

Wi-Fi Direct to Hell

Andrés Blanco



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Whoami

Interests and expertise include network security, reverse engineering, and privacy. I enjoy playing with IEEE 802.11 security.

What?

Wi-Fi Direct specification defines the architecture and protocols to facilitate device-to-device connectivity based on the IEEE 802.11 infrastructure mode.

- Wi-Fi Direct can be used by an attacker to access a device.
- Devices supporting the protocol extend the IEEE 802.11 attack surface.

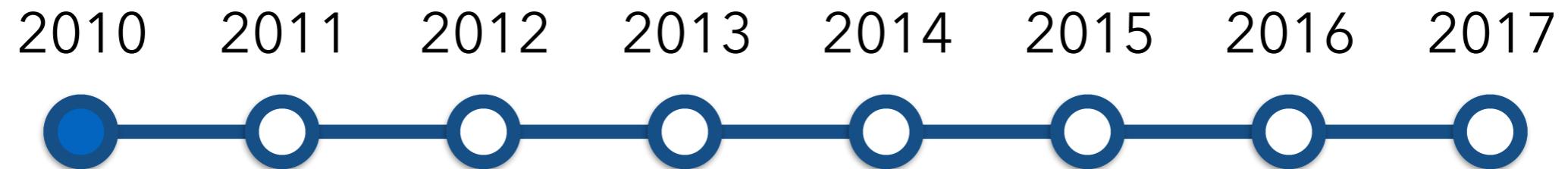
Why?

- There are several vendors that have implemented the protocol in an insecure way.

Wi-Fi Alliance

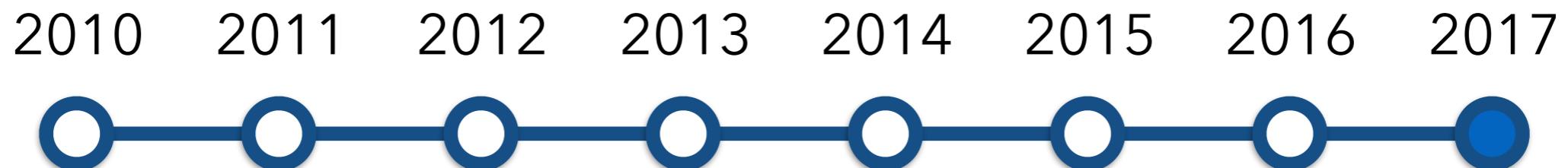
- WPS (Wi-Fi Protected Setup)
- Wi-Fi Display
- Wi-Fi Direct
- Hotspot 2.0

Wi-Fi Direct



First public release of the technical specification

Wi-Fi Direct

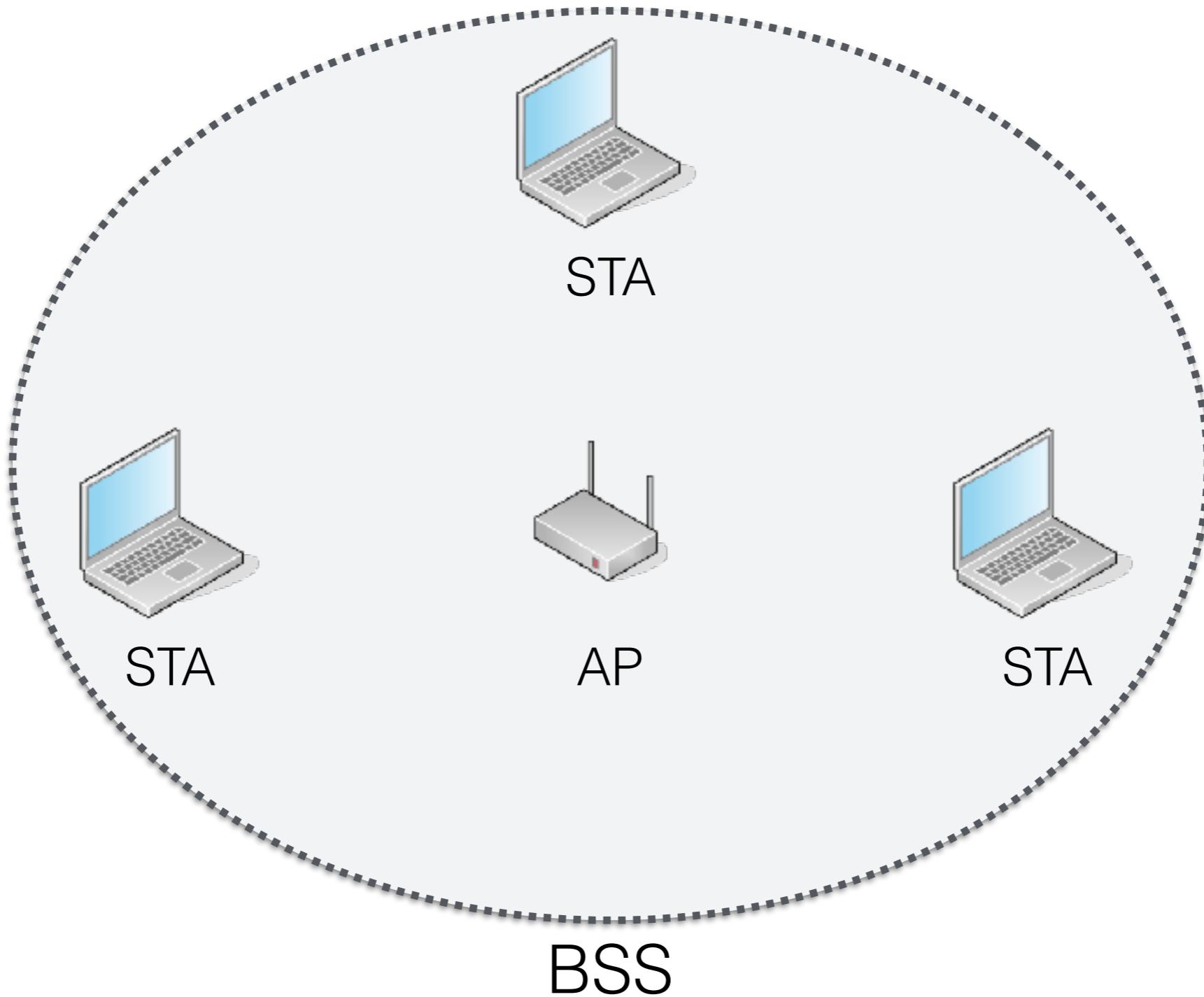


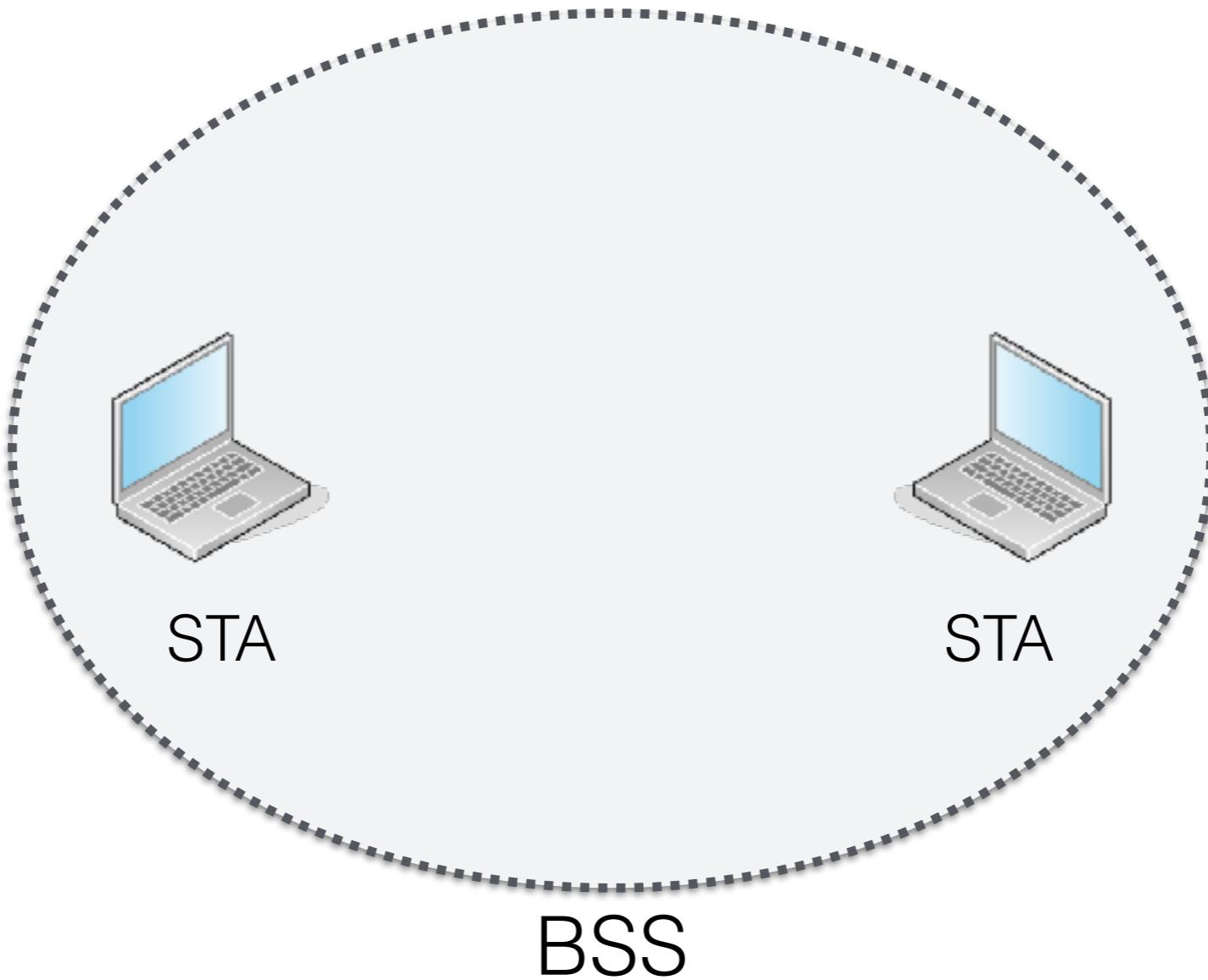
13280 Wi-Fi Direct certified products

Wi-Fi Direct

- P2P Discovery
- P2P Group Operations
- P2P Legacy Support

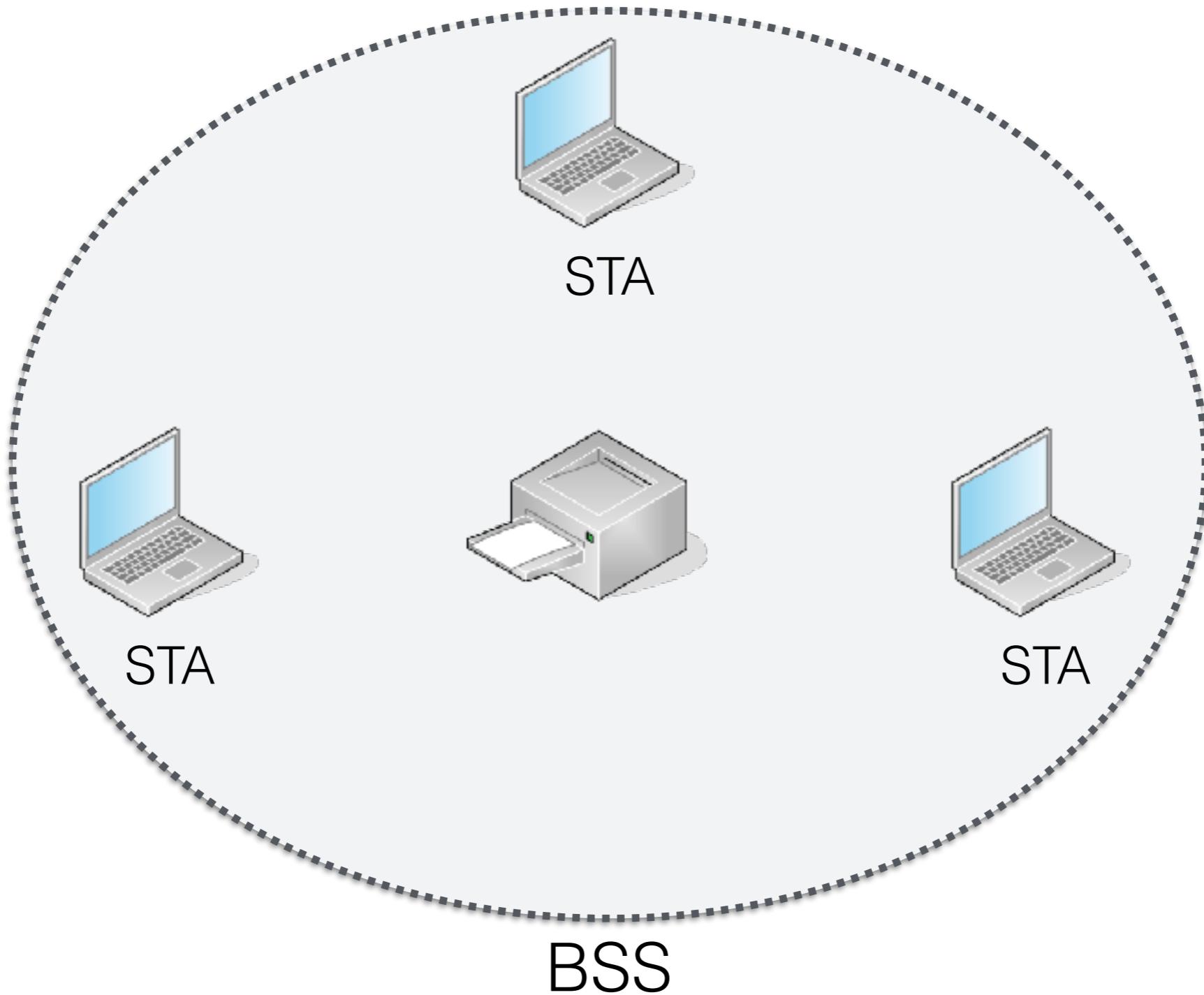
Infrastructure Mode



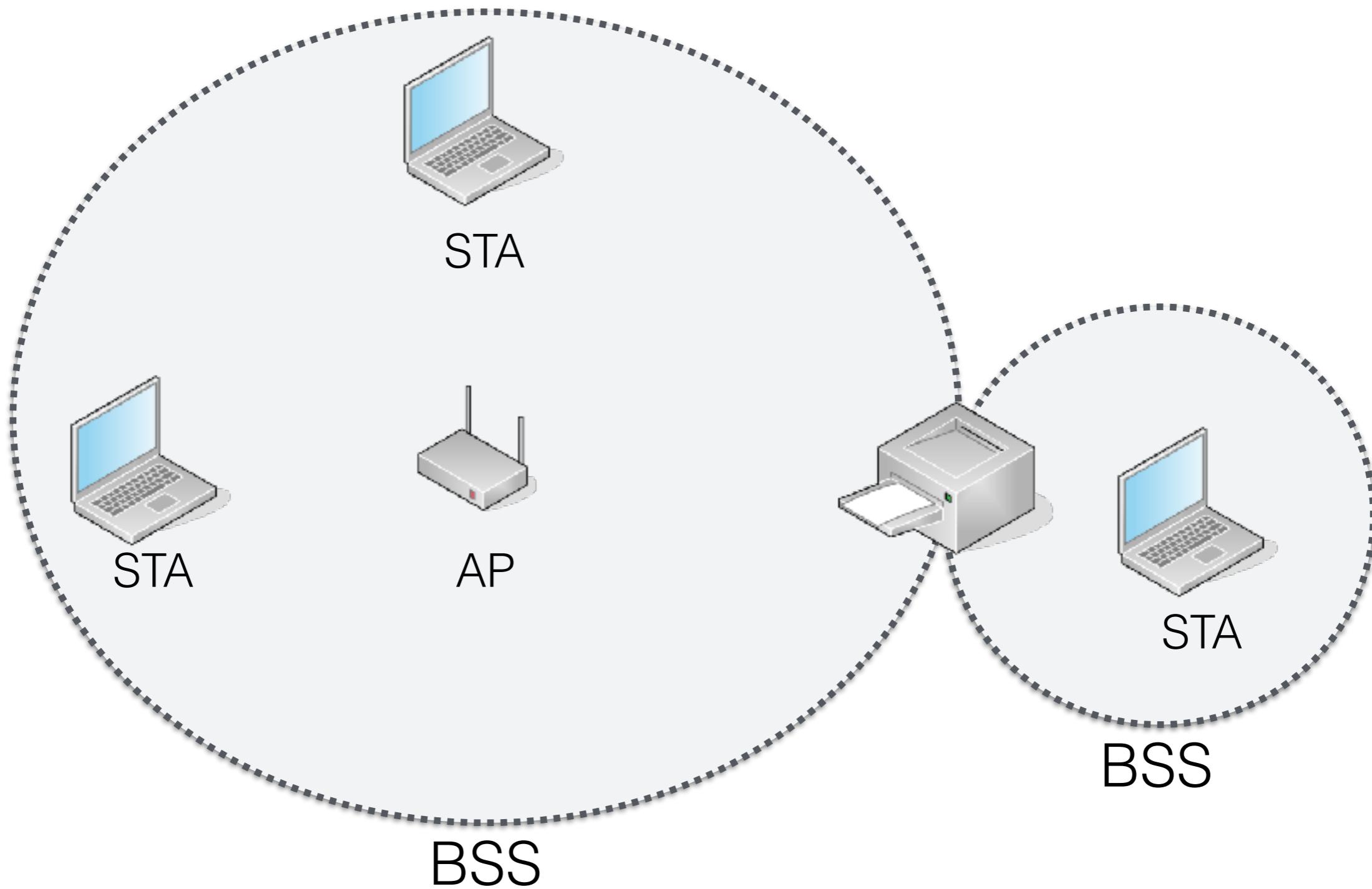


Ad Hoc Mode

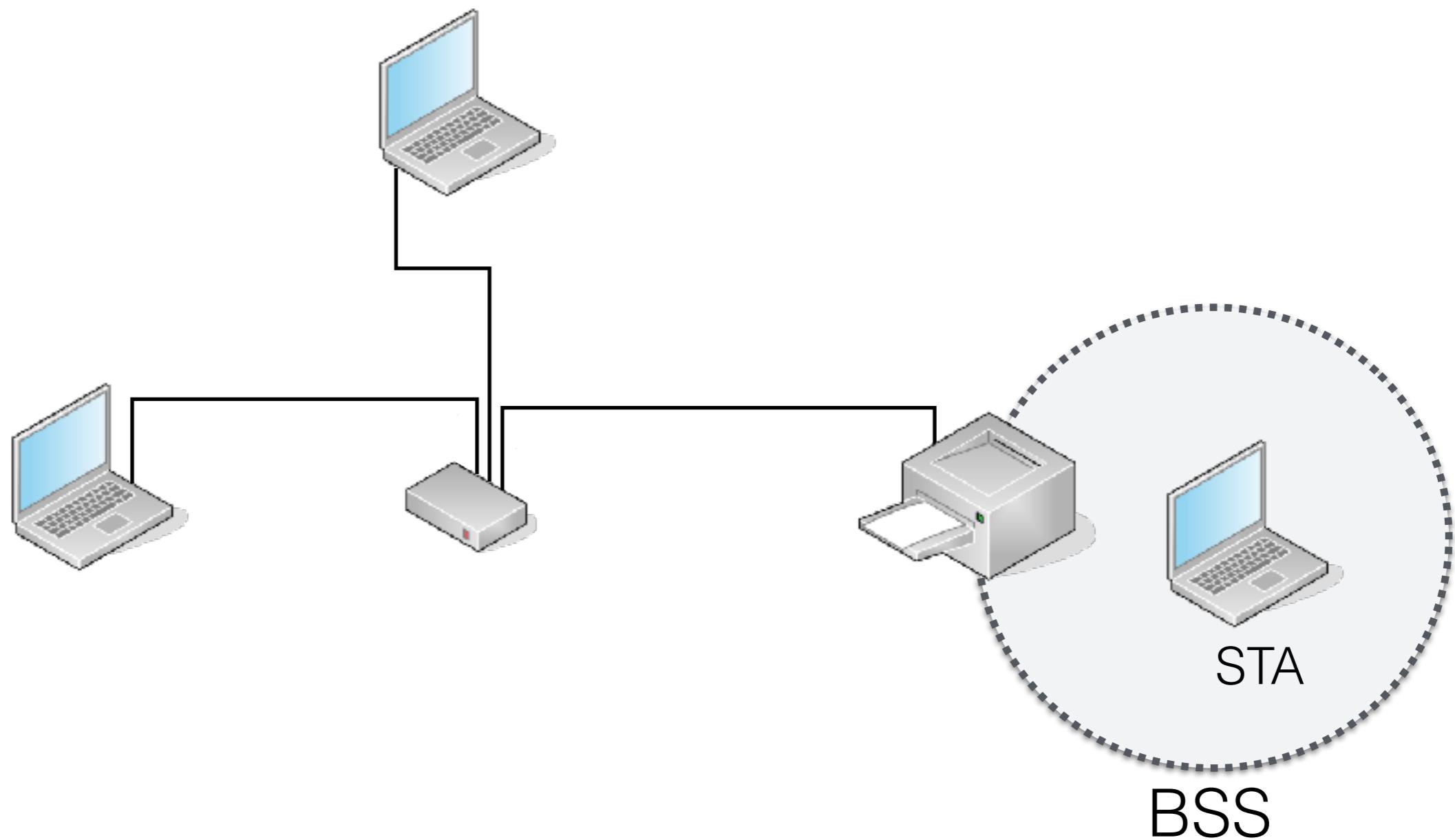
Wi-Fi Direct



Wi-Fi Direct

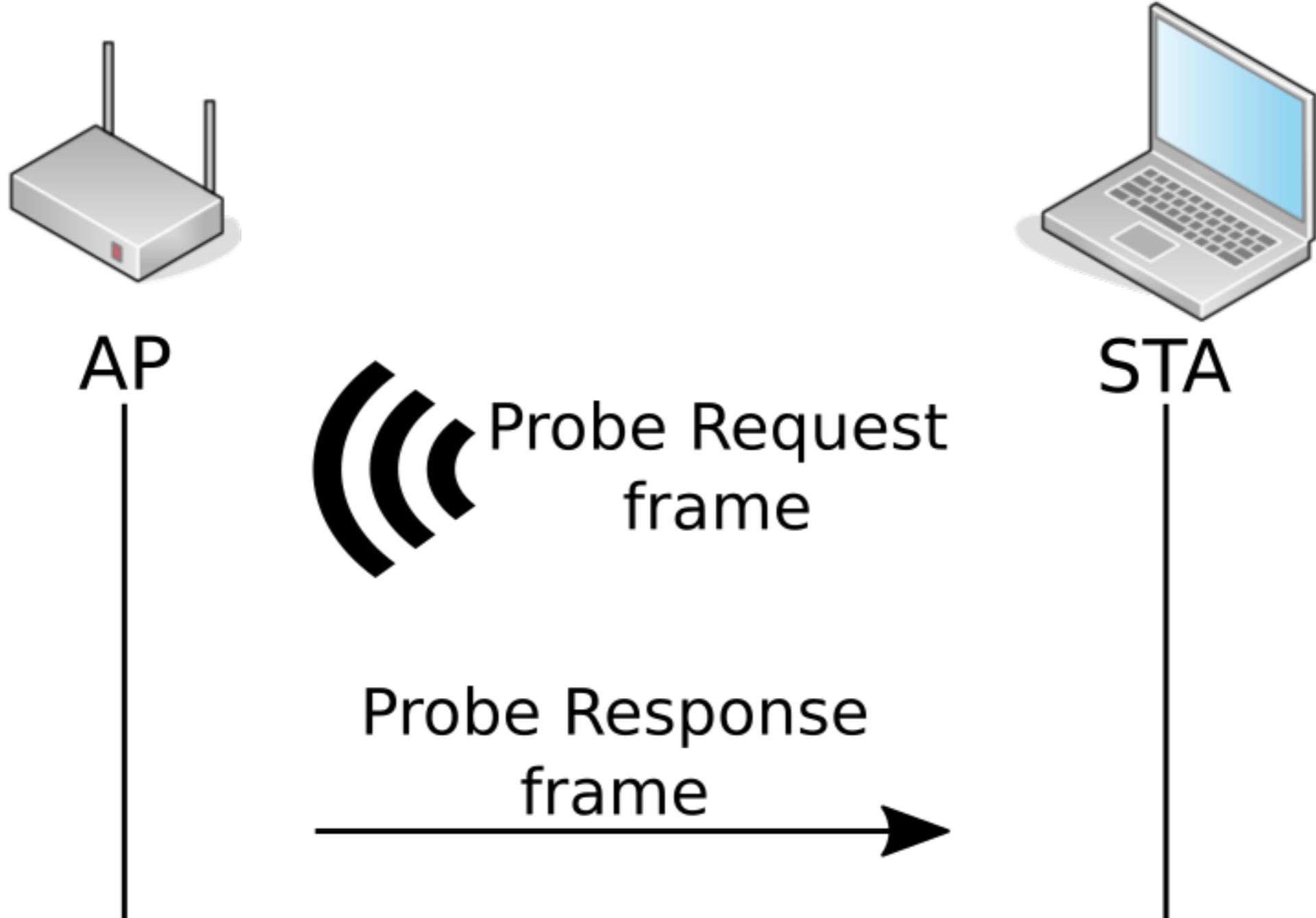


Wi-Fi Direct



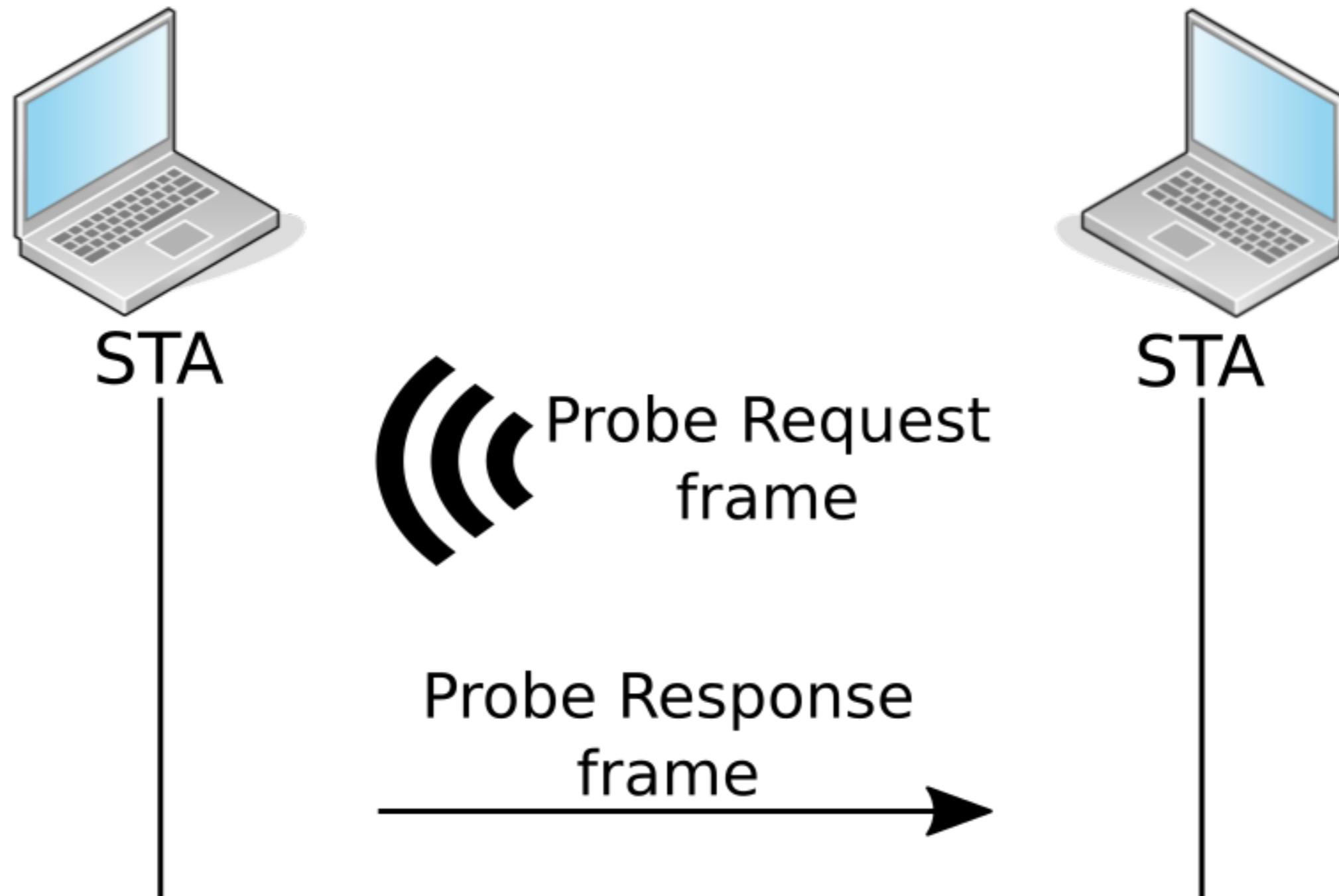
802.11 Discovery





802.11 Discovery

P2P Discovery



- Radiotap Header v0, Length 36
- 802.11 radio information
- ▼ IEEE 802.11 Probe Request, Flags:C
 - Type/Subtype: Probe Request (0x0004)
 - Frame Control Field: 0x4000
 - .000 0000 0000 0000 = Duration: 0 microseconds
 - Receiver address: ff:ff:ff:ff:ff:ff
 - Destination address: ff:ff:ff:ff:ff:ff
 - Transmitter address: 8a:28: [REDACTED]
 - Source address: 8a:28: [REDACTED]
 - BSS Id: ff:ff:ff:ff:ff:ff
 - 0000 = Fragment number: 0
 - 0011 0101 1011 = Sequence number: 859
 - Frame check sequence: 0x272d3650 [correct]
 - [FCS Status: Good]
- ▼ IEEE 802.11 wireless LAN management frame
 - ▼ Tagged parameters (253 bytes)
 - Tag: SSID parameter set: DIRECT-
 - Tag: Supported Rates 6(B), 9, 12(B), 18, 24(B), 36, 48, 54, [Mbit/sec]
 - Tag: DS Parameter set: Current Channel: 6
 - Tag: HT Capabilities (802.11n D1.10)
 - Tag: Extended Capabilities (8 octets)
 - Tag: VHT Capabilities (IEEE Std 802.11ac/D3.1)
 - Tag: Vendor Specific: 00:50:f2: WPS
 - Tag: Vendor Specific: 50:6f:9a: P2P

P2P Discovery

- Radiotap Header v0, Length 36
- 802.11 radio information
- IEEE 802.11 Probe Response, Flags:C
- ▼ IEEE 802.11 wireless LAN management frame
 - Fixed parameters (12 bytes)
 - ▼ Tagged parameters (235 bytes)
 - Tag: SSID parameter set: DIRECT-
 - Tag: Supported Rates 6(B), 9, 12(B), 18, 24(B), 36, 48, 54, [Mbit/sec]
 - Tag: DS Parameter set: Current Channel: 3
 - Tag: Vendor Specific: 00:50:f2: WPS
 - Tag: Vendor Specific: 50:6f:9a: Wi-Fi Display
 - ▼ Tag: Vendor Specific: 50:6f:9a: P2P
 - Tag Number: Vendor Specific (221)
 - Tag length: 47
 - OUI: 50-6f-9a (Wi-FiAll)
 - Vendor Specific OUI Type: 9
 - P2P Capability: Device 0x25 Group 0x80
 - ▼ P2P Device Info
 - Attribute Type: P2P Device Info (13)
 - Attribute Length: 35
 - P2P Device address: cc:b1:10:f1:b7:ff

P2P Discovery

Device Name attribute type: 0x1011
Device Name attribute length: 14
Device Name: [TV] UN32J5500

- ▶ Radiotap Header v0, Length 36
- ▶ 802.11 radio information
- ▶ IEEE 802.11 Action, Flags:c
- ▼ IEEE 802.11 wireless LAN management frame

▼ Fixed parameters

Category code: Public Action (4)

Public Action: GAS Initial Request (0x0a)

Dialog token: 0x00

Tag Number: Advertisement Protocol (108)

Tag length: 2

P2P Discovery

OUI: 50-6f-9a (Wi-FiAll)

ANQP WFA Subtype: P2P (9)

Service Update Indicator: 0

▼ Service TLV (Transaction ID: 1 Type: UPnP)

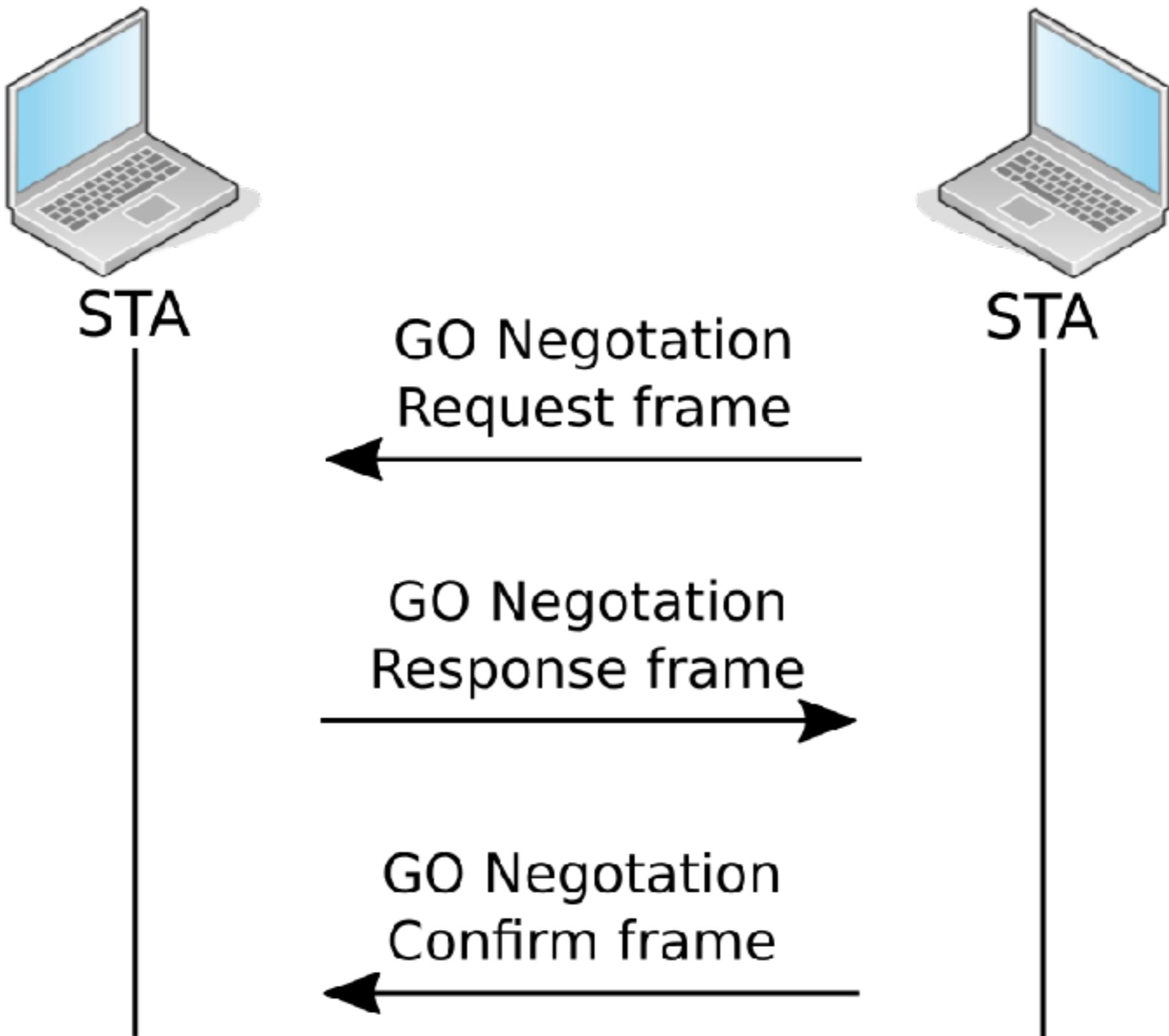
Length: 54

Service Protocol Type: UPnP (2)

Service Transaction ID: 1

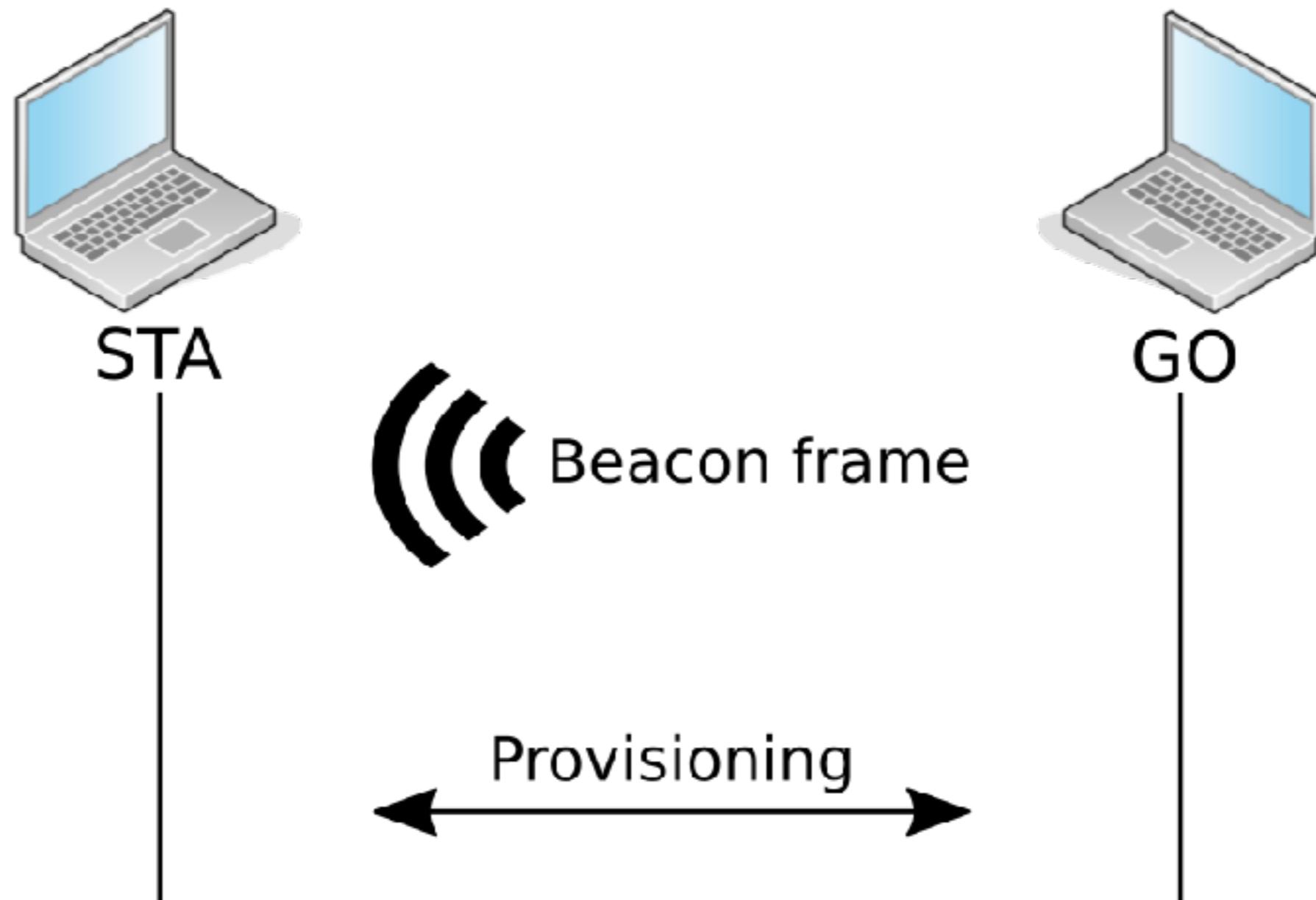
Query Data: 1075726e3a736368656d61732d75706e702d6f72673a6465 . .

0000	00	00	24	00	2f	40	00	a0	20	08	00	00	00	00	00	00	..\$./@..	
0010	8e	87	36	7c	02	00	00	00	10	0c	76	09	c0	00	ec	00	.6v....	
0020	00	00	ec	00	d0	00	3c	00								<.		
0030												10	c8	04	0a	00	6c	
0040	02	00	00	42	00	dd	dd	3e	00	50	6f	9a	09	00	00	36	...B...>	.Po....	
0050	00	02	01	10	75	72	6e	3a	73	63	68	65	6d	61	73	2durn:schemas		
0060	75	70	6e	70	2d	6f	72	67	3a	64	65	76	69	63	65	3a	upnp-org:device		
0070	49	6e	74	65	72	6e	65	74	47	61	74	65	77	61	79	44	Internet Gateway		
0080	65	76	69	63	65	3a	31	1c	f6	22	39					evice:1,"9			



P2P Group Formation

P2P Group Formation



TL-WN722N



```
$ iw phy  
Wiphy phy0  
    max # scan SSIDs: 4  
    max scan IE length: 2257 bytes  
    Retry short limit: 7  
    Retry long limit: 4  
    Coverage class: 0 (up to 0m)  
    Device supports RSN-IBSS.  
    Device supports AP-side u-APSD.  
    Device supports T-DLS.  
    Supported Ciphers:  
        * WEP40 (00-0f-ac:1)  
        * WEP104 (00-0f-ac:5)  
        * TKIP (00-0f-ac:2)
```

Interface Requirements

- * 00-0f-ac:15
- * 00-0f-ac:11
- * 00-0f-ac:12

Available Antennas: TX 0x1 RX 0x3

Configured Antennas: TX 0x1 RX 0x3

Supported interface modes:

- * IBSS
- * managed
- * AP
- * AP/VLAN
- * WDS
- * monitor
- * mesh point
- * P2P-client
- * P2P-GO

wpa_cli v2.5

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See README for more details.

Selected interface 'wlp2s0'

Interactive mode

> p2p_find 5

OK

<3>CTRL-EVENT-SCAN-STARTED

<3>P2P-DEVICE-FOUND 70:5a:██████████ p2p_dev_addr=72:5a:██████████ pri_dev_type=3-0050F204-1
'DIRECT-66-HP OfficeJet Pro 8710' config_methods=0x5a88 dev_capab=0x4 group_capab=0x1 vendor_el
new=1

<3>P2P-DEVICE-FOUND 32:cd:██████████ p2p_dev_addr=32:cd:██████████ pri_dev_type=3-0050F204-5
'DIRECT-KIM283x Series' config_methods=0x98 dev_capab=0x4 group_capab=0x9 vendor_elems=1 new=1

<3>P2P-DEVICE-FOUND ce:b1:██████████ p2p_dev_addr=ce:b1:██████████ pri_dev_type=7-0050F204-1
'[TV] UN32J5500' config_methods=0x188 dev_capab=0x25 group_capab=0x80 new=1

<3>CTRL-EVENT-SCAN-STARTED

wpa_cli

<3>CTRL-EVENT-SCAN-STARTED

<3>CTRL-EVENT-SCAN-STARTED

<3>CTRL-EVENT-SCAN-STARTED

<3>P2P-FIND-STOPPED

<3>P2P-DEVICE-LOST p2p_dev_addr=ce:b1██████████

<3>P2P-DEVICE-LOST p2p_dev_addr=32:cd██████████

<3>P2P-DEVICE-LOST p2p_dev_addr=72:5a██████████

[Settings](#)[SEARCHING...](#)[RENAME DEVICE](#)

My Pixel

Peer devices

DIRECT-66-HP OfficeJet Pro 8710

Available



DIRECT-KIM283x Series

Available



Remembered groups

android

Search:

Name	Type	Phy	Signal	Channel	Last Seen	Data	Packets
[REDACTED]	Wi-Fi AP	IEEE802.11	-94	11	Oct 22 2017 20:01:26	0 B	
E4:C8:[REDACTED]	Wi-Fi Client	IEEE802.11	-75	2.462 GHz	Oct 22 2017 20:01:20	0 B	
E0:AC:[REDACTED]	Wi-Fi Client	IEEE802.11	-80	2.437 GHz	Oct 22 2017 20:01:26	124 B	
DIRECT-KIM283x Series	Wi-Fi AP	IEEE802.11	-41	8	Oct 22 2017 20:01:26	0 B	
DIRECT-66-HP OfficeJet Pro 8710	Wi-Fi AP	IEEE802.11	-75	8	Oct 22 2017 20:01:26	0 B	
DC:CF:[REDACTED]	Wi-Fi Bridged Device	IEEE802.11	-89	2.437 GHz	Oct 22 2017 20:00:02	178 B	
D0:66:[REDACTED]	Wi-Fi Bridged Device	IEEE802.11	-81	2.427 GHz	Oct 22 2017 20:00:49	210 B	

kismet

Oct 22 2017 20:01:23 Detected new 802.11 Wi-Fi device 16:98: [REDACTED] packet 9976

Oct 22 2017 20:01:23 Detected new 802.11 Wi-Fi device 68:27: [REDACTED] packet 9957

Oct 22 2017 20:01:21 Detected new 802.11 Wi-Fi device 48:F7: [REDACTED] packet 9316

Oct 22 2017 20:01:17 Detected new 802.11 Wi-Fi device F8:1A: [REDACTED] packet 8677

Oct 22 2017 20:01:09 Detected new 802.11 Wi-Fi device 4A:F7: [REDACTED] packet 7532

Oct 22 2017 20:01:09 Detected new 802.11 Wi-Fi device 54:A0: [REDACTED] packet 7450

Oct 22 2017 20:00:59 Detected new 802.11 Wi-Fi device 90:5F: [REDACTED] packet 6315

CH 3][Elapsed: 0 s][2017-10-22 19:40

BSSID	PWR	Beacons	#Data, #/s	CH	MB	ENC	CIPHER	AUTH	ESSID
78:45:██████	-68	3	0 0	6 54e.	WPA2 CCMP	PSK	██████████	██████████	██████████
A0:E4:██████	-87	2	0 0	11 54e	WPA2 CCMP	PSK	██████████	██████████	██████████
18:1E:██████	-86	2	0 0	11 54e	WPA2 CCMP	PSK	██████████	██████████	██████████
FA:8F:██████	-76	6	0 0	11 54e.	OPN				██████████
A0:8E:██████	-86	4	0 0	11 54e	WPA2 CCMP	PSK	██████████	██████████	██████████
54:DC:██████	-79	2	0 0	4 54e	WPA2 CCMP	PSK	██████████	██████████	██████████
78:45:██████	-78	3	0 0	6 54e.	WPA2 CCMP	PSK	██████████	██████████	██████████
70:5A:██████	-51	6	0 0	8 54e	WPA2 CCMP	PSK	DIRECT-66-HP OfficeJet Pro	██████████	██████████
32:CD:██████	-39	5	0 0	8 54e	WPA2 CCMP	PSK	DIRECT-KIM283x Series	██████████	██████████
60:14:██████	-64	10	3 1	11 54e.	WPA2 CCMP	PSK	██████████	██████████	██████████
84:00:██████	-63	11	0 0	11 54e	WPA2 CCMP	PSK	██████████	██████████	██████████
84:00:██████	-77	8	0 0	6 54e	WPA2 CCMP	PSK	██████████	██████████	██████████
FA:8F:██████	-83	5	0 0	6 54e.	OPN				██████████
20:25:██████	-77	2	0 0	6 54e	WPA2 CCMP	PSK	██████████	██████████	██████████
60:14:██████	-45	14	0 0	6 54e.	WPA2 CCMP	PSK	██████████	██████████	██████████
78:45:██████	-25	17	0 0	8 54e.	WPA2 CCMP	PSK	██████████	██████████	██████████
60:14:██████	-61	13	0 0	6 54e.	WPA2 CCMP	PSK	██████████	██████████	██████████
E0:69:██████	-90	2	0 0	1 54e	WPA TKIP	PSK	██████████	██████████	██████████
C4:04:██████	-47	22	0 0	3 54e	WPA2 CCMP	PSK	██████████	██████████	██████████

airodump-ng

1C:49:██████	-79	6	0 0	1 54e	WPA CCMP	PSK	██████████	██████████	██████████
BSSID STATION PWR Rate Lost Frames Probe									
54:DC:██████	60:A4:██████	-82	0 - 1	0		1	██████████	██████████	██████████
(not associated)	A4:77:██████	-81	0 - 1	0		2	██████████	██████████	██████████
60:14:██████	E4:C8:██████	-82	0e- 1	34		6	██████████	██████████	██████████

█

- Device Capabilities: service discovery, concurrent operation, p2p invitation procedure

- Group Capabilities: ip address allocation

P2p Device Info:

- P2P Device address: ae:37: [REDACTED]

wig

MAC Address: ae:37: [REDACTED]

WPS Information:

Device Name: My Pixel

Primary Device Type: Telephone

Response Type: '\x00'

Model Number: Pixel

Vendor Extension: '\x007*\x00\x01 '

Serial Number: FA71S0 [REDACTED]

Version: 1.0

Model Name: Pixel

Wifi Protected Setup State: Not-Configured

Config Methods: Display, Push Button, Keypad

Uuid E: 2C48E129BEFF566FAFCAF5670562E4E6

Manufacturer: Google

Wi-Fi Direct Information:

P2p Capability:

- Device Capabilities: service discovery, concurrent operation, p2p invitation procedure
- Group Capabilities:

P2p Device Info:

- P2P Device address: ae:37: [REDACTED]
- Config Methods: Display, Push Button, Keypad
- Primary Device Type: Telephone
- Number of Secondary Device Types: 0
- Device Name: My Pixel



Monitor P2P Devices



HP Printers



NETWORK

Wi-Fi Direct

Status

+ General

+ Wired (802.3)

+ Wireless (802.11)

- Wi-Fi Direct

[Status](#)

+ AirPrint™

Wi-Fi Direct Settings

Change the Wi-Fi Direct settings, and then click Apply.

Status

On

Wi-Fi Direct Name

DIRECT-66-HP

OfficeJet Pro 8710

Connection Method

Automatic

Wi-Fi Direct Password

12345678

[Generate](#)

Automatic

12345678

[Generate](#)

HP Printers

[Apply](#)

[Cancel](#)



NETWORK

+ General

+ Wired (802.3)

+ Wireless (802.11)

- Wi-Fi Direct

Status

+ AirPrint™

Wi-Fi Direct

Status

Wi-Fi Direct Settings

Change the Wi-Fi Direct settings, and then click Apply.

Status

On

Wi-Fi Direct Name

DIRECT-66-HP

Connection Method

Manual

Wi-Fi Direct Password

77346443

HP Printers

Apply

Cancel



Samsung Printers



Information

Settings

Security

Maintenance

Settings

Network Settings

General

TCP/Pv4

TCP/Pv6

Raw TCP/P, LPR, IPP

AirPrint

Samsung Cloud Print

Google Cloud Print

WSD

SLP

UPnP

mDNS

SNMP

SNMPv1/v2

SNMPv3

HTTP

Proxy

Wi-Fi

Wi-Fi

Wi-Fi Direct™

Restore Default

Wi-Fi Direct™

[Apply](#)[Undo](#)

Wi-Fi Direct™

Wi-Fi Direct™:

On

Device Name:

M283x Series

IP Address:

192.168.3.1

Group Owner:

Activate

Network Key:

24767897

 Hide Network Key

Wi-Fi Direct™ Status

Current Role:

Group Owner

Current SSID:

DIRECT-KIM283x Series

Current Status:

Connected (0)

Information Desk

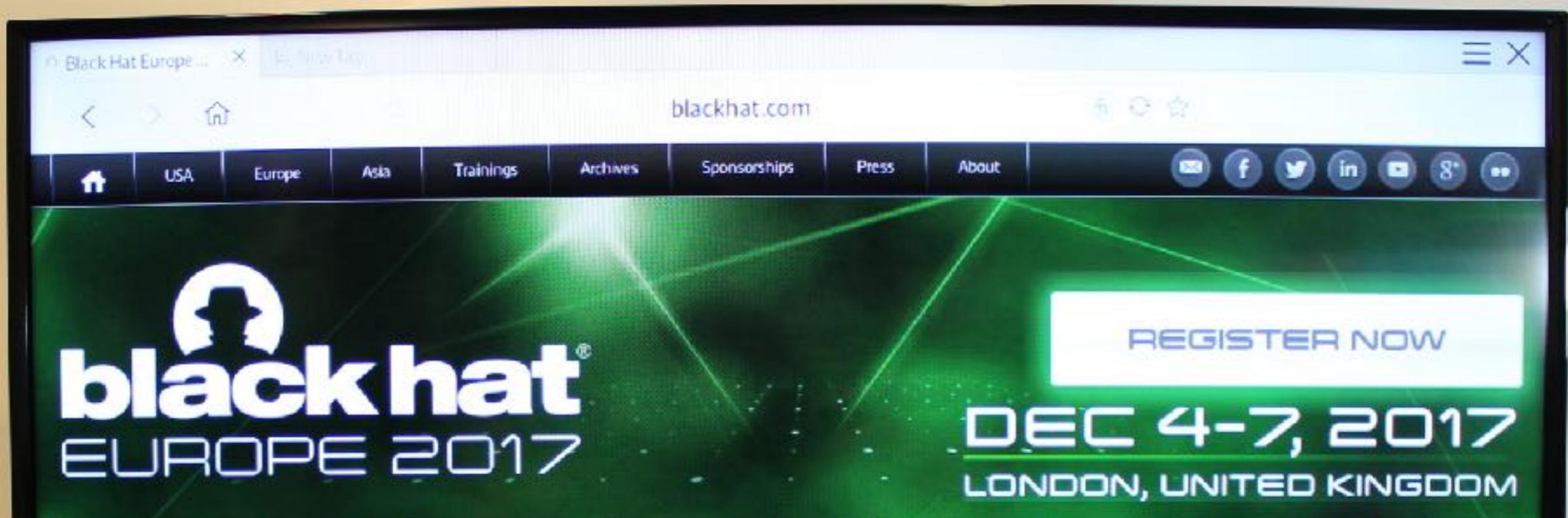
Recent Links

[Wi-Fi Direct™](#)[General](#)[SNMPv3](#)[Home](#)

Samsung Printers



Samsung Printers



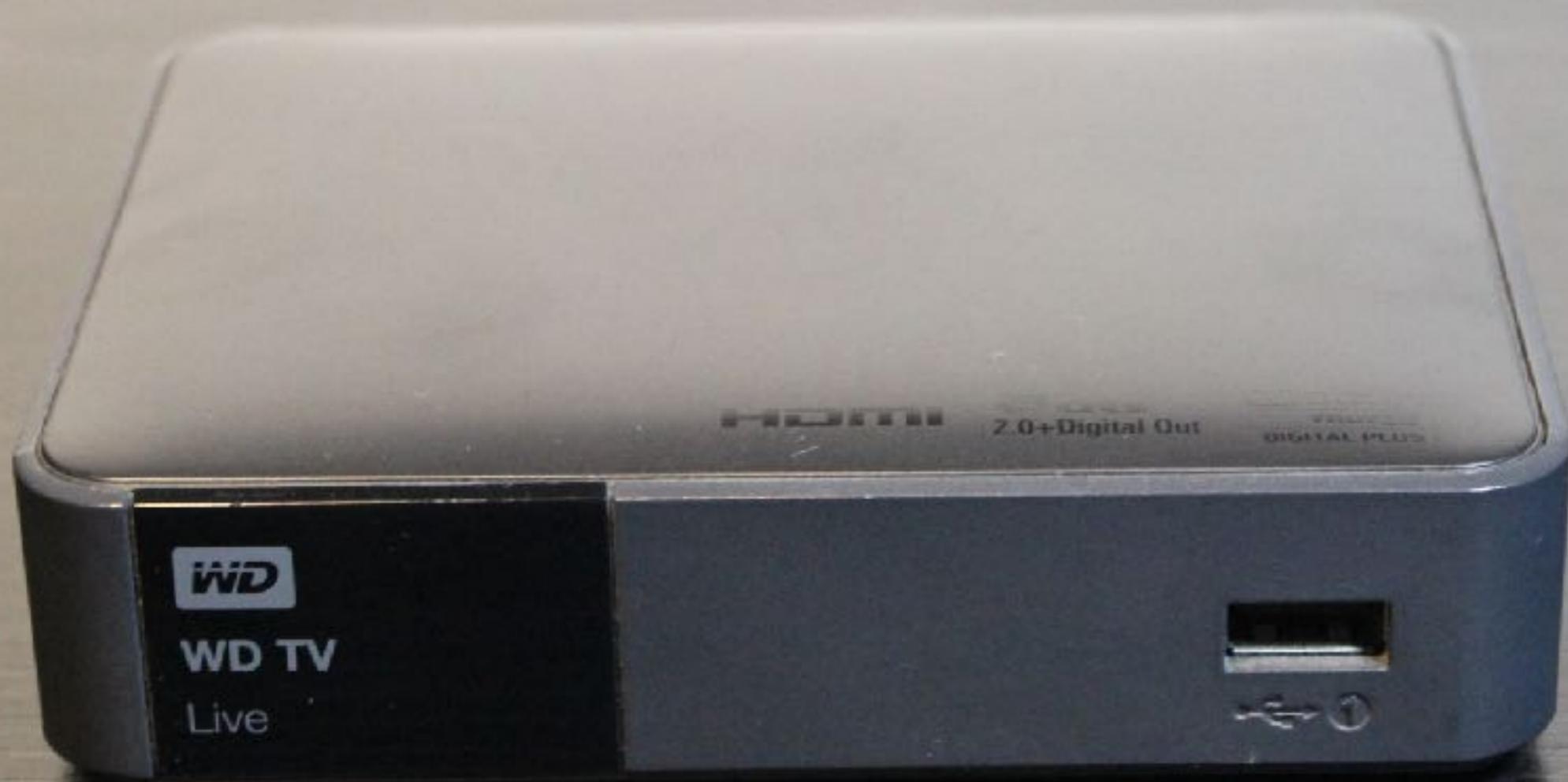
Samsung Smart TV

Black Hat provides attendees with the very latest in research, development, and trends in Information Security. Here the brightest professionals and researchers in the industry will come together for a total of four days—two days of deeply technical hands-on Trainings, followed by



- Radiotap Header v0, Length 36
- 802.11 radio information
- ▼ IEEE 802.11 Action, Flags:c
 - Type/Subtype: Action (0x000d)
 - Frame Control Field: 0xd000
.000 0000 0011 1100 = Duration: 60 microseconds
 - Receiver address: ae:37:██████████
 - Destination address: ae:37:██████████
 - Transmitter address: ce:b1:██████████
 - Source address: ce:b1:██████████
 - BSS Id: ae:37:██████████
 - 0000 = Fragment number: 0
 - 1000 1010 0100 = Sequence number: 2212
 - Frame check sequence: 0x94f60964 [correct]
[FCS Status: Good]
- ▼ IEEE 802.11 wireless LAN management frame
 - ▼ Fixed parameters
 - Category code: Public Action (4)
 - Public Action: Vendor Specific (0x09)
 - OUI: 50-6f-9a (Wi-FiAll)
 - WFA Subtype: 9
 - P2P Public Action Subtype: GO Negotiation Confirmation (2)
 - P2P Public Action Dialog Token: 1
 - Tagged parameters (126 bytes)

Samsung Smart TV



WD TV Live

```
Completed SYN Stealth Scan at 22:04, 4.61s elapsed (1000 total ports)
Initiating Service scan at 22:04
Scanning 5 services on 192.168.69.61
Completed Service scan at 22:04, 26.03s elapsed (5 services on 1 host)
Initiating OS detection (try #1) against 192.168.69.61
```

WD TV Live

```
Completed NSE at 22:05, 0.00s elapsed
```

```
Nmap scan report for 192.168.69.61
```

```
Host is up (0.0033s latency).
```

```
Not shown: 995 closed ports
```

PORT	STATE	SERVICE	VERSION
80/tcp	open	http	Apache httpd (PHP 5.2.17)
139/tcp	open	netbios-ssn	Samba smbd 3.X (workgroup: WORKGROUP)
443/tcp	open	ssl/http	Apache httpd (PHP 5.2.17)
445/tcp	open	netbios-ssn	Samba smbd 3.X (workgroup: WORKGROUP)
30000/tcp	open	unknown	

```
MAC Address: 02:90:A9:67:7B:7E (Unknown)
```

```
OS fingerprint not ideal because: Didn't receive UDP response. Please try again with -
```

```
No OS matches for host
```

```
Network Distance: 1 hop
```

TRACEROUTE

HOP	RTT	ADDRESS
1	3.34 ms	192.168.69.61

```
NSE: Script Post-scanning.
```

```
Initiating NSE at 22:05
```

```
Completed NSE at 22:05, 0.00s elapsed
```

```
Initiating NSE at 22:05
```

```
Completed NSE at 22:05, 0.00s elapsed
```



WD TV Live

Login

Password

Language

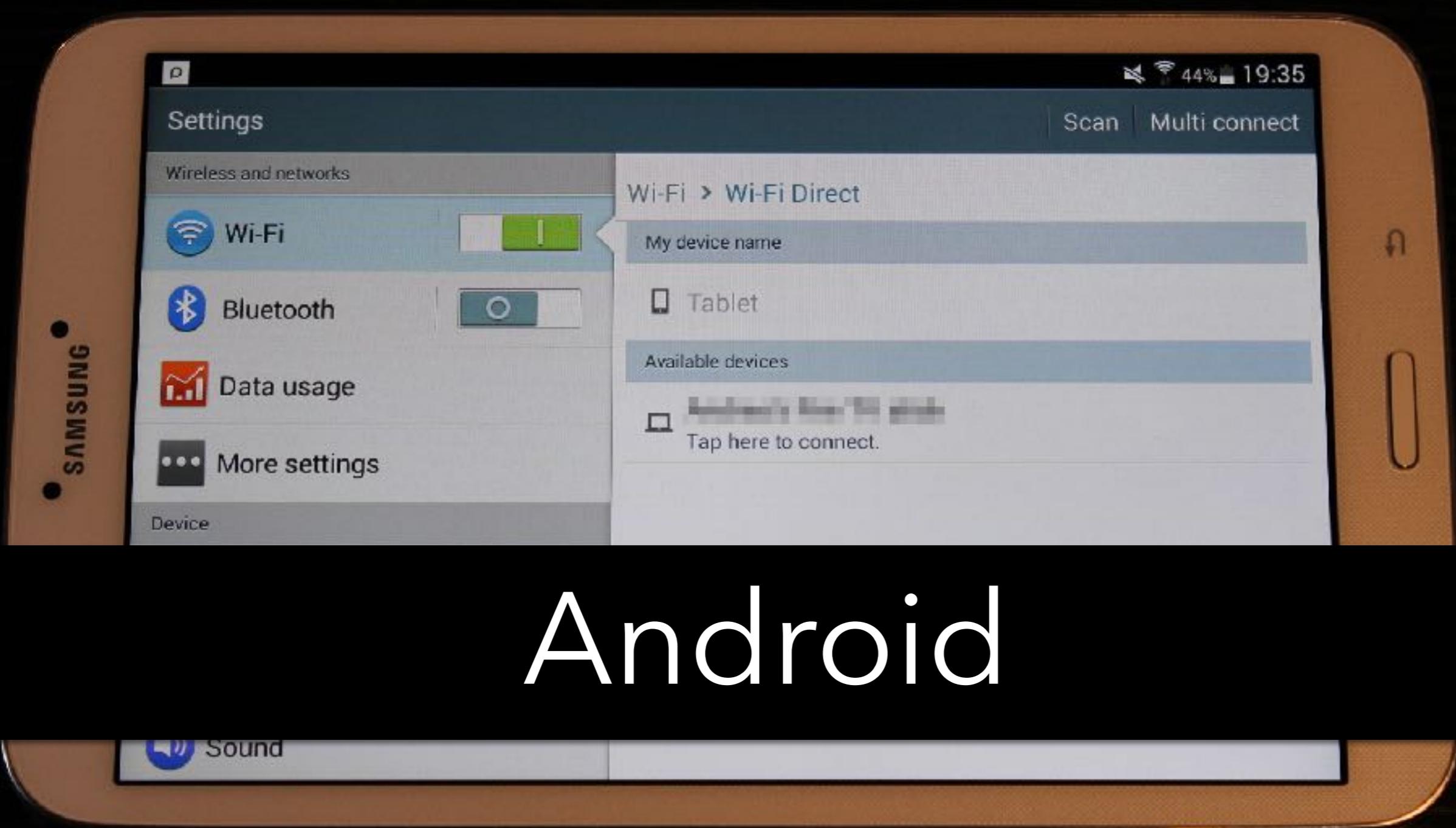
English 

I accept [END USER LICENSE AGREEMENT](#)

Keep me signed in

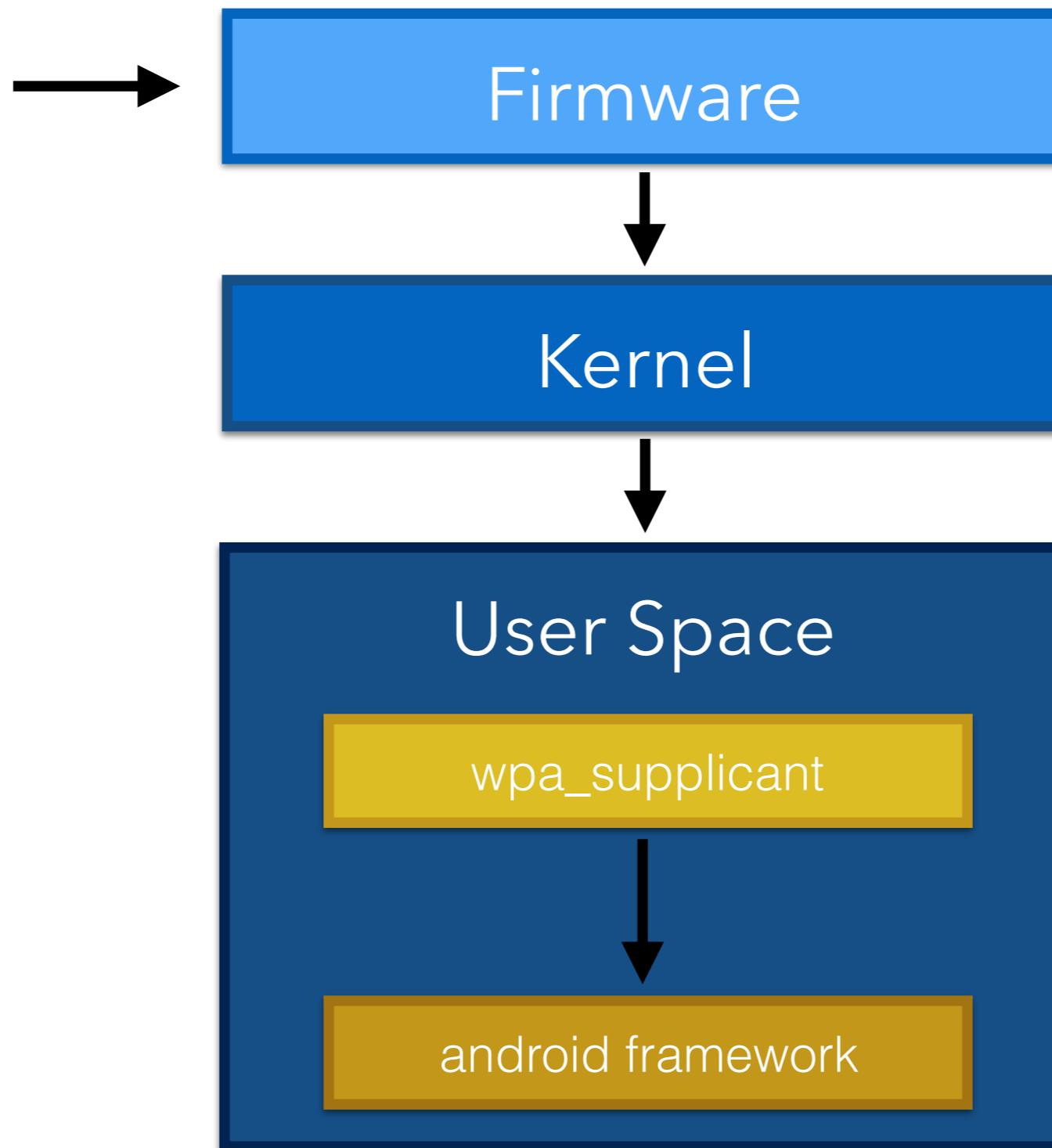
Login





Android

Android



```
private static final Pattern detailedDevicePattern = Pattern.compile(  
    "((?:[0-9a-f]{2}:){5}[0-9a-f]{2}) " +  
    "(\\d+ )?" +  
    "p2p_dev_addr=((?:[0-9a-f]{2}:){5}[0-9a-f]{2}) " +  
    "pri_dev_type=(\\d+-[0-9a-fA-F]+-\\d+) " +  
    "name='(.*)' " +  
    "config_methods=(0x[0-9a-fA-F]+) " +  
    "dev_capab=(0x[0-9a-fA-F]+) " +  
    "group_capab=(0x[0-9a-fA-F]+) " +  
    "( wfd_dev_info=0x000006([0-9a-fA-F]{12}))?"  
) ;
```

Android

```
/**  
 * @param string formats supported include  
 * P2P-DEVICE-FOUND fa:7b:7a:42:02:13 p2p_dev_addr=fa:7b:7a:42:02:13  
 * pri_dev_type=1-0050F204-1 name='p2p-TEST1' config_methods=0x188 dev_capab=0x27  
 * group_capab=0x0 wfd_dev_info=000006015d022a0032  
 *  
 * P2P-DEVICE-LOST p2p_dev_addr=fa:7b:7a:42:02:13  
 *  
 * AP-STA-CONNECTED 42:fc:89:a8:96:09 [p2p_dev_addr=02:90:4c:a0:92:54]  
 *  
 * AP-STA-DISCONNECTED 42:fc:89:a8:96:09 [p2p_dev_addr=02:90:4c:a0:92:54]  
 *  
 * fa:7b:7a:42:02:13  
 *  
 * Note: The events formats can be looked up in the wpa_supplicant code  
 * @hide  
 */  
public WifiP2pDevice(String string) throws IllegalArgumentException {  
    String[] tokens = string.split("[ \\n]");  
    Matcher match;  
  
    if (tokens.length < 1) {  
        throw new IllegalArgumentException("Malformed supplicant event");  
    }  
}
```

```
D/TCMD ( 519): Listening for incoming client connection request
I/wpa_supplicant( 3482): P2P-DEVICE-FOUND 70:5a:0f:16:ed:54 p2p_dev_addr=72:5a:0f:16:b4:66 pri_dev
name='DIRECT-66-HP OfficeJet Pro 8710' config_methods=0x5a88 dev_capab=0x4 group_capab=0x1 level=
I/wpa_supplicant( 3482): P2P-DEVICE-FOUND 00:de:ad:fa:fa:fa p2p_dev_addr=00:de:ad:fa:fa:fa pri_dev
5 name='fafafa<FA><FA>' config_methods=0x188 dev_capab=0x21 group_capab=0x0 level=-27
D/MDMCTBK ( 267): reply_len: 40 reply is = <3>P2P-DEVICE-FOUND 70:5a:0f:16:ed:54 p2
D/MDMCTBK ( 267): Event received = P2P-DEVICE-FOUND 70:5a:0f:16:ed:54 p2
D/MDMCTBK ( 267): reply_len: 40 reply is = <3>P2P-DEVICE-FOUND 00:de:ad:fa:fa:fa p2
D/MDMCTBK ( 267): Event received = P2P-DEVICE-FOUND 00:de:ad:fa:fa:fa p2
D/WifiP2pService( 1024): InactiveState{ when=-1ms what=147477 obj=Device: DIRECT-66-HP OfficeJet P
D/WifiP2pService( 1024): deviceAddress: 72:5a:0f:16:b4:66
D/WifiP2pService( 1024): primary type: 3-0050F204-1
```

Android

```
D/WifiP2pService( 1024): level: -49 target=com.android.internal.util.StateMachine$SmHandler }
D/WifiP2pService( 1024): P2pEnabledState{ when=-1ms what=147477 obj=Device: DIRECT-66-HP OfficeJet
D/WifiP2pService( 1024): deviceAddress: 72:5a:0f:16:b4:66
D/WifiP2pService( 1024): primary type: 3-0050F204-1
D/WifiP2pService( 1024): secondary type: null
D/WifiP2pService( 1024): wps: 23176
D/WifiP2pService( 1024): grpcapab: 1
D/WifiP2pService( 1024): devcapab: 4
D/WifiP2pService( 1024): status: 3
D/WifiP2pService( 1024): wfdInfo: null
D/WifiP2pService( 1024): level: -49 target=com.android.internal.util.StateMachine$SmHandler }
W/dalvikvm( 1024): threadid=71: thread exiting with uncaught exception (group=0x4171bd40)
E/AndroidRuntime( 1024): *** FATAL EXCEPTION IN SYSTEM PROCESS: WifiMonitor
E/AndroidRuntime( 1024): java.lang.IllegalArgumentException: Malformed supplicant event
E/AndroidRuntime( 1024):         at android.net.wifi.p2p.WifiP2pDevice.<init>(WifiP2pDevice.java:21
E/AndroidRuntime( 1024):         at android.net.wifi.WifiMonitor$MonitorThread.handleP2pEvents(WifiM
E/AndroidRuntime( 1024):         at android.net.wifi.WifiMonitor$MonitorThread.dispatchEvent(WifiMon
E/AndroidRuntime( 1024):         at android.net.wifi.WifiMonitor$MonitorThread.run(WifiMonitor.java
I/Process ( 1024): Sending signal. PID: 1024 SIG: 9
I/ServiceManager( 255): service 'package' died
I/ServiceManager( 255): service 'sensorservice' died
```

While sitting here (and enjoying the free Wi-Fi)

Kevin made notes for the meeting. Jane emailed the office. Pete had a stare-off with a squirrel. Claire published the changes. Rohan amended the contract. Stuart didn't see the football in time.

Many unique needs
One solution

Helen heroically pulled off a triple club sandwich.
Phyllis edited the PowerPoint presentation.
Michelle started the PowerPoint presentation.
Kathy finally made eye contact with the guy from finance.
Raj edited the proposal.

Availability



Confusion

Weakest Link



Bridge



Attack Surface



Questions

<https://github.com/6e726d/BHEU17>

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