

Why 2.4 GHz is Trying to eat Your Brain!

Joel Crane

IT Professional Wi-Fi Trek 2015
#wifitrek



Introduction

Joel Crane, CWNA, CWAP

Human Interface (support, training, and customer advocate) at metageek

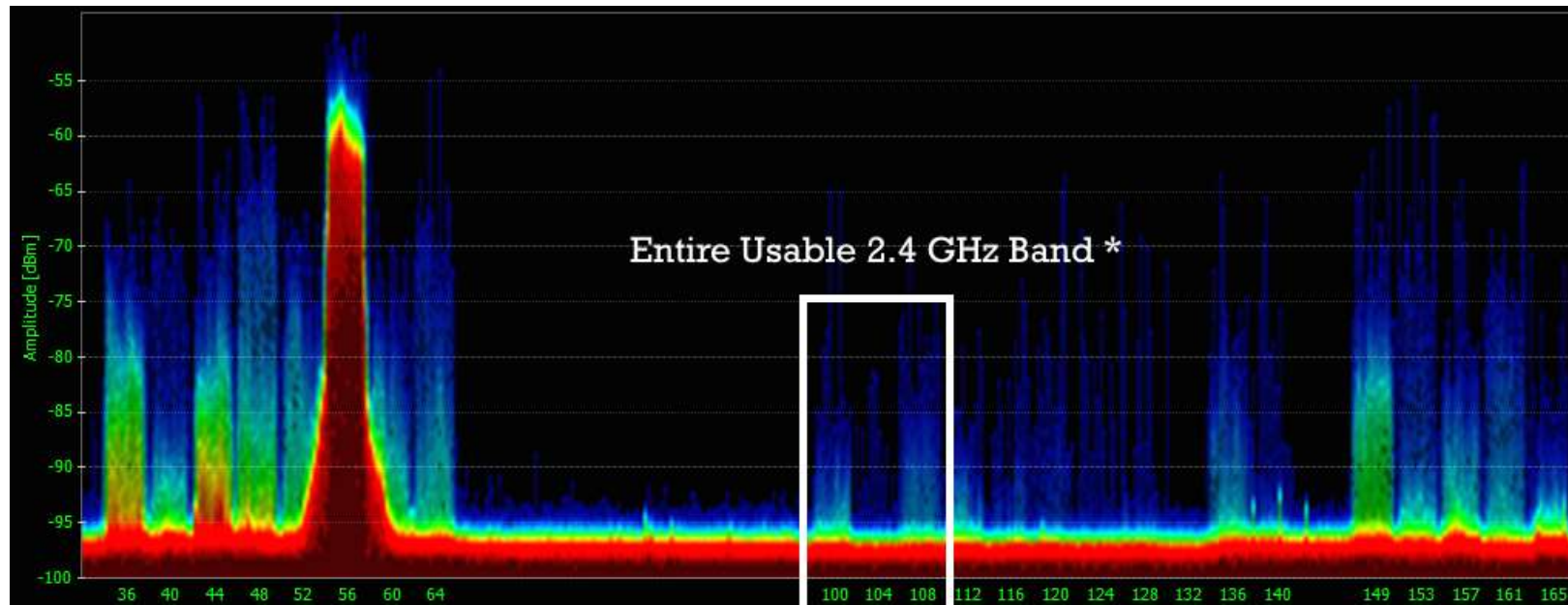
Twitter: @FuelCellWiFi



2.4 GHZ IS DEAD.

Is 2.4 GHz *Really* Dead?

- 2.4 GHz is tiny compared to 5 GHz

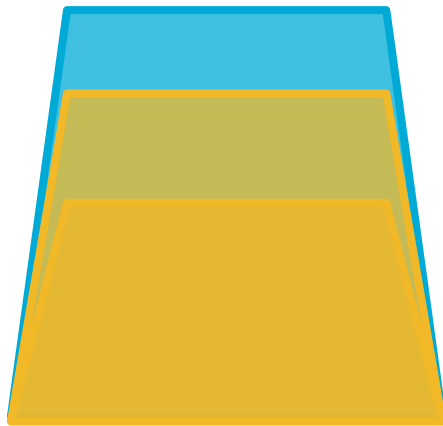


*About three 20 MHz channels.

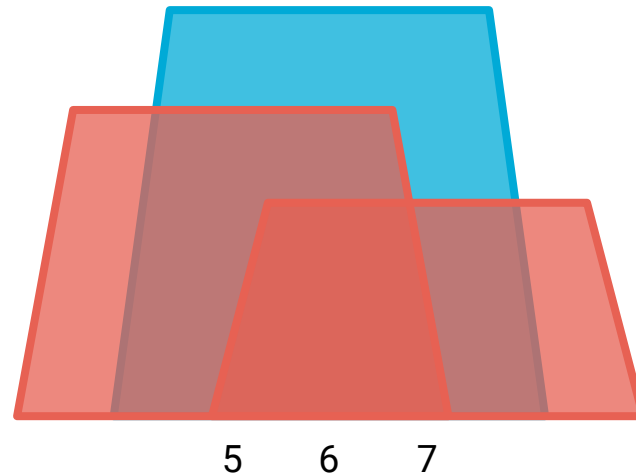
Is 2.4 GHz *Really* Dead?

- Tons of 802.11 congestion
- Tons of non-802.11 congestion

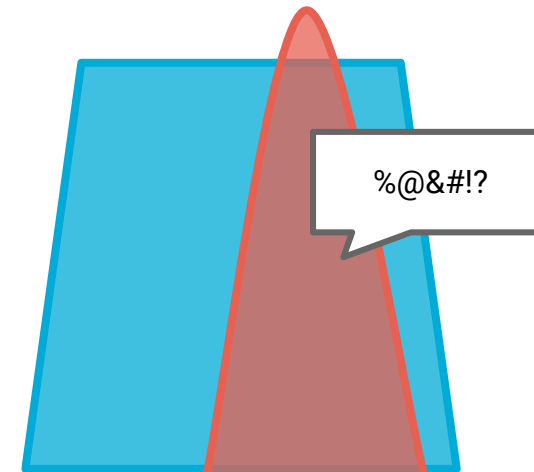
Co-Channel



Adjacent-Channel



Non-Wi-Fi



Is 2.4 GHz *Really* Dead?

- RF propagates really well
- That isn't necessarily a good thing...

2.4 GHz sounds pretty dead.



2.4 GHz is ~~DEAD~~
UNDEAD

2.4 GHz is Undead

- Adjacent-channel interference runs rampant, unchecked
- Legacy data rates and 802.11b protection mechanisms limp and crawl
- Screaming, snarling transmit power keeps us on edge

2.4 GHz is Undead

- Cheap, single-band clients zombies
- IoT loZ
- RTLS
- SOHO
- P2P, P2MP Links

A Zombie

- 2015 Moto G
 - b/g/n only
 - No one cares
 - Seriously, no one cares




Motorola Moto G (3rd Generation) - Black - 8 GB - Global GSM Unlocked Phone

by Motorola

★★★★★ 160 customer reviews | 54 answered questions

#1 New Release in Unlocked Cell Phones

Price: **\$179.99** 

In Stock.

Ships from and sold by Amazon.com.

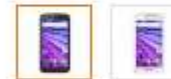
Want it Friday, Sept. 18? Order within **3 hrs 37 mins** and choose **Two-Day Shipping** at checkout. [Details](#)

Style: **Phone**

Phone

Phone and Power Bank

Color: **Black**



- Advanced water resistance
- 13 MP camera which includes a color-balancing dual LED Flash
- 5" HD display; Brilliant display quality and the strength of Corning® Gorilla® Glass
- Quad core processing power in a great value product
- 5MP rear camera with a VGA front facing camera
- Great 24hr battery performance with a 2470mAh battery
- Expandable memory; Slot for an optional microSD card with up to 32 GB capacity.
- 4G LTE Speed; Browse, stream music, watch video, and play games at blazing speed.

Moar Zombies

Smarter right out of the box

Our no-contract phones use WiFi in the home, office or anywhere else as the primary network for calls, texts and data. And if there isn't any WiFi around? No problem, your Republic smartphone automatically switches itself over to cellular so you can stay connected.



moto e

(2nd Gen.)

MOTO E (2ND GEN.) SPECS:

- ✓ 3G + 4G LTE Data
- ✓ 8GB Internal Memory with removable storage options
- ✓ Android™ Lollipop® 5.1
- ✓ 5MP Tap-to-Focus Camera
- ✓ 4.5" qHD Display
- ✓ Black, White with removable [Motorola Bands](#)

Color:

Capacity: [8GB](#)

[More Information](#)

[Accessories](#)

\$129

[ADD TO CART](#)

3.9 (352)

Ships in 2-3 days



moto x

(2nd Gen.)

MOTO X (2ND GEN.) SPECS:

- ✓ 3G + 4G LTE Data
- ✓ 16GB Internal Memory
- ✓ Android™ Lollipop® 5.1
- ✓ 13MP Tap-to-Focus Camera
- ✓ 5.2" AMOLED Full HD Display
- ✓ Black, White or Design Your Own

Color:

Capacity: [16GB](#)

[More Information](#)

[Accessories](#)

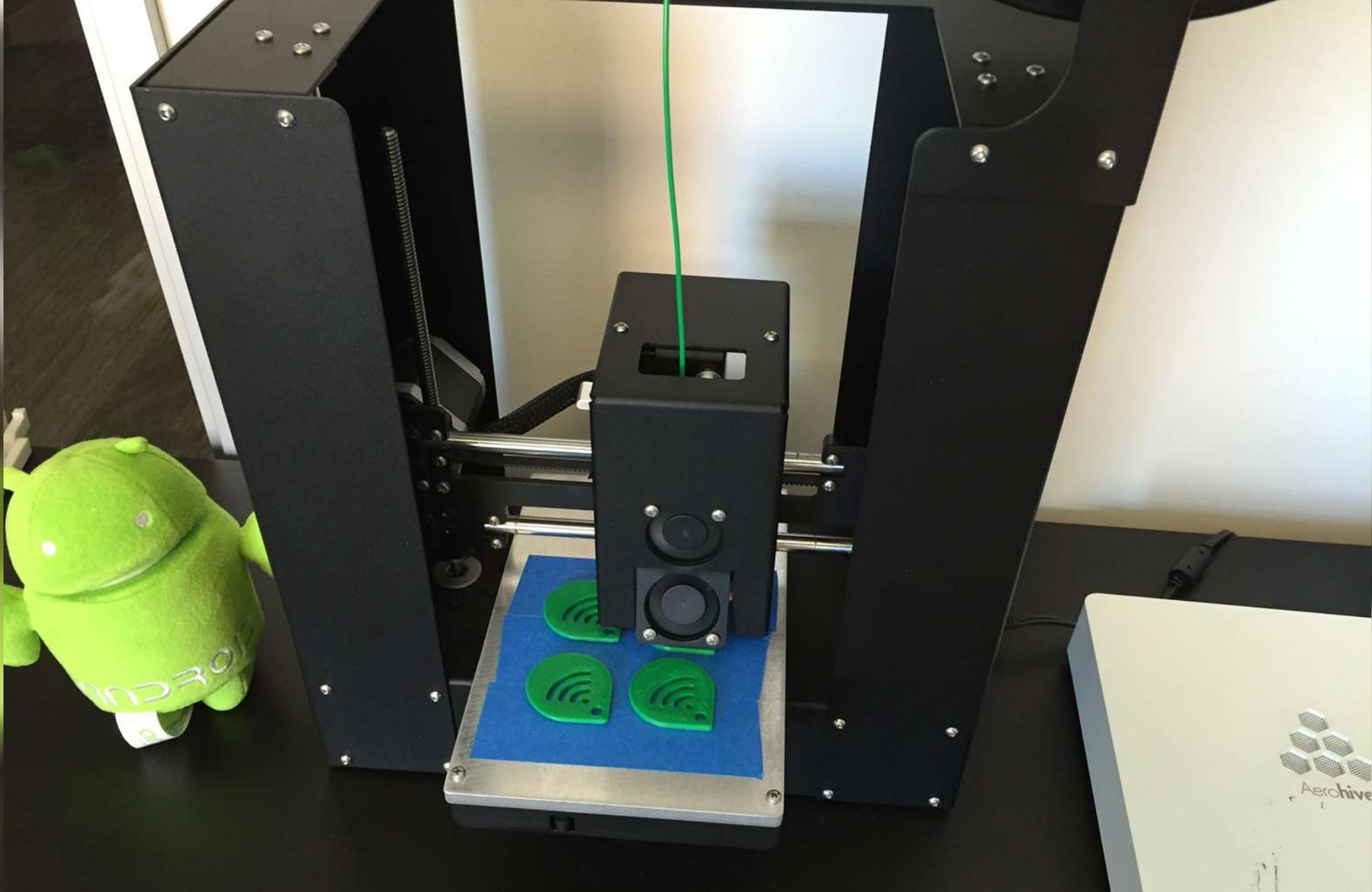
32GB available
BUILD YOURS >

~~\$399~~
\$299

[ADD TO CART](#)

4.3 (741)

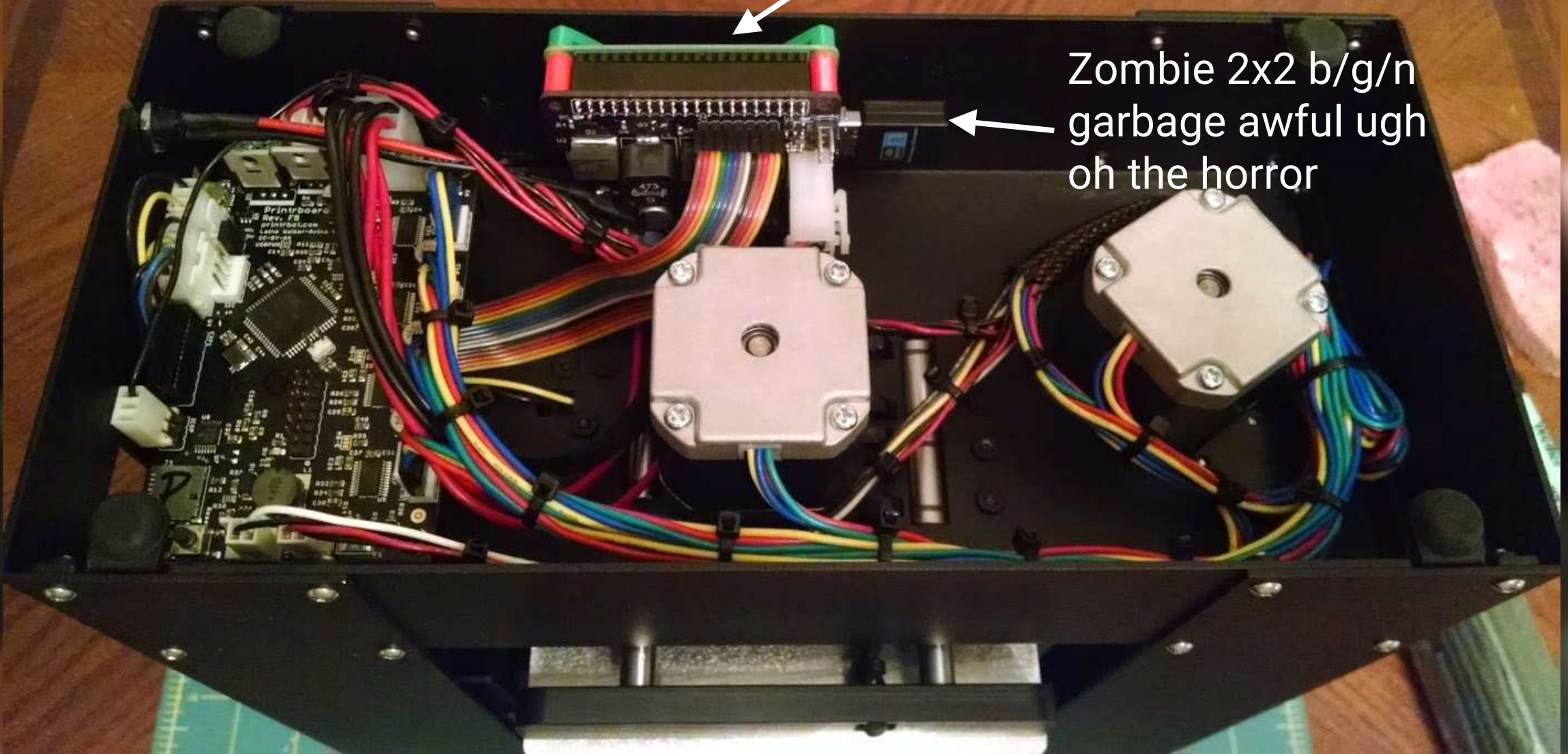
Ships in 2-3 days



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Raspberry Pi Model A+

Zombie 2x2 b/g/n
garbage awful ugh
oh the horror



Another Zombie

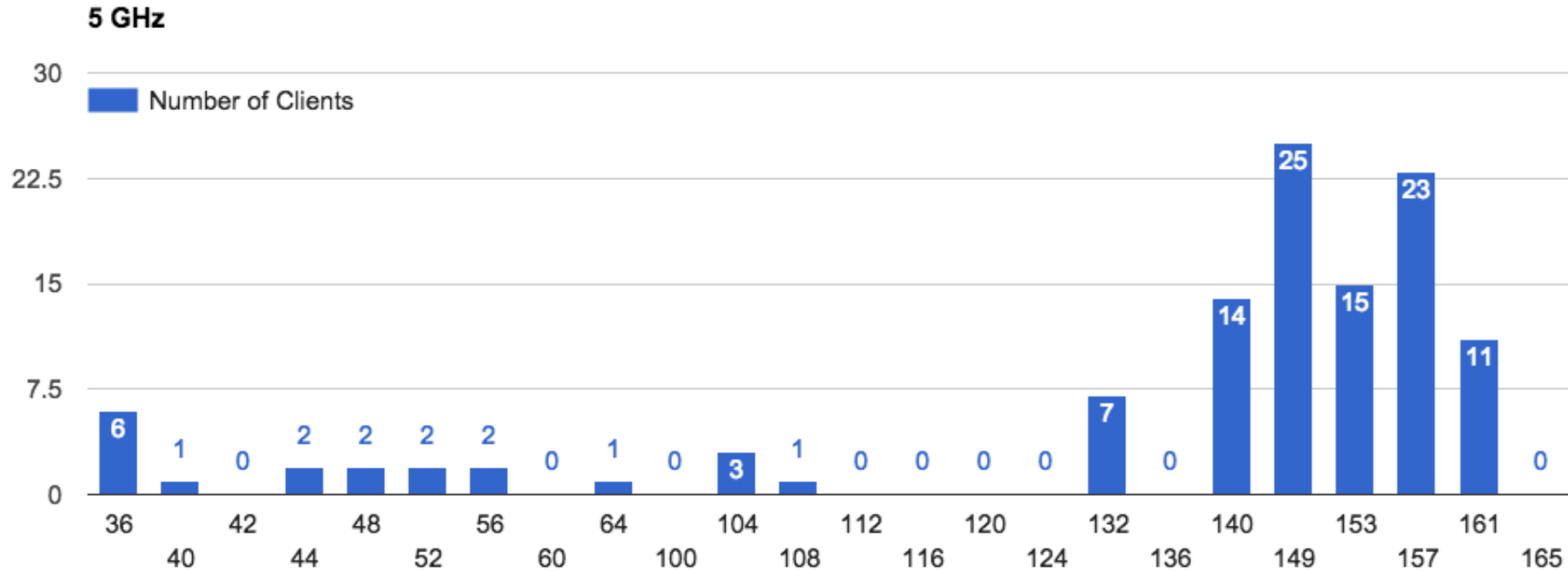
■ Raspberry Pi WLAN Adapters

- Mostly 1x1 b/g/n
- Rarely, 2x2 b/g/n
- No dual-band adapters

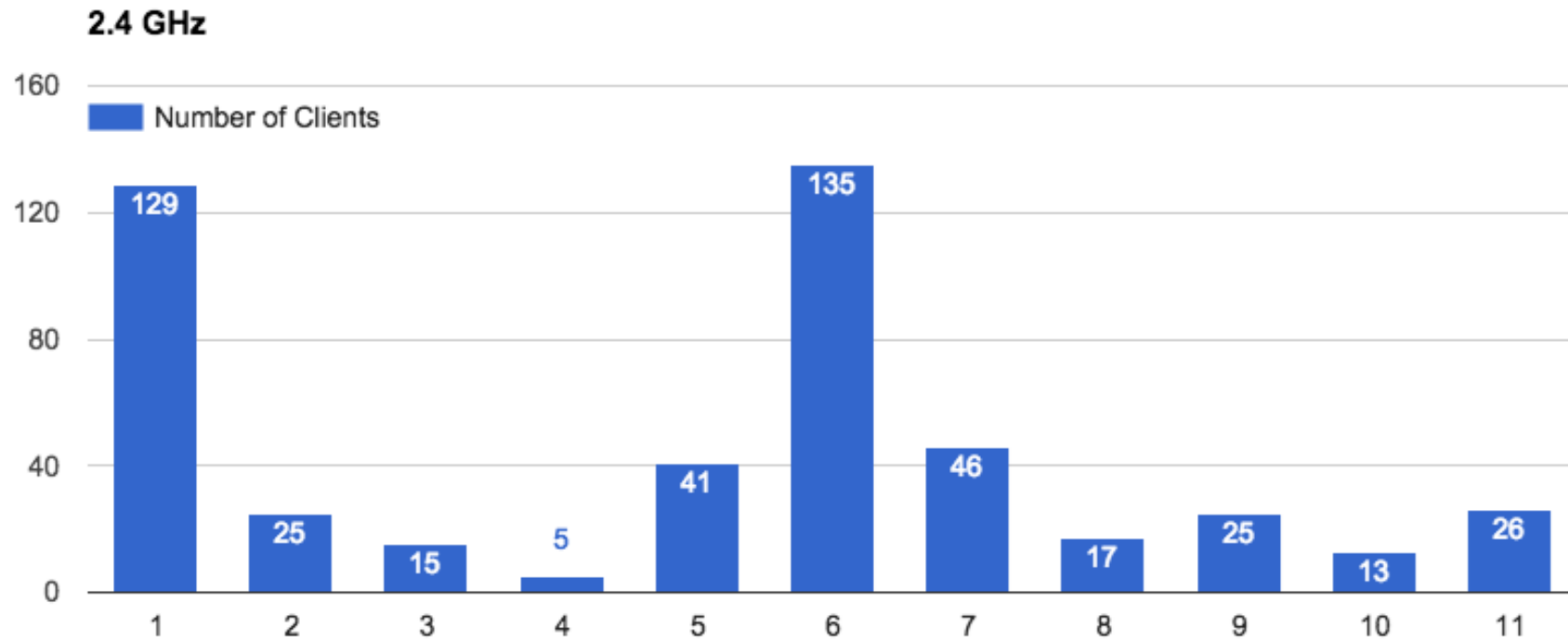
| Manufacturer ↕ | Name ↕ | Hardware description ↕ | Distro support | | | Works w/o hub ↕ | AP mode ↕ | Ad hoc ↕ | Notes ↕ |
|-------------------|---------------------------------------|-----------------------------------------------------------|----------------------------------------------------------------------------|---------------------|------------------------------------------------------------|-----------------|-----------|----------|--------------------------------------------------------------------------|
| | | | Debian ↕ | Raspbian ↕ | Other ↕ | | | | |
| 3COM | 3CRUSB10075 | ZyDAS zd1211rw | ? | ? | ? | ? | ? | ? | |
| 7DayShop | W-3S01BLK | Ralink RT5370 USB: 148f:5370 (Ralink Technology Corp.) | Wheezy preinstalled, but stops after 3-4 hours even with USB workarounds ↗ | ? | ? | Rev 2 | ? | ? | Created wpa.conf, edited 'interfaces' file and restarted the networking. |
| | W-3S01BLKTWIN | MAC mfr.: 7odd90 (Shenzhen Ogemray Technology Co., Ltd.) | | | | | | | |
| Adafruit | Miniature WiFi Module, Raspberry Pi ↗ | Realtek RTL8192cu | Wheezy preinstalled | preinstalled | RetroPie v2.3 preinstalled OpenELEC v4.0.5 preinstalled | Sometimes | ? | ? | |
| ALFA Network Inc. | AWUS036NEH | Ralink RT3070 | Squeeze install firmware-ralink | ? | ? | ? | ? | ? | |
| ALFA Network Inc. | AWUS036NH | Ralink RT3070 | Wheezy install firmware-ralink | install aircrack-ng | Arch use rt2800usb module | ? | ? | ? | |
| ALFA Network Inc. | AWUS036H (500mW version) | Ralink RT3070 | ? | install aircrack-ng | ? | ? | ? | ? | This product is end-of-life. |
| ALFA Network Inc. | AWUS036H (1W version) | Realtek 8187L | ? | install aircrack-ng | ? | Rev 2? | ? | ? | This product is end-of-life. |
| ALFA Network Inc. | AWUS036NHA | Atheros AR9271 | ? | install aircrack-ng | ? | Sometimes | ? | ? | Power: Pi does not boot with adapter inserted; insert after boot. |
| ALFA Network Inc. | AWUS036NHR | Realtek RTL8188RU | ? | Yes | ? | Sometimes | ? | ? | |

5 GHZ CLIENTS CAN BE INFECTED

5 GHz Clients: 115



2.4 GHz Clients: 477



2.4 GHZ HEALTH RISK ADVISORY

UNITED STATES FREQUENCY ALLOCATIONS THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

| | | |
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ACTIVITY CODE

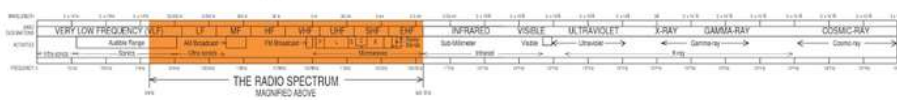
| | |
|--|--|
| | |
| | |

ALLOCATION USAGE DESIGNATION

| Service | Example | Description |
|-----------|---------|--------------------------------------|
| Primary | FIXED | Capital Letters |
| Secondary | Mobile | 1st Capital with three lower letters |

This chart is a graphic representation of the Table of Frequency Allocations used by the FCC and is not intended to be construed as a license. It is for informational purposes only and does not constitute a license to use any of the frequencies shown. For complete information, users should consult the Table of Frequency Allocations.

U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management
October 2003



PLEASE NOTE: THE SPECTRAL ALLOTMENT SHOWN IN THE SPECIFIC FREQUENCY BANDS IS SUBJECT TO CHANGE WITHOUT NOTICE.



THE RULES

For zombie apocalypse survival

Rule #1

Carry weapons.

Crossbows!



Samurai Swords!



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Certified Wireless Network Professional



Crowbars!



A piece of chicken...?

Saved screenshot as 2015-09-25_23.56.12.png



Tools

- Use the right tool for the right job
 - Wi-Fi Scanners
 - Spectrum Analyzers
 - Packet Analyzers
 - Virtual RF Planning/Site Survey Tools
- Get training, understand underlying 802.11
- Set them up before you leave!

A high-angle photograph of a multi-lane highway. The left side of the highway is completely blocked by a massive traffic jam of cars and a bus. The right side of the highway is clear, and a person is riding a brown horse down the center of the road. To the right of the highway, there is a train wreck with several derailed passenger cars. In the background, a city skyline with several tall skyscrapers is visible under a blue sky with light clouds.

Rule #3

Whenever possible, rescue.

A large crowd of people is gathered in a stadium, with a large pile of debris in the foreground. The scene is dimly lit, suggesting an indoor arena or stadium. The crowd is dense, and the debris is piled high, creating a sense of chaos or a major event. The text "USE BAND STEERING" is overlaid in white, bold, sans-serif font across the center of the image.

USE BAND STEERING



SOCIALLY ENGINEERED BAND STEERING

#wifitrek

Certified Wireless Network Professional



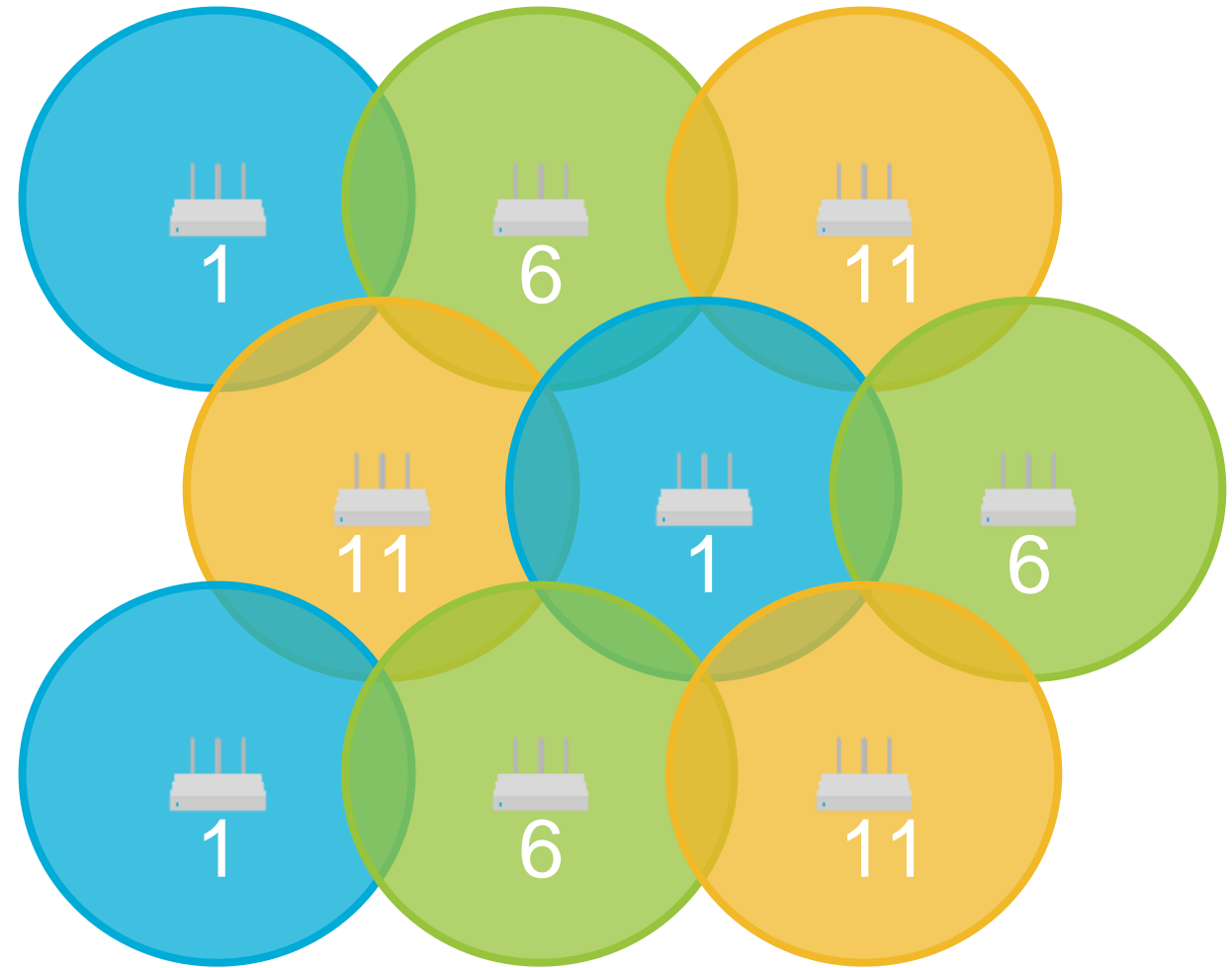


Rule #4

Have a plan.

Design for Containment

- Set requirements
- Design to requirements
 - Reuse channels efficiently
 - Minimize co-channel interference
- Test requirements



Rule #6

Put down easy targets.

Rule #9

Travel light.

| CHANNEL | CHANNEL UTILIZATION | ON-CHANNEL NETWORKS | MAX SIGNAL | OVERLAPPING NETWORKS | MAX OVERLAPPING SIGNAL | ZOMBIES PRESENT |
|---------|---------------------|---------------------|------------|----------------------|------------------------|-----------------|
| 1 | 8.3% | 14 | -48 dBm | 7 | -72 dBm | Yes |
| 2 | 8.7% | 4 | -72 dBm | 16 | -48 dBm | Yes |
| 3 | 8.6% | 1 | -76 dBm | 36 | -48 dBm | Yes |
| 4 | 8.9% | 1 | -76 dBm | 37 | -48 dBm | Yes |
| 5 | 10.0% | 0 | -76 dBm | 26 | -52 dBm | |
| 6 | 11.1% | 17 | -52 dBm | 8 | -54 dBm | Yes |
| 7 | 13.9% | 1 | -69 dBm | 24 | -52 dBm | Yes |
| 8 | 16.6% | 2 | -72 dBm | 36 | -44 dBm | Yes |
| 9 | 17.8% | 3 | -54 dBm | 35 | -44 dBm | Yes |
| 10 | 21.1% | 1 | -77 dBm | 20 | -44 dBm | Yes |
| 11 | 27.8% | 14 | -44 dBm | 7 | -54 dBm | Yes |
| 36 | 0.2% | 0 | N/A | 0 | N/A | |
| 40 | 0.0% | 0 | N/A | 1 | -95 dBm | |
| 44 | 0.0% | 3 | -86 dBm | 3 | -86 dBm | |
| 48 | 0.1% | 0 | N/A | 2 | -86 dBm | |
| 52 | 0.0% | 0 | N/A | 0 | N/A | |



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Rule #11

Stay quiet.



Rule #13

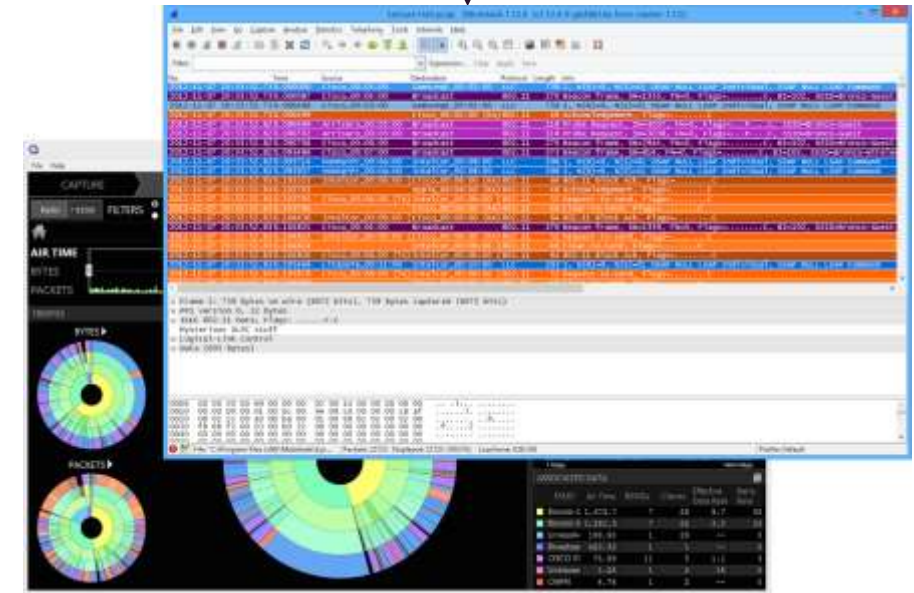
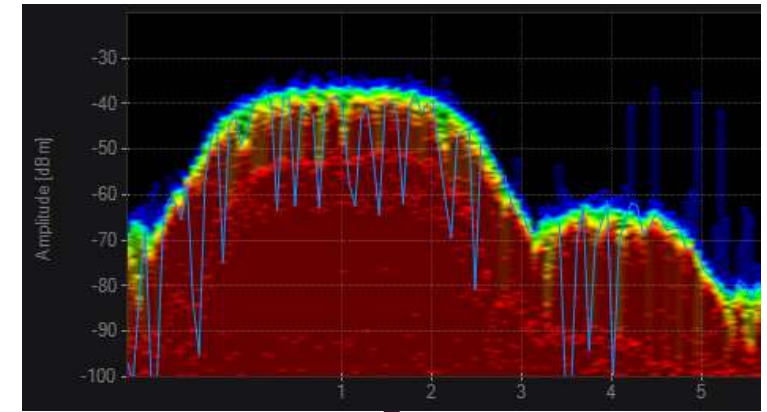
Become one of them.

Rule #0

Warn others.

Educate Others

- SMB, home automation, pro-sumers
 - “Worse range”
 - “There’s no support for it”
 - “It’s more expensive”
- Teach Command-line tools
- Teach Layer 1 -> Layer 2 Troubleshooting



Vendors, join the fight!

- Make it difficult to cause adjacent-channel interference
 - Ship with 40 MHz channels disabled
 - Encourage users to turn down the transmit power

Mi-Fi Zombies



- Mi-Fi vendors... seriously!?
- A little common sense in firmware can go a long way

2.4 GHZ ISN'T DEAD...
IT'S A ZOMBIE.



PLEASE STAND BY