Wi-Fi Peer-to-Peer on Linux

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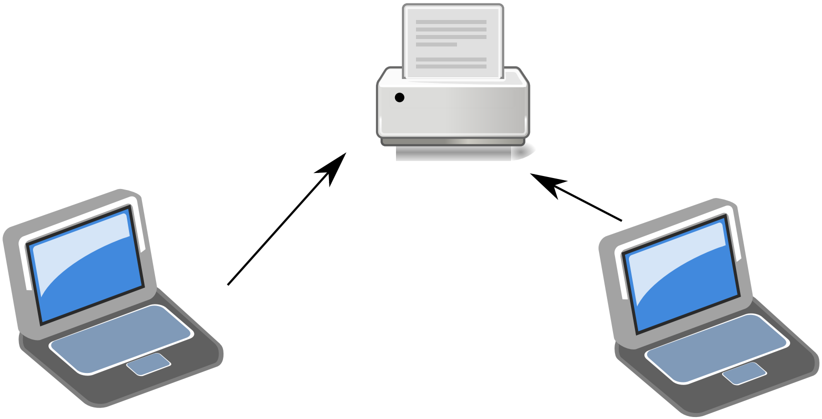
Introduction – P2P vs. Wi-Fi Direct?

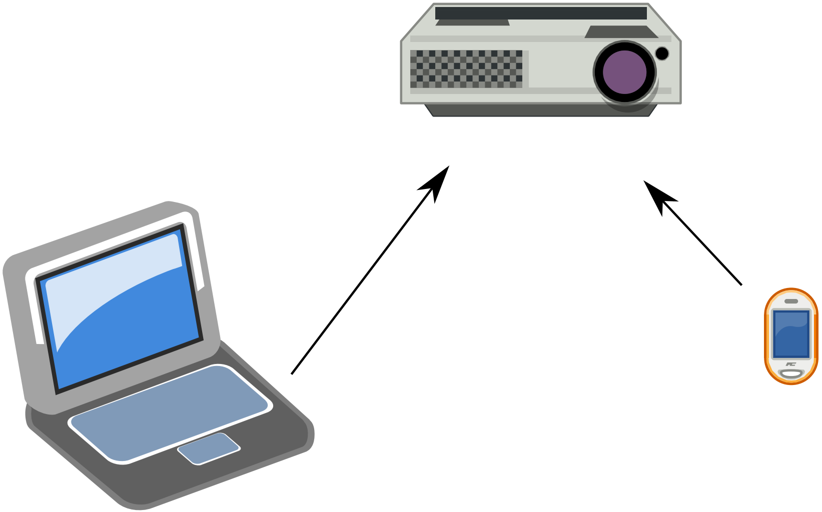
- Wi-Fi Peer-to-Peer (P2P): technology, technical specification
- Wi-Fi Direct: marketing and certification

Linux: use P2P term, certification is not upstream's job

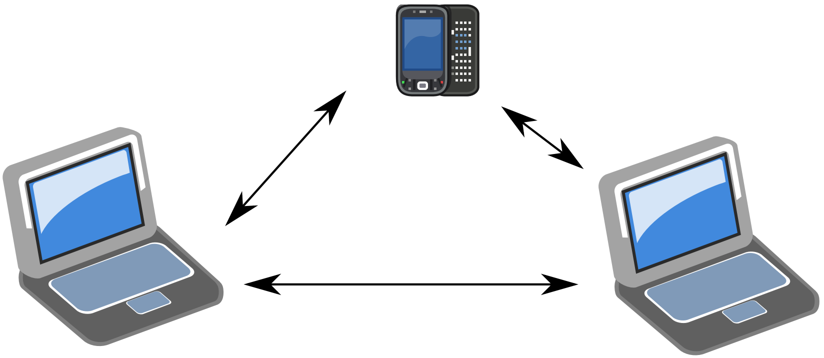
Introduction – Use cases



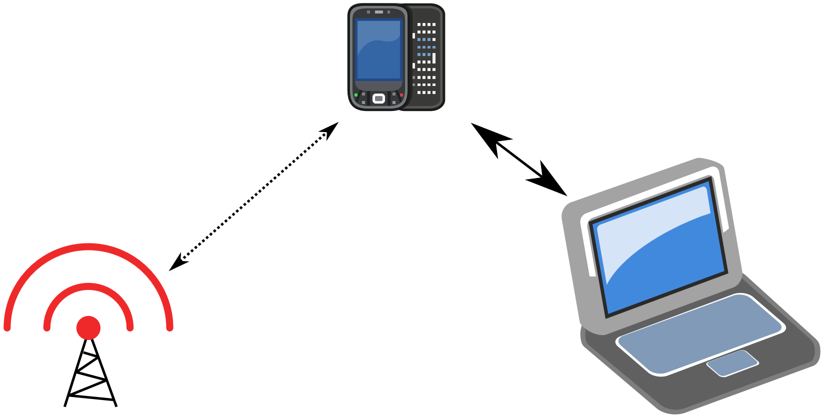
Introduction – Use cases



Introduction – Use cases



Introduction – Use cases



Introduction – Specification

Current draft is v1.0.16, available for members and for sale, built using

- vendor-specific primitives in IEEE 802.11
- WPA2
- Wi-Fi Simple Configuration

some terminology

- P2P Group
- P2P Device
- P2P Group Owner (GO)
- P2P Client
- “legacy” device

Device discovery

- for speed: only on social channels 1, 6, 11
- probe request/response mechanism
- search: device scans (on social channels)
- listen: device listens for probe requests

Group formation

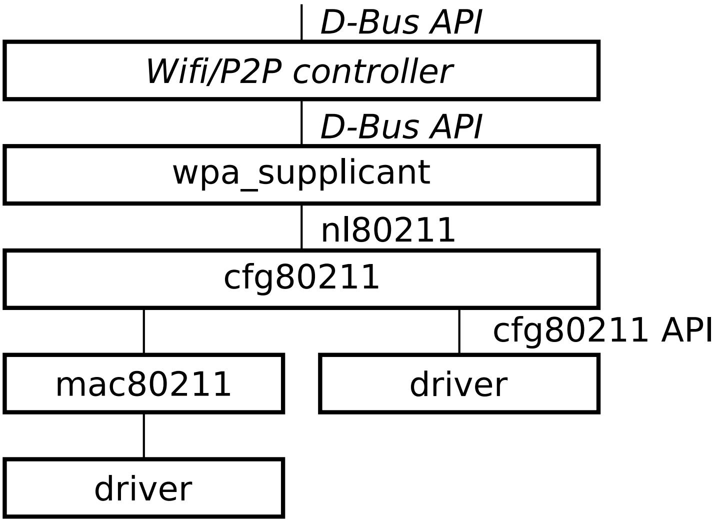
- GO negotiation
- provisioning (WSC)
- autonomous P2P group

Invitation

- ask a P2P device to join an existing group
- invitation could be by GO
- device may invite another device into the group it is part of
- also used to invoke persistent group

Some details

- Group's SSID: "DIRECT-XY[postfix]"
- P2P wildcard: "DIRECT-"
- GO appears as AP to legacy devices
- P2P IEs convey name, device capabilities
- enhanced powersave (for GO)


D-Bus API
Wifi/P2P controller
D-Bus API
wpa_supplicant
nl80211
cfg80211
cfg80211 API
mac80211
driver
driver

Implementation

mac80211

- must support AP and STA modes
- must receive probe requests

cfg80211

- must also support cfg80211 APIs

Implementation

- remain on channel
- management frame RX/TX
- WIP: P2P listen/search offload
- WIP: off-channel management frame TX/RX

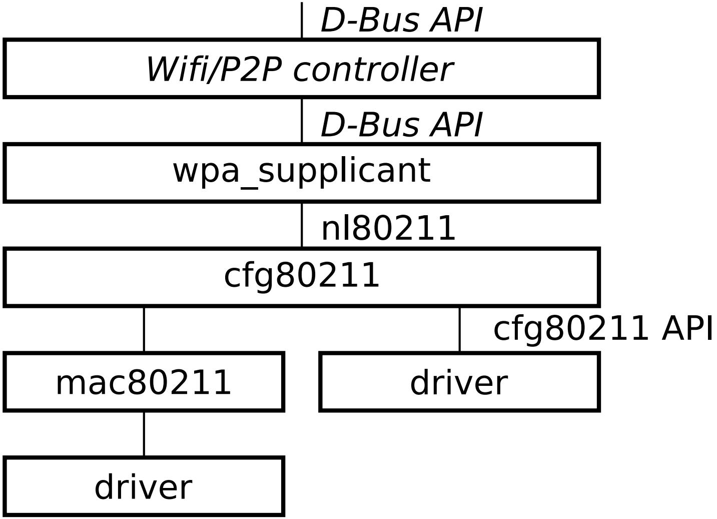
Implementation

- ability to insert IEs into e.g. probe requests
- off-channel for various use cases
- ability to hand certain frames to userspace for processing (e.g. probe request, action frames)
- implemented in mac80211, available to full-MAC drivers via cfg80211
- special APIs for optimisation

Implementation

- handles the entire P2P protocol
- provides primitives for all P2P operations
- provides service registration APIs
- provides APIs over D-Bus (WIP)

Implementation



Usage

What do we have now?

- primitives to create connections
- ability to advertise services
- ability to be discovered (when in find or listen state)

Usage

But ... we can’t actually use it from most applications.

- many applications controlling one wpa_supplicant?
- or even running their own instance of it?
- which determines P2P device name and similar properties?
- which runs DHCP client/server and manages network?

Application APIs – Overview

Applications are more concerned with

- enabling/disabling P2P
- registering a service (if offering one)
- UI to find/select a peer
- connections with peers
- releasing those connections

Application APIs – Problems

Such things could be implemented by applications with the primitives, but

- code duplication between apps
- could lead to conflicts between different P2P usages
- could lead to conflicts between P2P and “internet connection”
- could run into HW limitations

Application APIs – Consequence

As a consequence, management component needed:

- context aware between concurrent P2P usages
- can arbitrate concurrent P2P usages
- can make decisions about which primitives to use

Application APIs – Consequence

Management component closely coupled with connection manager

- single entity controlling wireless
- aware of all usage of a given device
- may need to be aware of P2P's enterprise management features
- could also manage multiple devices (if available)

Application APIs – Consequence

However: multiple connection managers exist

- NetworkManager (Gnome, KDE, ...)
- ConnMan
- FlimFlam
- Wicd?
- ...?

Application APIs – Proposed solution

- common, stable D-Bus API
- could become freedesktop.org specification
- implemented by connection manager or another middle layer
- applications can be independent of connection manager
- easily usable from many languages

Questions?

References

- Wi-Fi Peer-to-Peer (P2P) Technical Specification (Draft Version 1.0.16)
- http://wireless.kernel.org/

wpa_supplicant P2P primitives

- p2p_find
- p2p_stop_find
- p2p_connect
- p2p_listen
- p2p_group_remove
- p2p_group_add
- p2p_prov_disc
- p2p_get_passphrase
- p2p_serv_disc_req
- p2p_serv_disc_cancel_req
- p2p_serv_disc_resp
- p2p_service_update
- p2p_serv_disc_external
- p2p_service_flush
- p2p_service_add
- p2p_service_del
- p2p_reject
- p2p_invite
- p2p_peers
- p2p_peer
- p2p_set
- p2p_flush
- p2p_presence_req
- p2p_ext_listen