

Manufacturers of wireless devices at Swinburne

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Abstract—To gain an insight in to the market share of laptop and mobile device manufacturers at Swinburne University, we analyse the OUIs in two previously captured data sets of 802.11 traffic from around our office at the Swinburne Hawthorn campus. We find that Apple devices have an overwhelming majority, around an order of magnitude larger in number of devices than the next closest competitor.

Index Terms—CAIA, Swinburne, device manufacturers

I. INTRODUCTION

For a separate project [1], we set up three wireless Access Points (APs) to observe wireless traffic around our office. Using these APs, we captured two sets of data, both including the source MAC address and timestamp for every frame that our APs saw over a period of time. We use this data to provide a brief insight in to the devices used by the students and staff whose 802.11 transmissions come within range of our 6th floor office, in the EN building of Swinburne University's Hawthorn campus.

In both data sets, devices manufactured by Apple were seen in numbers an order of magnitude higher than the next highest competitor. The rest of the competition remained fairly close, with much tighter gaps between subsequent manufacturers.

The report is structured as follows: Section II covers background information. Section III details the methods used to capture and analyse the data. Section IV investigates the results found, and is followed by the conclusion in section V.

II. BACKGROUND

Every 802.11 Wireless device transmits a unique identifier when they send a frame. This is called the Media Access Control (MAC) address and it is used to identify source and destination hosts in a network

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broadcast domain. The first half of this 48-bit identifier is the Organisationally Unique Identifier (OUI). The OUI identifies the manufacturer of the 802.11 chip or the company which made the device. OUIs are assigned to companies which apply to the IEEE and each OUI provides the manufacturer with a set of 16,777,216 MAC addresses to assign to devices.

The prior project from where we sourced the data from is [1]. Both sets of data were originally captured to gauge what distribution of signal strengths were seen from within our office.

Wireless traffic scope

Swinburne University provides a wireless network called 'swinwifi', side by side with Eduroam [2]. These wireless networks span all of the Swinburne Hawthorn campus, servicing the tens of thousands of Swinburne staff and students there. One or more of the nearby SwinWifi APs was operating on channel 1, so we chose to set our APs to monitor this channel.

Client broadcast packets sent over a wireless network can be retransmitted by other APs elsewhere on the same broadcast domain. This is likely the majority of the traffic that we saw. However, we were unable to confirm how large the broadcast domain was, and subsequently, the geographical distribution of clients seen in our sample.

There are also a number of other small wireless networks within range which appear to be the likes of mobile 3G hotspots and ad-hoc networks.

III. METHODOLOGY

The data capture used three TP-Link TL-WR1043N/ND v1 APs spread around our office. Each of these runs OpenWRT. tcpdump is used by the APs to monitor the traffic passing by on channel 1. A script running on a PC processed the data from each AP and recorded which MAC addresses had been seen in a given 15 second block.

One data set contains data from 5:43PM on Friday the 17th of August 2012 to 11:33AM on Monday the 20th of August 2012. The other data set was captured between 5PM Monday the 15th of October and 2:06PM on Tuesday the 16th of October. Both use the same capture methodology, and were captured using APs located in our office, EN605 on the 6th floor of the EN building at Swinburne's Hawthorn campus. The weekend capture overlapped with the university's annual Open Day on Sunday the 19th of August. Official figures estimate around 10,000 people attended the event.

The manufacturer information is sourced directly from the IEEE [3].

IV. RESULTS

A. Raw numbers

It is worth noting that some device have a MAC address assigned by the chip manufacturer (eg, Foxconn) and some have a MAC address assigned by the company the chip will end up being in (eg, Apple, HTC).

1) *Weekend set:* 19,411 unique MAC addresses were seen. Of those:

- 238 MAC addresses (1.2%) had an OUI not assigned by the IEEE.
- Around 130 manufacturers were seen.
- 12,997 MAC addresses (67%) were from Apple products (Macbooks, iPhones, iPads, etc).
- Of the remainder, there were 980 Samsung devices (5.0%), 800 HTC devices (4.1%), 525 Intel devices (2.7%), 300 Hon Hai Precision Ind. Co. Ltd devices (Foxconn) (1.5%), 160 Nokia (0.8%) devices and 140 Blackberry devices (0.7%).
- 13 Nintendo devices were seen, which are likely to be only the 3DS model.¹

2) *Weekday set:* During the 21 hour recording period, 14,835 MAC unique addresses were seen. Of those:

- 222 MAC addresses (1.4%) had an OUI not assigned by the IEEE
- Around 100 manufacturers were seen
- 9882 of these were Apple products (66.6%)
- Of the remainder, 511 were HTC (3.4%), 796 Intel devices (5.3%), 906 Samsung devices (6.1%), 571 Hon Hai Precision Ind. Co. Ltd. (Foxconn) (3.8%), 132 Nokia devices (0.8%), 44 Blackberry devices (0.2%) and 4 Nintendo devices.

¹Nintendo 3DS consoles feature "StreetPass", which broadcasts an adhoc wifi network to search for other 3DS devices. This adhoc traffic is likely the only traffic seen from the consoles. as the 3DS cannot join SwinWifi thanks to their lack of enterprise WiFi authentication method support.

B. Devices over time

The day/night cycle is clearly visible in Fig 1. As this data set was captured over the weekend, it is fairly quiet. The peak at the end is a Monday morning, as thousands of students descend upon the campus, and their laptops and phones associate with the Swinburne 'swinwifi' wireless network. The brief dip near the end is likely a network outage of some kind, as all three APs saw no traffic for a short period of time.

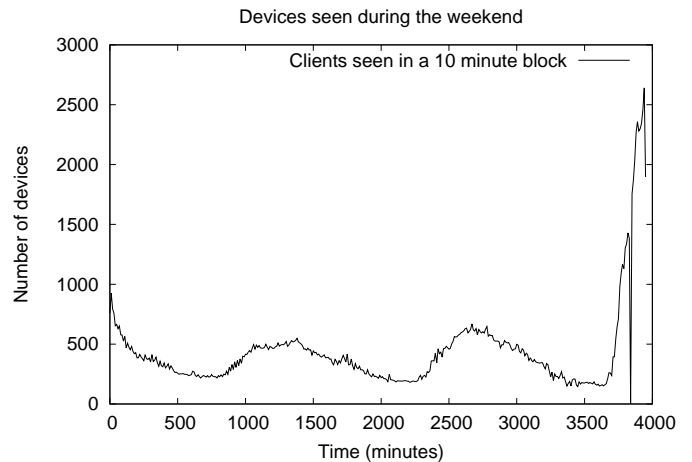


Figure 1. The number of clients seen over the weekend

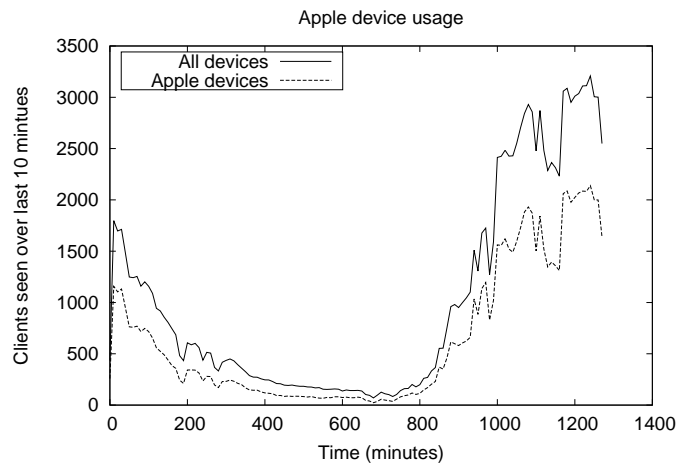


Figure 2. The number of clients seen over a weekday, and the dominance of Apple

Figure 2 shows the market penetration of Apple around the university campus during a week day. All of Apple's products, including laptops, phones and tablets, are included under "Apple" in this graph.

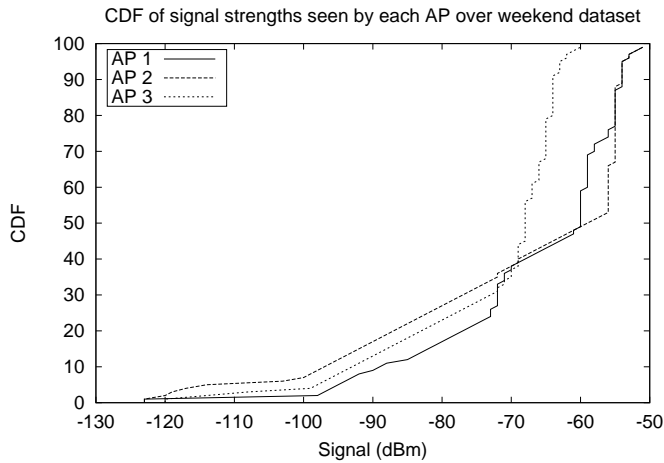


Figure 4. CDF of signal strength of every frame seen by each AP during the three day capture

C. Manufacturers

The distribution of device manufacturers from Section IV-A1 are represented as a histogram in Fig 3. Again, the dominance of Apple is prevalent, far beyond the nearest competitor.

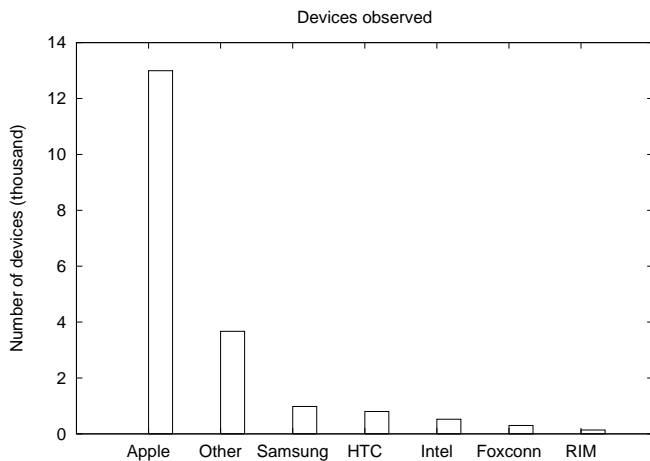


Figure 3. The largest 6 manufacturers compared

The competition trailing behind Apple is all fairly well balanced, with much smaller gaps between them.

D. Signal strength

The wireless network spreads across the entire campus, and likewise it is used from all over the campus. Almost all of the wireless traffic seen by our APs was from well outside our office, as demonstrated by Fig 4 - traffic originating from devices within the lab typically saw a signal strength of around -25 to -40dBm, well above the 99th percentile.

V. CONCLUSIONS

In this report, we have analysed the set of MAC addresses seen by monitoring APs within our office. A majority of devices seen were manufactured by Apple, with the competition trailing far behind on a much more level playing field. Weekdays are substantially busier than weekends.

REFERENCES

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