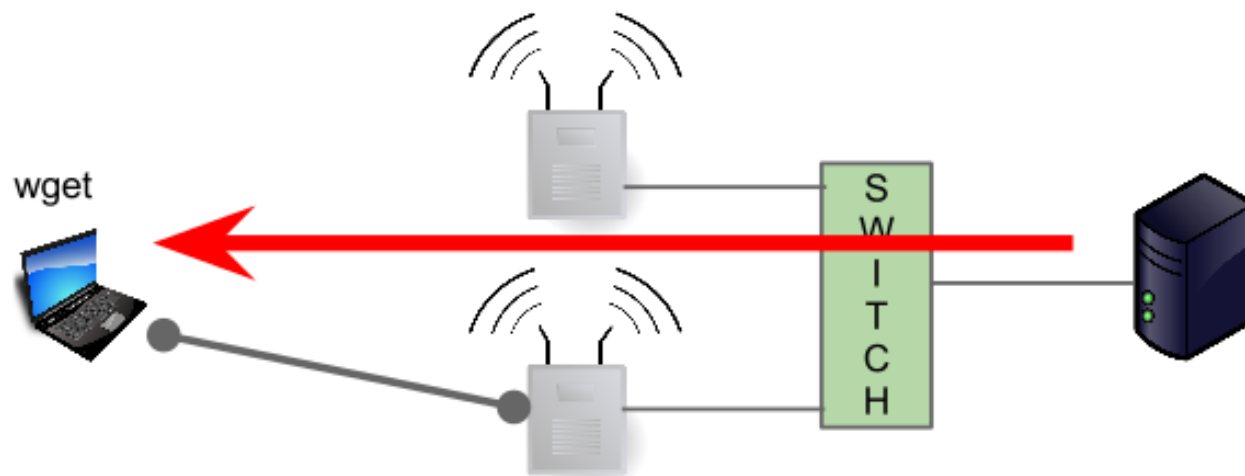
Are LVAPs feasible?

LVAP Handoff Experiment



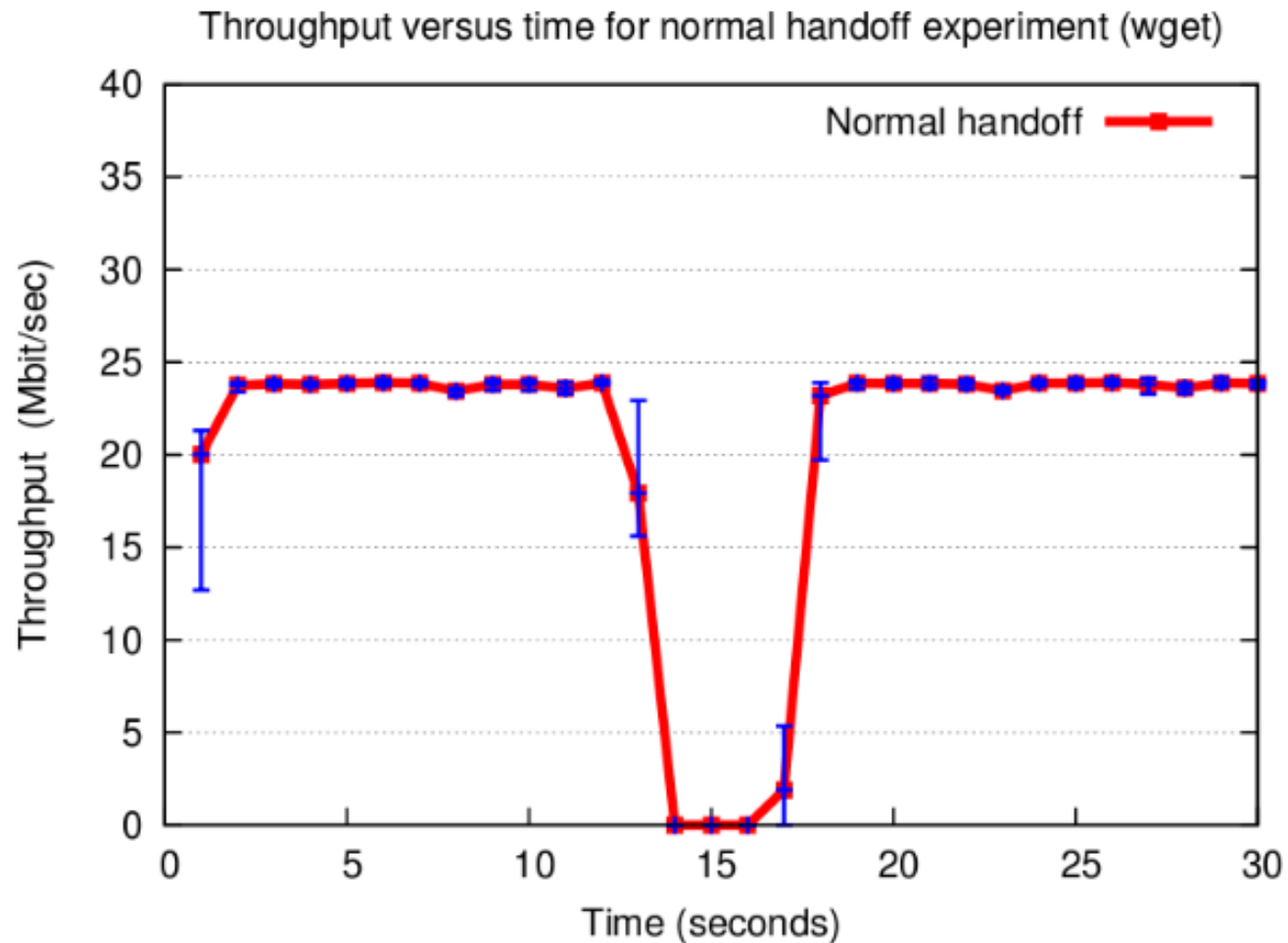
- APs in 5Ghz channel, open authentication
- Client does HTTP download
- Perform a single handoff in regular 802.11 and Odin settings
- Observe throughput drop

LVAP Handoff Experiment

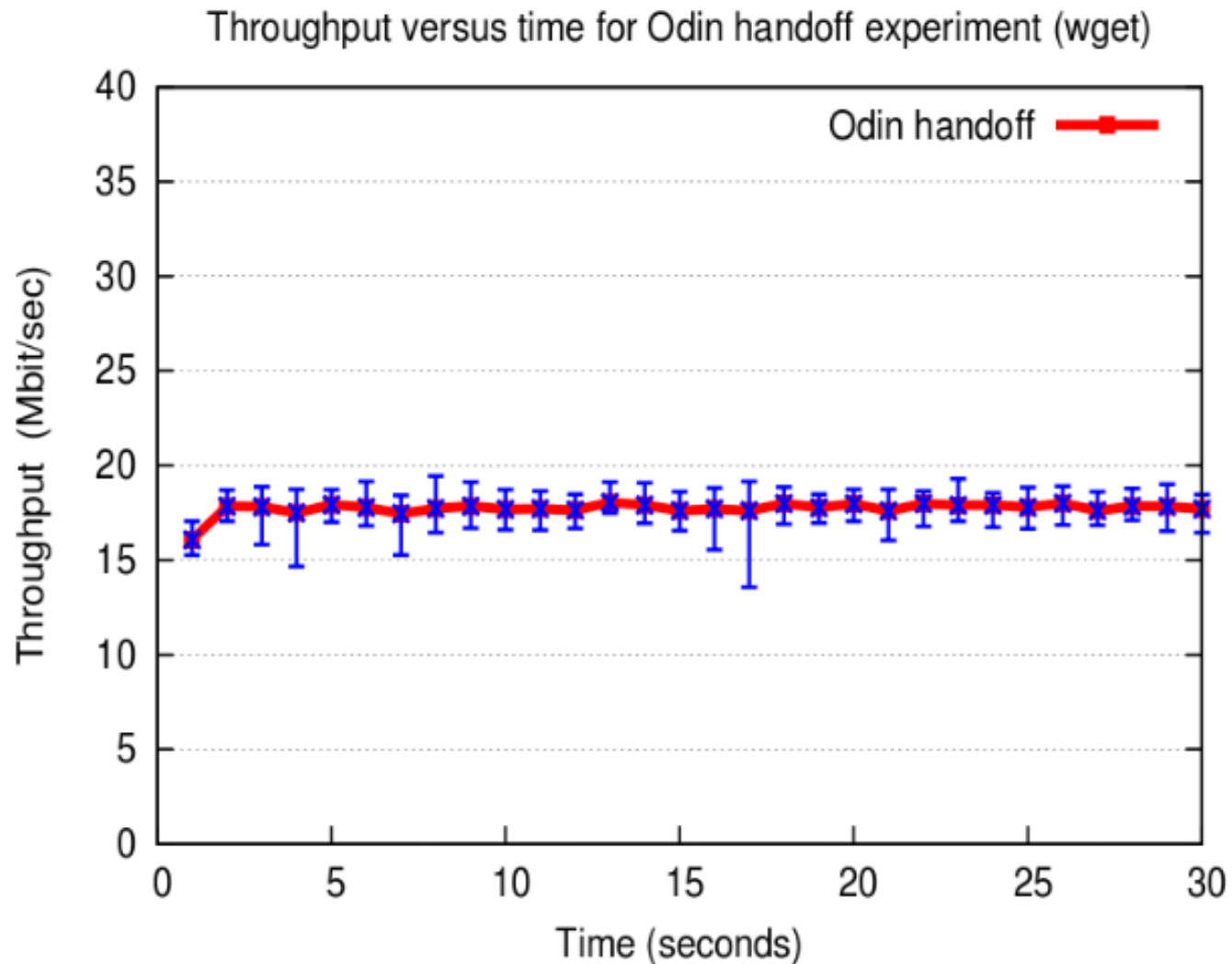


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Regular 802.11



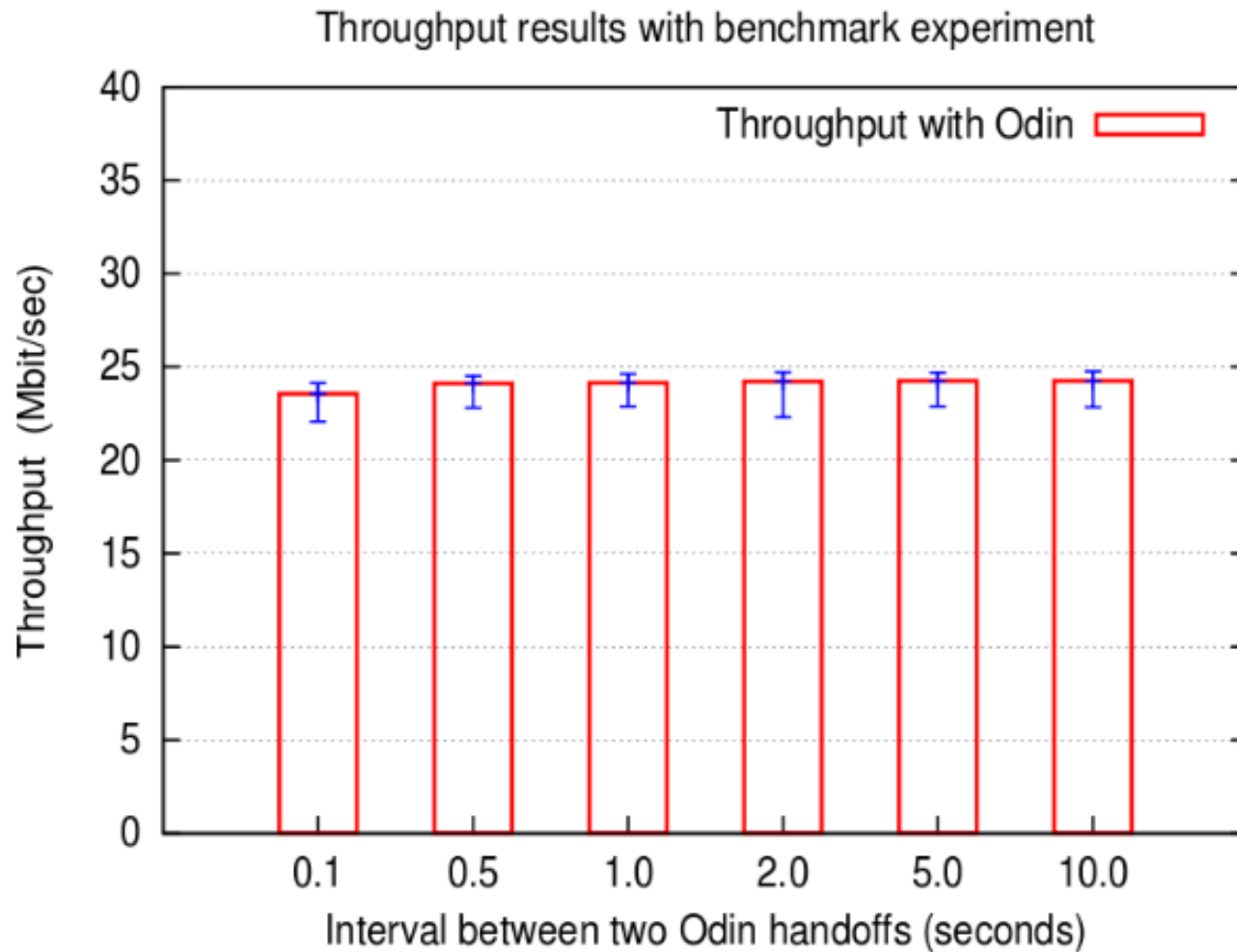
LVAP-handoff (Odin)



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



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)!)

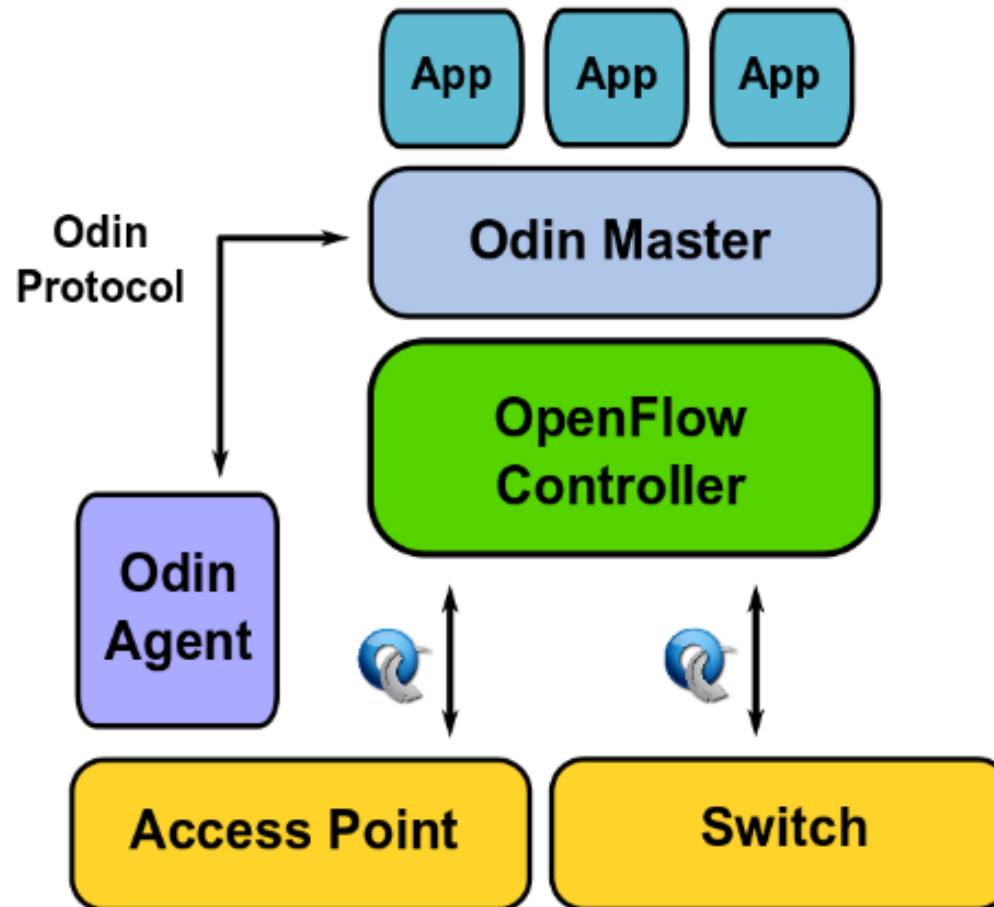


github.com/lalithsuresh/odin



bowl.tu-berlin.de

Odin: High Level View



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
```


Towards SDN



Open Interfaces



"Network Applications"