Jack-Daniyel Strong

Jack is the President of J-D Strong Consulting, Inc. and Strong Solutions. As a member of the Apple Consultants Network, grew from a one-man consultancy into an Apple Authorized Reseller and Service Provider for the Eastern Washington and Northern Idaho area. Most recently, JD joined the team of Watchman Monitoring to help with documentation and support.

STRONG SOLUTIONS
TECHNOLOGIES FOR A DIGITAL LIFE

J-D strong consulting
business technology solutions

Consultants Network

MACTECH PRO EVENTS

WATCHMAN MONITORING

What does
Good Wi-Fi
mean in 2019?

MACTECH PRO EVENTS

Thanks to
Jeanette Lee
Ruckus Wireless

MACTECH PRO EVENTS

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Roll over image to zoom in

Linksys WRT54GL Wi-Fi Wireless-G Broadband Router

by Linksys

4.2 out of 5 stars 6,213 customer reviews | 1000+ answered questions

Get the Best Deal

List Price: $79.99

Price: $38.96 & FREE Shipping. Details

You Save: $41.03 (51%)

Coupon Save an extra $0.44 when you apply this coupon. Details

Note: Available at a lower price from other sellers that may not offer free Prime shipping.

Free Amazon tech support included

Model: **WRT54GL**

WRT1900ACS	WRT3200ACM	WRT54GL
$159.99	$249.97	$38.96

- Linux-based Internet-sharing Router with built-in 4-port Switch and Wireless-G Access Point
- Shares a single Internet connection (10/100 WAN) with 4 Ethernet wired (10/100 switched LAN ;Compliant with the IEEE 802.11b/g protocol;LEDs: Power, DMZ, WLAN, Ethernet (1, 2, 3, 4), Internet
- Max. Link Rate:54 Mbps; Has 2 External Antennas ; supports WPA2 standards for use of the available encryption regardless of client devices and features a built in SPI firewall to prevent potential attacks from the Internet
- Interface: Ethernet Port; Ports: 1x 10/100 WAN, 4x 10/100 Switched LAN, 1x Power;Dimensions 3.91 x 3.85 x 3.92" / 99.5 x 97.8 x 99.6 mm
- Platform Compatibility: Windows XP , Windows Vista 32/64 ; package includes router and no modem. Operating Humidity:10 to 85% Noncondensing

Compare with similar items

Used & new (63) from $20.58 & FREE shipping.

MACTECH PRO EVENTS

Agenda

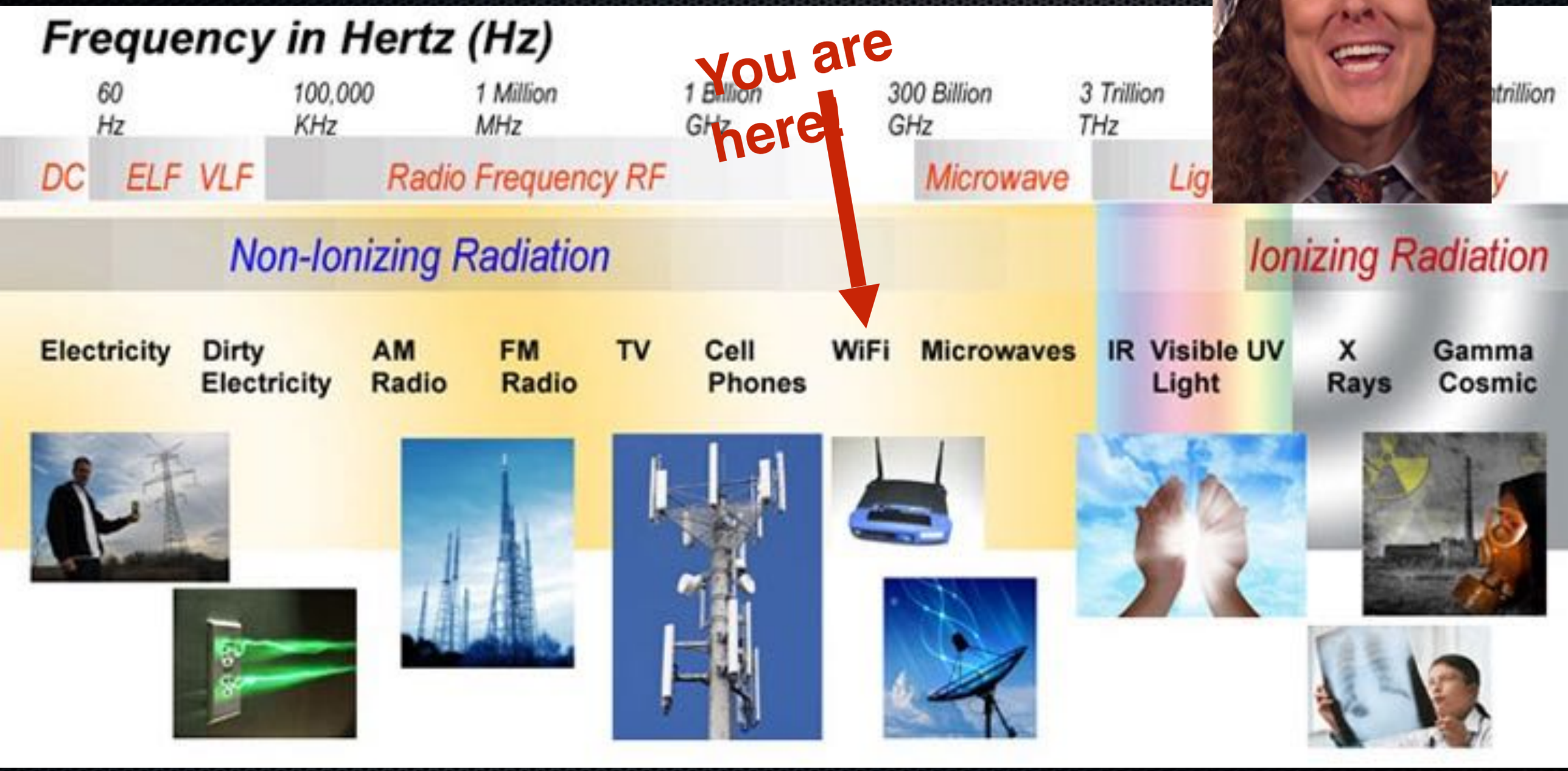
- A brief history of Wi-Fi
- Wi-Fi 6
- AP Density
- Wi-Fi Mesh
- 5G

What is Wi-Fi?

- Only means "Wi-Fi." (Wireless Fidelity)
- A trademark of the Wi-Fi Alliance.
- 'human' for the IEEE 802.11 family of wireless networking protocols.
- 802.11 is an alphabet soup of protocols
  - 802.11a,b,d,e,g,h,i,j,k,n,r,v…ac,…ax,ay
- Wireless Networking using RF waves for communication between two or more systems.

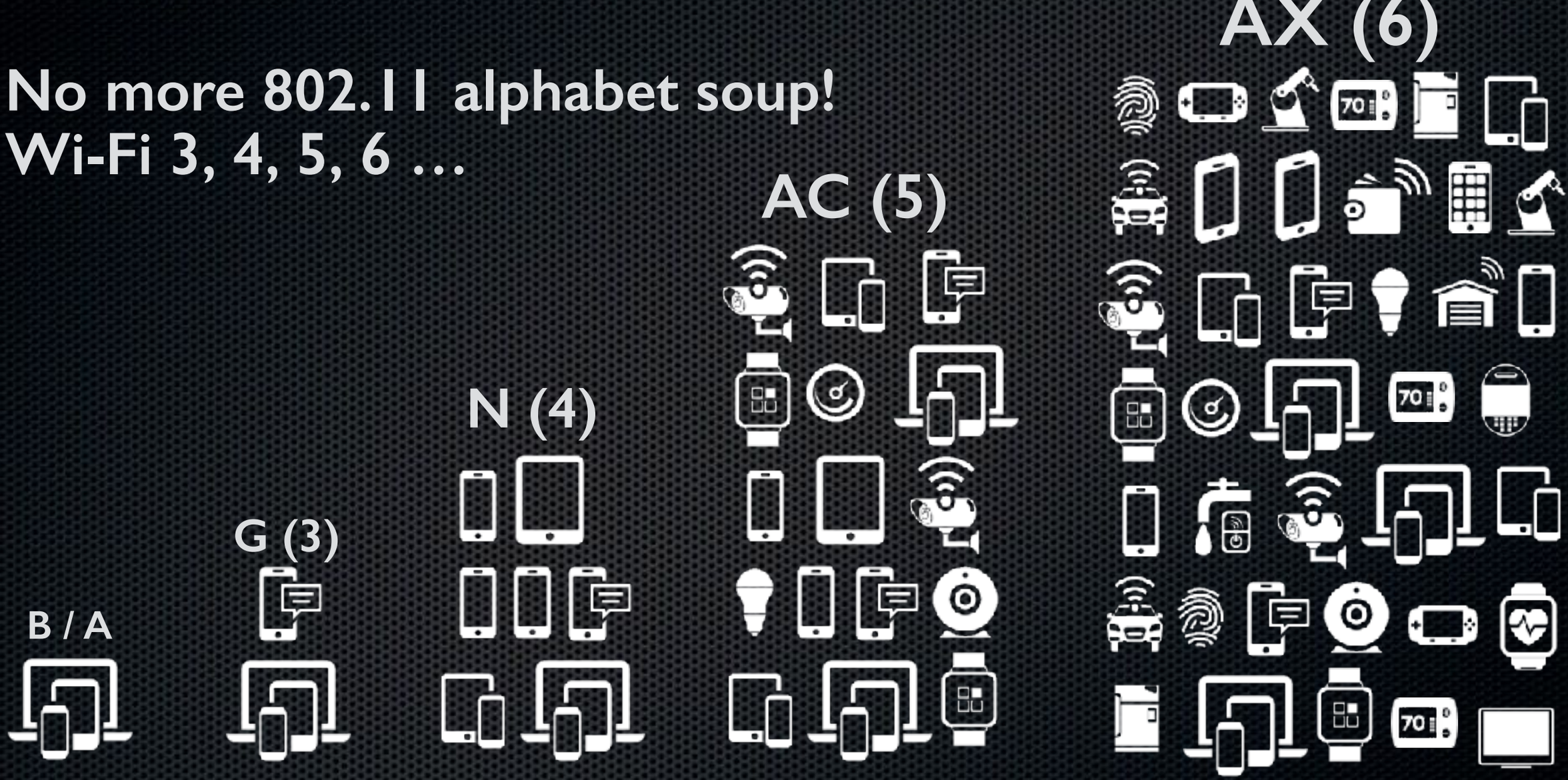
courage
What is frequency, Kenneth?
And as they punched and kicked him, they repeated: "What is the frequency, Kenneth?"
The building's doorman saw the attack and phoned the building superintendent, who rushed to the lobby.

Frequency


Frequency in Hertz (Hz)
60 Hz
100,000 KHz
1 Million MHz
1 Billion GHz
300 Billion GHz
3 Trillion THz
DC
ELF VLF
Radio Frequency RF
Microwave
Non-Ionizing Radiation
Ionizing Radiation
You are here!
Electricity
Dirty Electricity
AM Radio
FM Radio
TV
Cell Phones
WiFi
Microwaves
IR
Visible UV Light
X Rays
Gamma Cosmic

Evolution of Wi-Fi

No more 802.11 alphabet soup!
Wi-Fi 3, 4, 5, 6 …



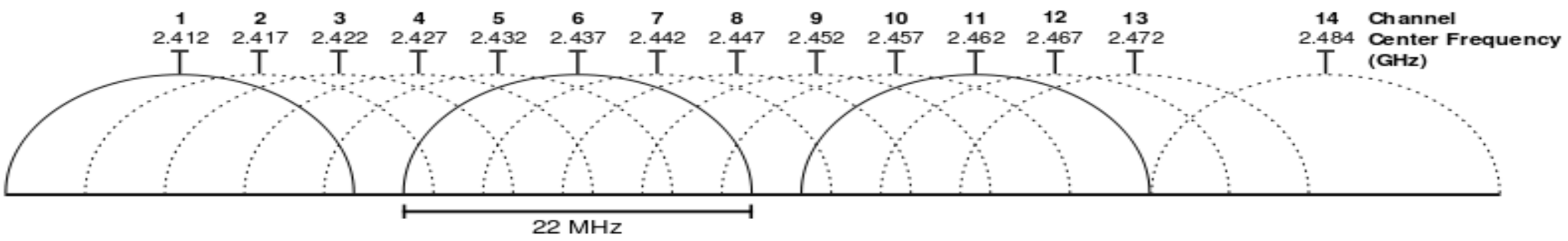
Battle of the Bands

2.4 Ghz **5 Ghz**

¯_(ツ)_/¯

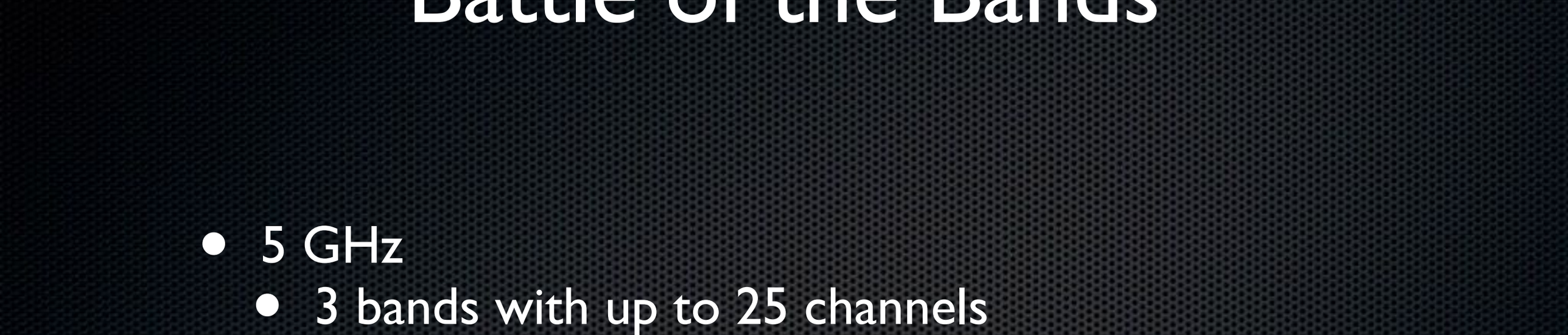
Battle of the Bands

- 2.4 GHz
  - Traditionally 3 non-overlapping channels (1, 6, 11)
  - Lots of non-Wi-Fi transmitters in band
  - Legacy equipment



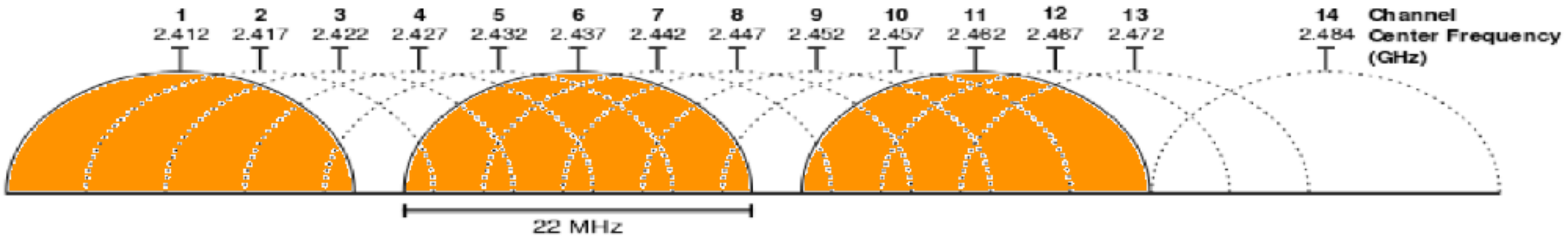
Battle of the Bands

- 5 GHz
  - 3 bands with up to 25 channels
  - Not as widely adopted
  - Relatively "clean" spectrum



Battle of the Bands - 2.4 Ghz

- 802.11b/g/n
- Propagates better through obstructions like walls
- Widely adopted frequency for millions of devices
- **Heavily** congested
- MANY non-network sources of interference

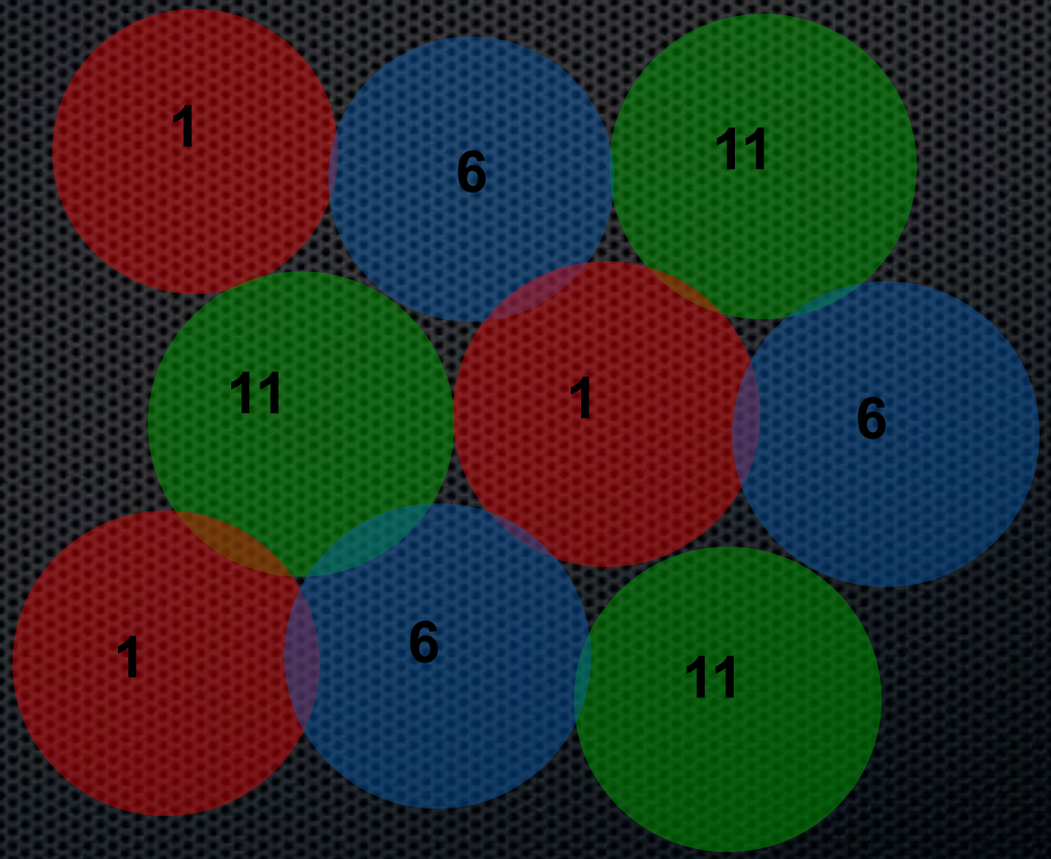


Battle of the Bands - 5 Ghz

- 802.11a/n/ac/ax
- Channel Width
- 802.11ac:
  - only 5 80MHz channels
  - only 2 160MHz channels! (including DFS)
- Frequency not the only measure of speed (QAM)

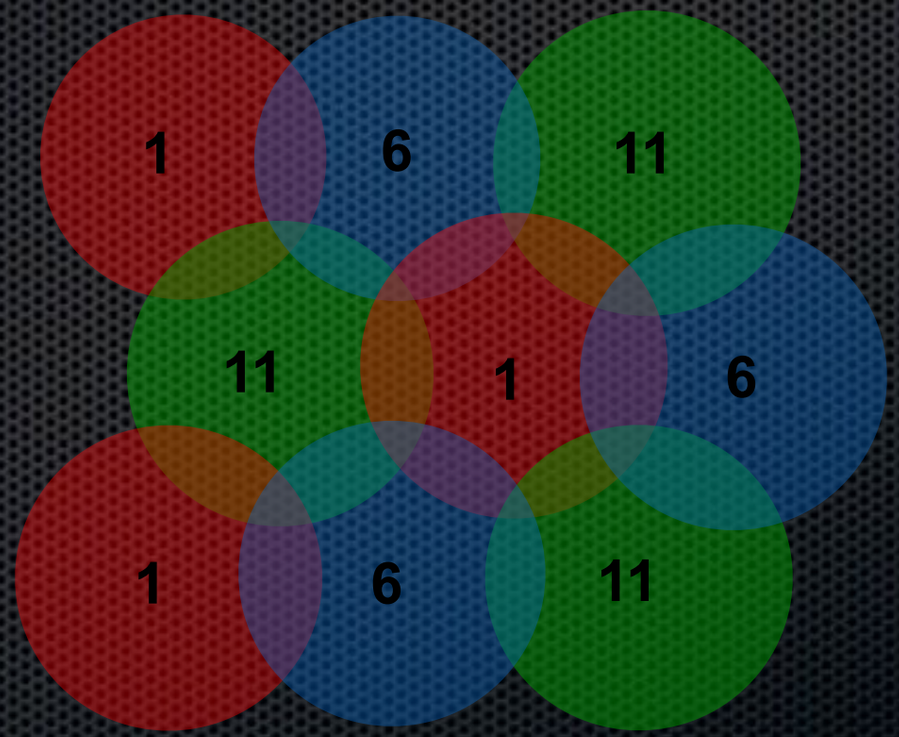
Battle of the Bands - AP Density

- 3 Channels

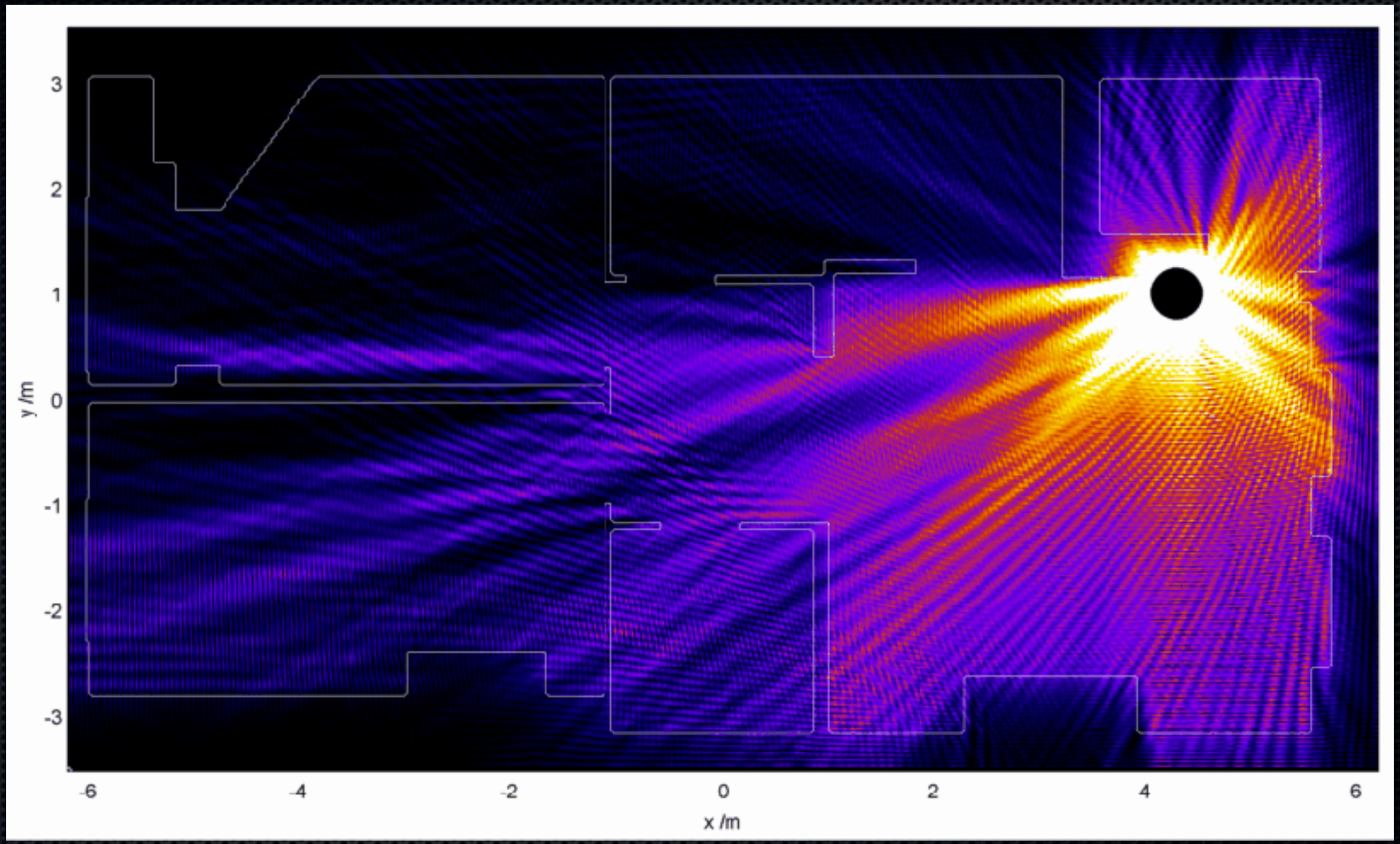


Battle of the Bands - AP Density

- Reality

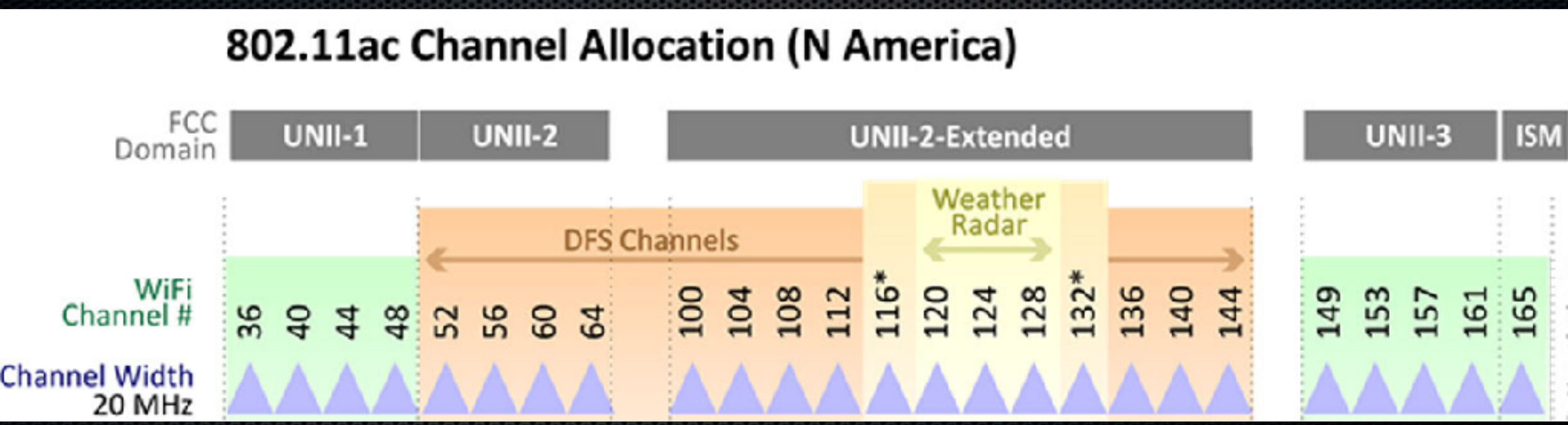


Battle of the Bands - AP Density



Battle of the Bands - AP Density

- 5 Ghz - 24 Channels!



Client Performance

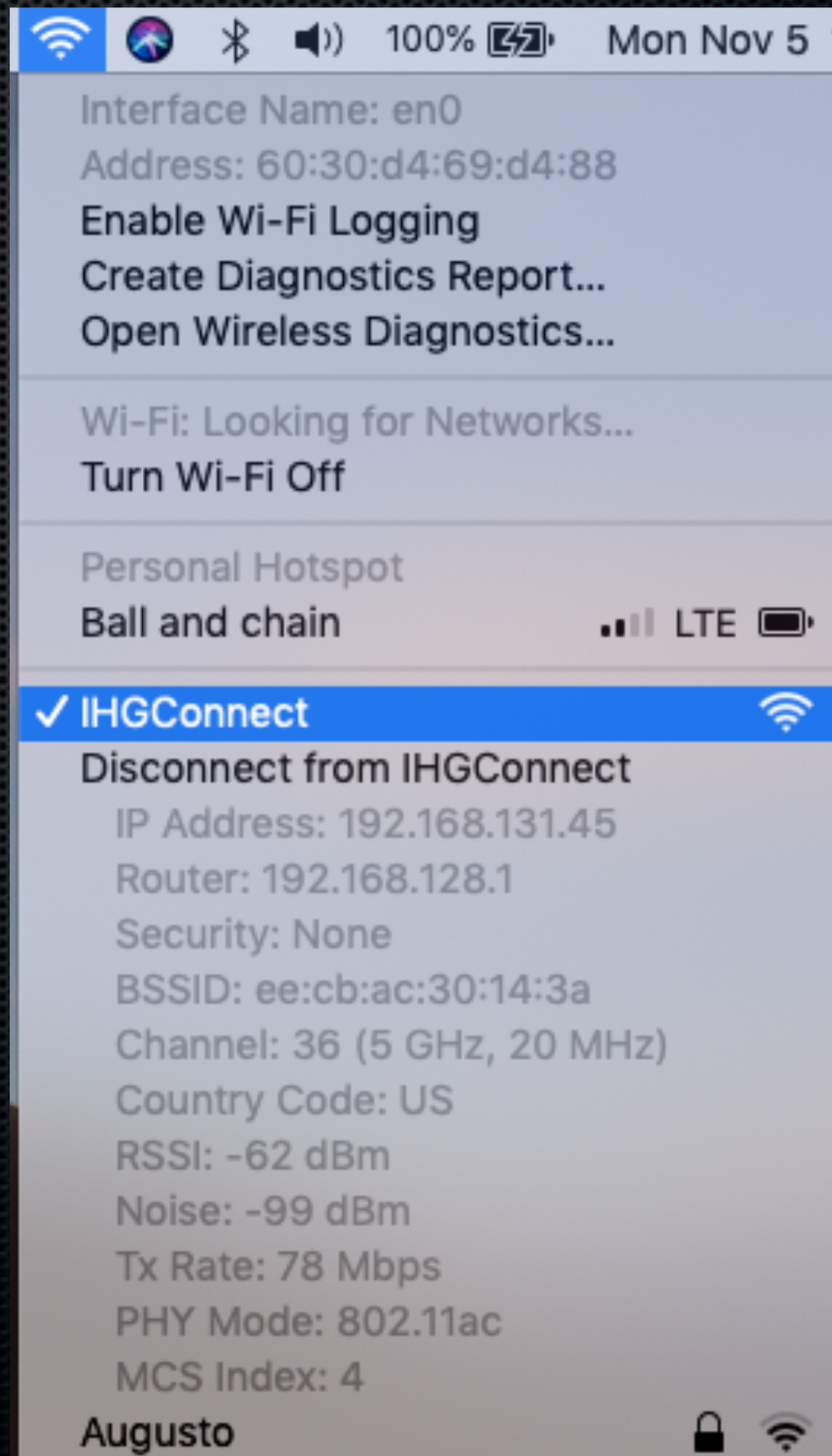
- PHY rate
  - Theoretical Max Speed
  - NOT the actual Speed

- Goodput
  - Good put = (PHY rate) – (Overhead)

- PHY: 866 Mbps – TCP & 802.11 overhead (~40%-50%) = a *goodput* of ~430 Mbps

Client Performance

- Option-Click for the 411
  - Security
  - BSSID
  - Channel, channel width
  - Country code
  - RSSI
  - Noise
  - Tx Rate
  - PHY mode
  - MCS index



Wi-Fi 6

802.11x
1.1 Gbit/s (2.4 Ghz)
4.8 Gbit/s (5 Ghz)
Lower Power
Better Performance

The Need for Wi-Fi 6

- Protocol Overhead & Inefficiency
- Limited Number of Channels
- Proliferation of Wi-Fi Devices
  - 8 Devices/User (2012) to 50 Devices/User (2022)
- IoT: multiple devices, low bandwidth
- Demand for increased Capacity with QoS

The Need for Wi-Fi 6 cont.

- Apps demand more
  - Social Media, On-Demand Video, etc.
  - Battery operated devices
  - Single Tx Channel

The Need for Wi-Fi 6 cont.

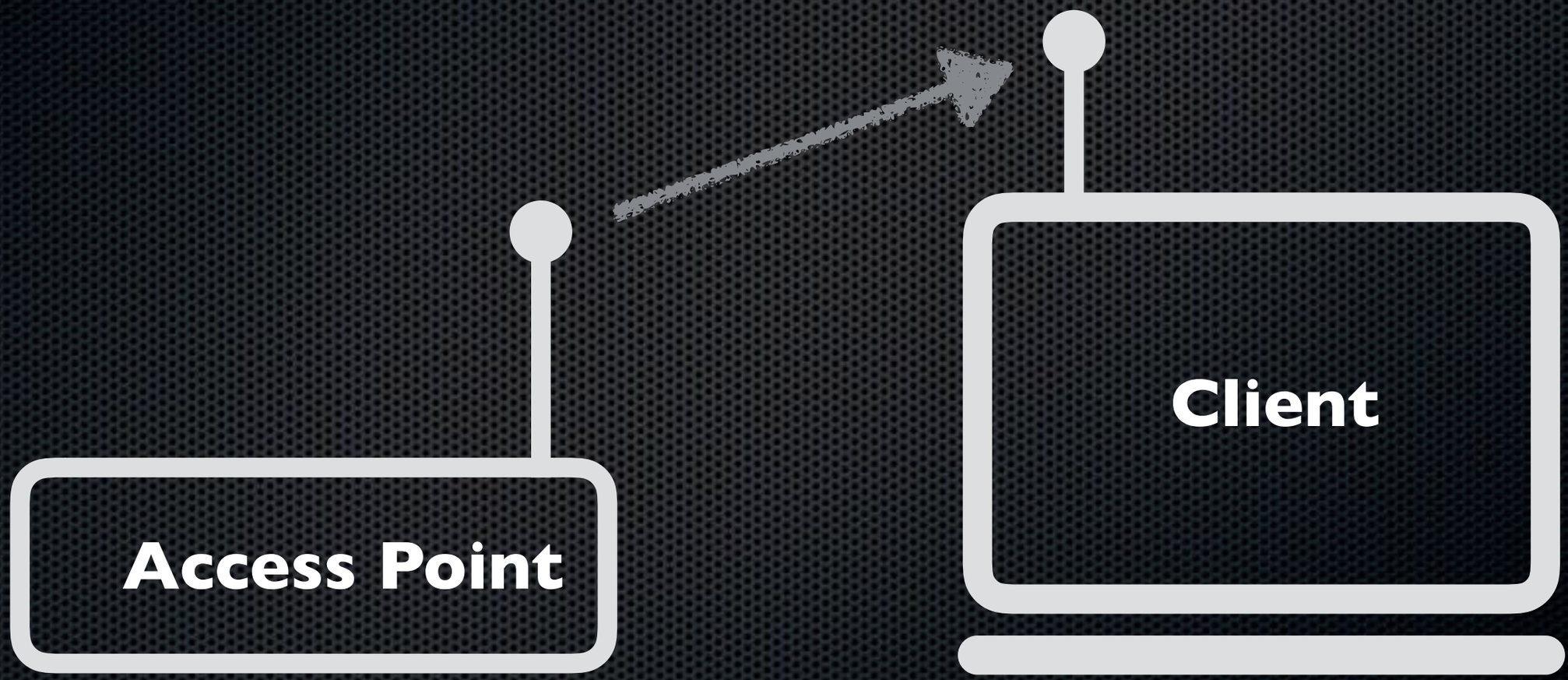
- High Density Environments
- Large Public Venues
- Mobile Data Offloading

Signals

In the Beginning…

One True Signal…

Tx x Rx : SS



1 x 1 : 1

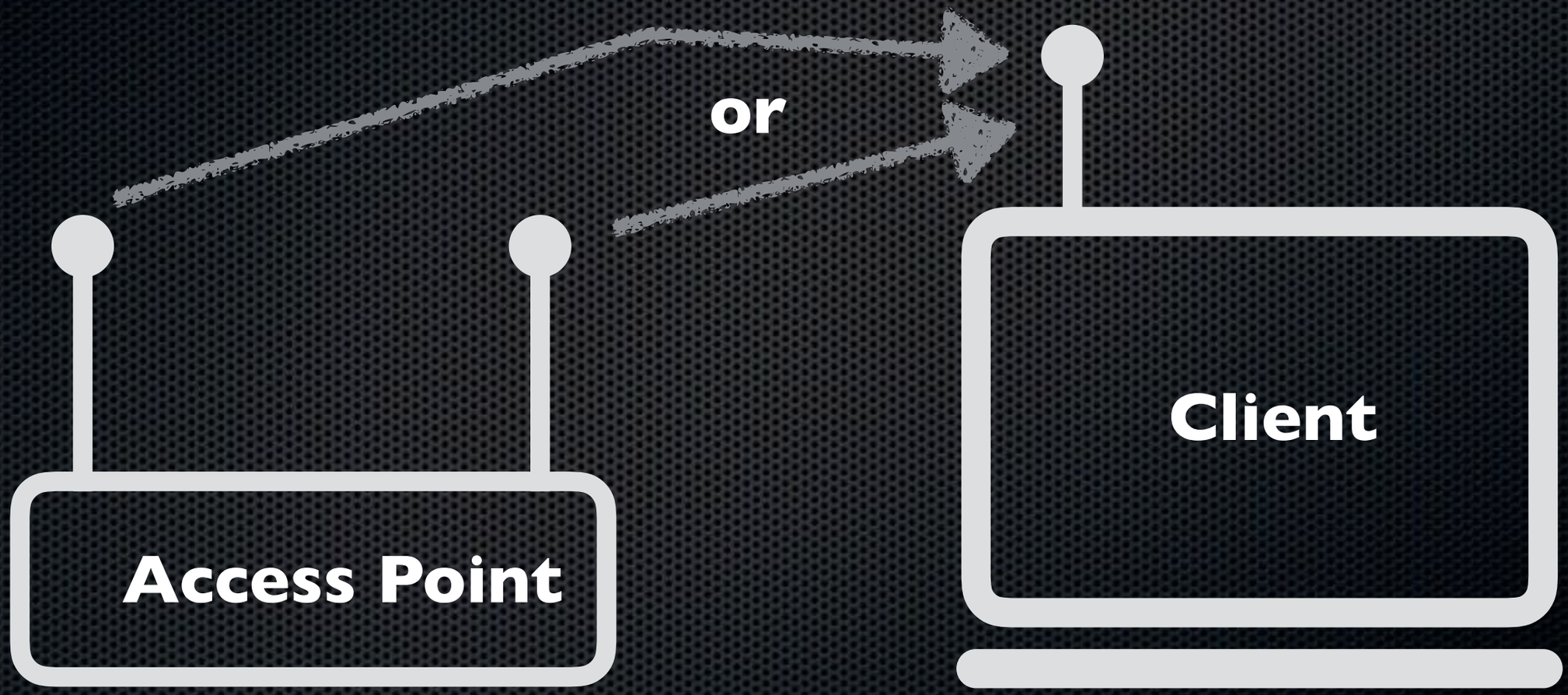
1 x 1 : 1

Two Signal Paths

Diversity

Tx x Rx : SS

or



2 x 2 : 1

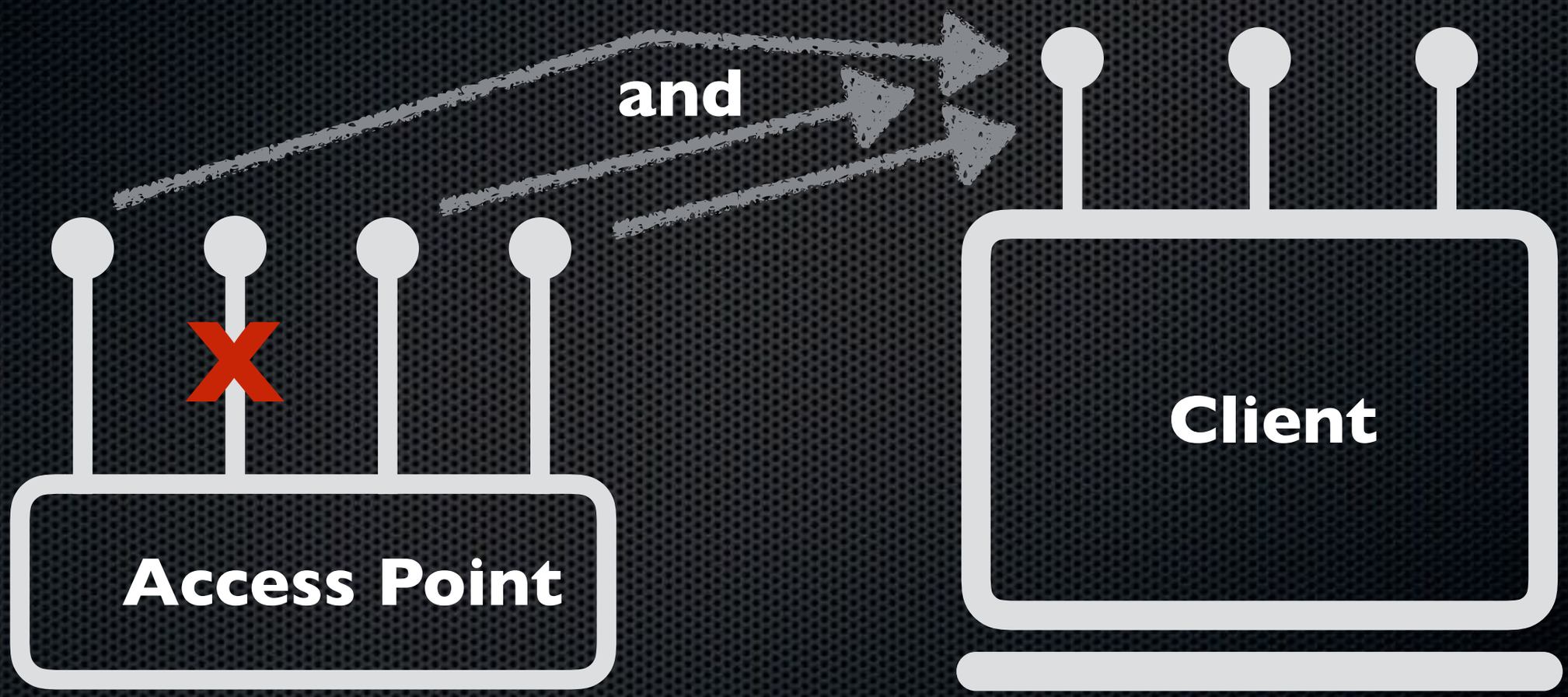
1 x 1 : 1

MIMO

Keep 'em Separated

Tx x Rx : SS

and

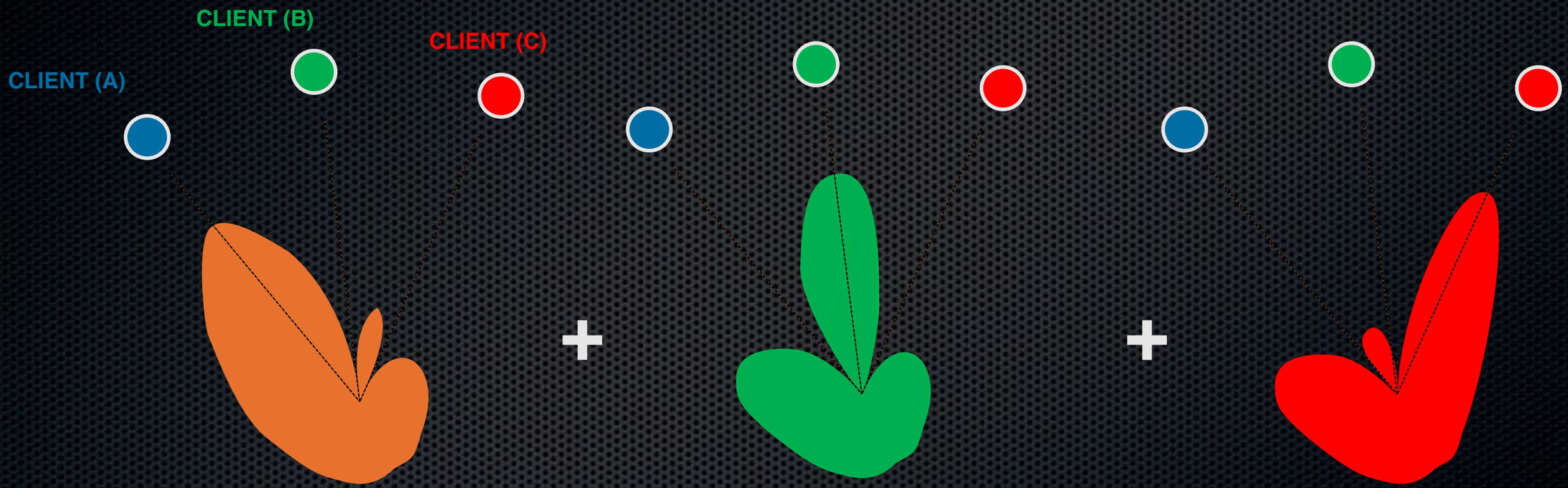


4 x 4 : 4

3 x 3 : 3

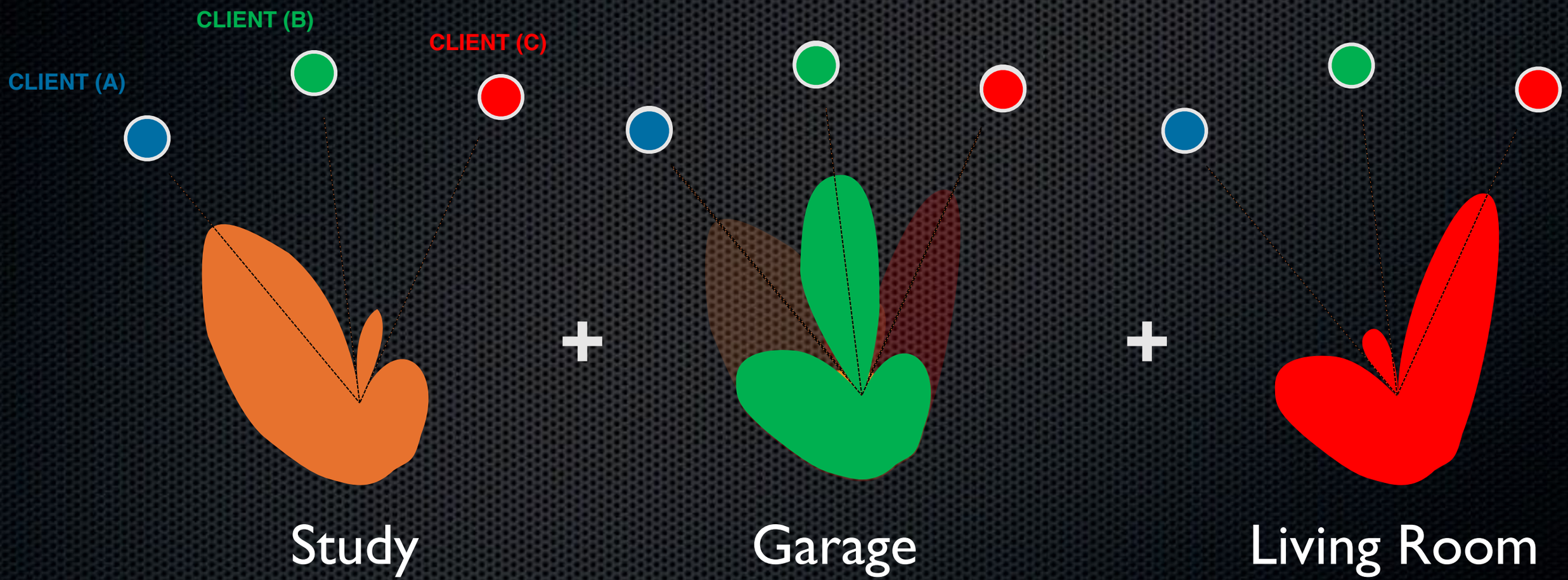
MU-MIMO

Tx Beamforming

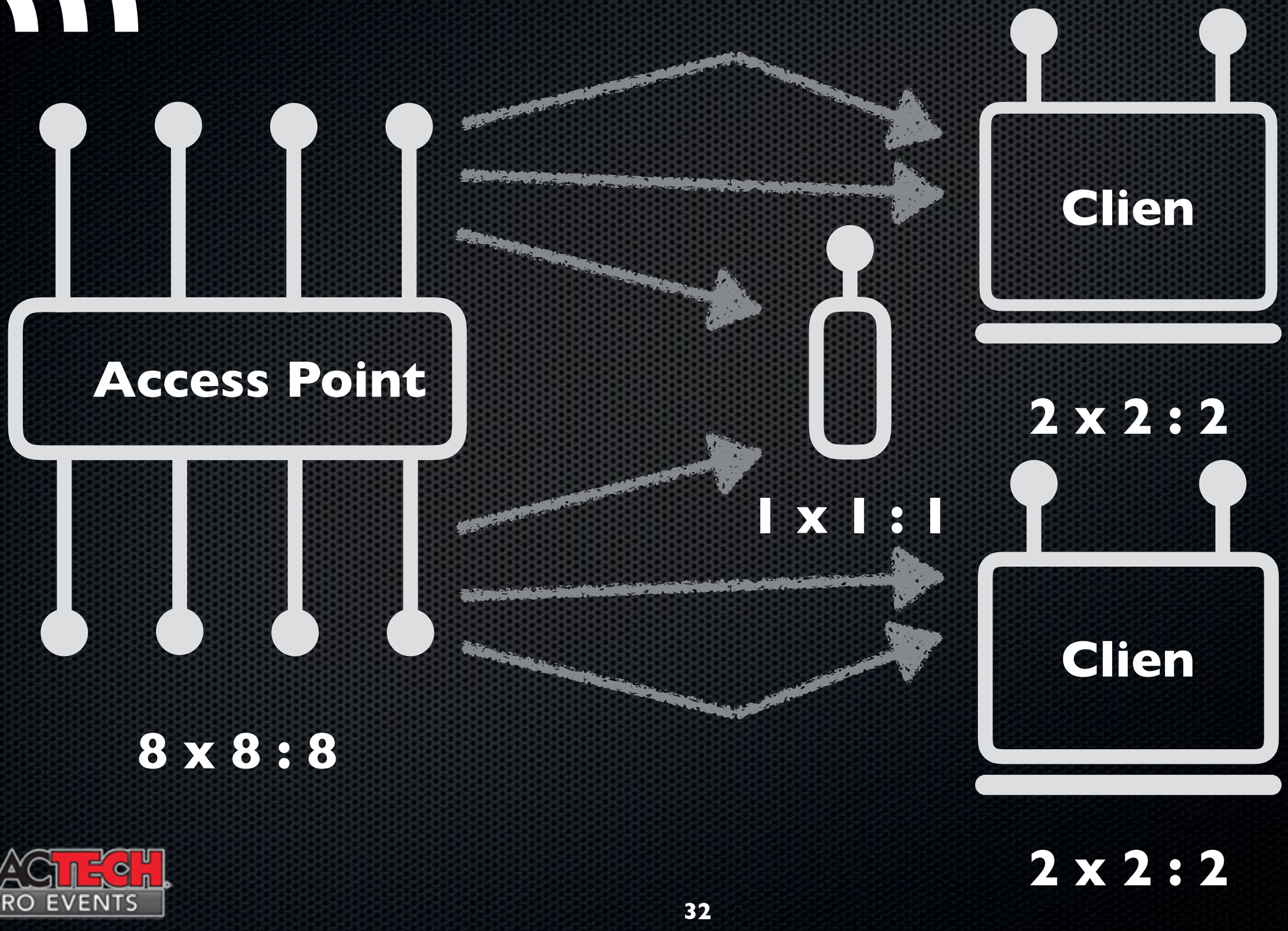


MU-MIMO

Tx Beamforming



8 Stream MU-MIMO



Wi-Fi 6 - The Details

- High Density Network Improvements
- Large Public Venues
- Mobile Data Offloading

Deployment Considerations

- Multi-Gb Peak Wi-Fi PHY = Multi-Gb Ethernet Backhaul
- Higher Power consumption = PoE+ from switch/controller

5 GHz Band # Radio	2.4 GHz Band # Radio	Average TCP T'put*	Ethernet Backhaul	Input Power over PoE
8x8	4x4	2.7 Gbps	5 Gbps	> PoE+
4x4	4x4	1.4 Gbps	2.5 Gbps	PoE+
▼	▼	▼	▼	▼
2x2	2x2	0.7 Gbps	1 Gbps	PoE

AP Density

AP Density

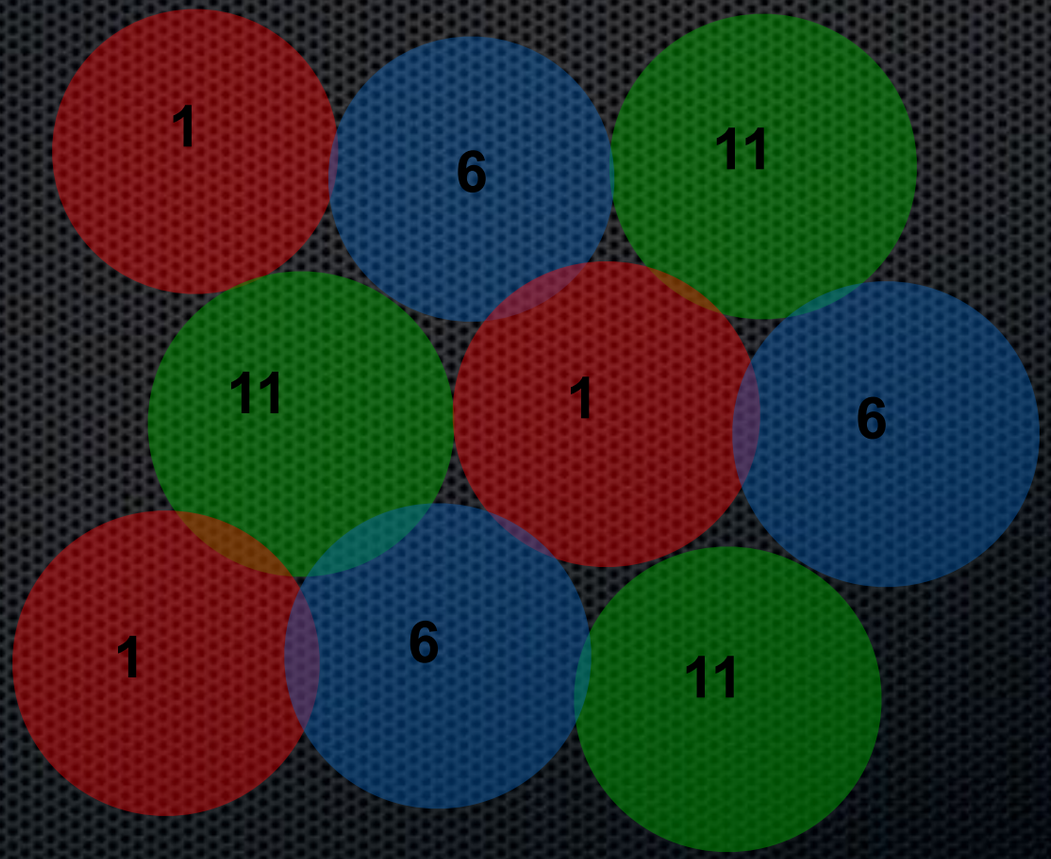
- How far can the signal from an AP go?
- Factors
  - Clients
  - Handheld Clients
  - Environment

AP Density

- How many clients can I have per AP?
- Factors
  - Clients
  - Application
- Advanced *Wi-Fu* moves:
  - Airtime Fairness
  - Client Load Balancing
  - Band Balancing

AP Density

- 3 Channels

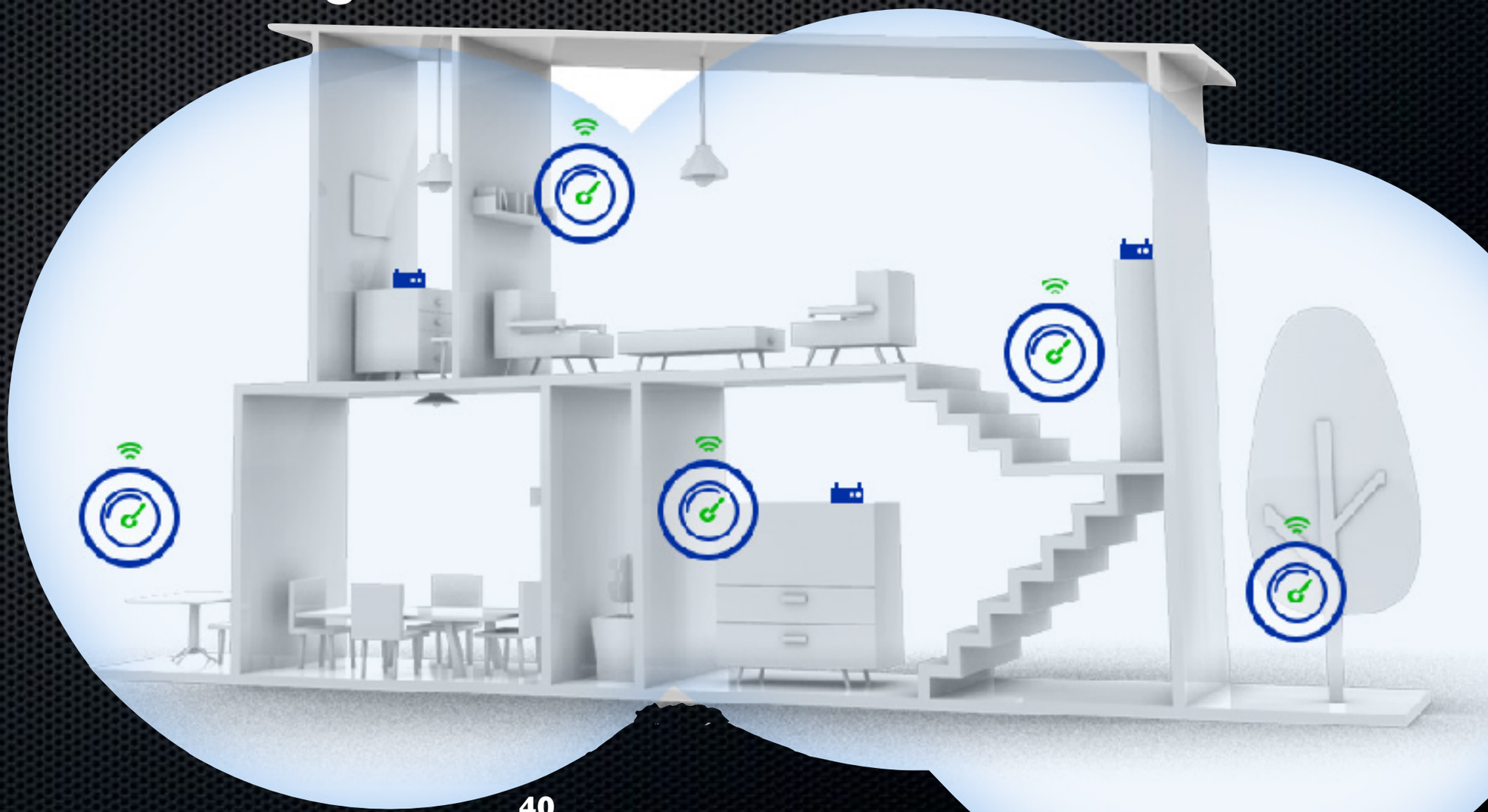


AP Density Considerations

- More Devices
- Infrastructure
- Clients

Let's Mesh It Out

- Improve Coverage
- Seamless Roaming

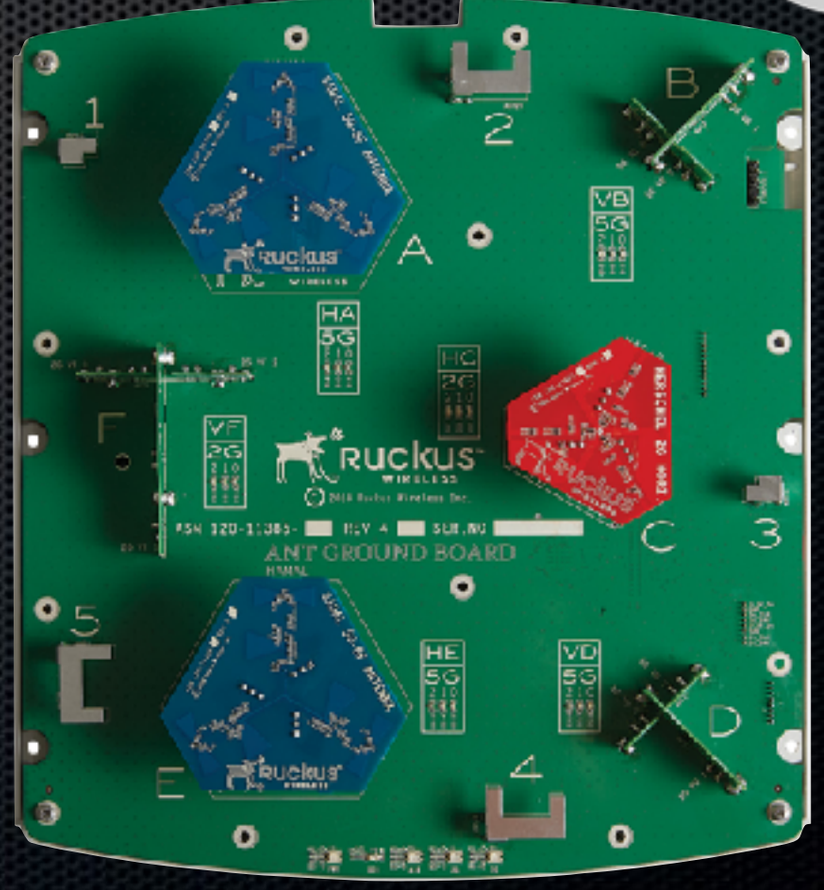


Let's Mesh It Out

- Range Extenders
- Wireless Mesh

AP Density

- Wired APs
- Wireless Controller



AP Density

- Which device decides when a client should roam to a new AP?

5G

MACTECH PRO EVENTS

1G, 2G, 3G, 4G, 5G

- G = Generation
- 1G - Analog Cellular
- 2G - CDMA, GSM & TDMA
- 3G - EVDO, HSPA & UMTS
- 4G - WiMAX & LTE

5G

- Greater speed
- Lower latency
- MO-MIMO

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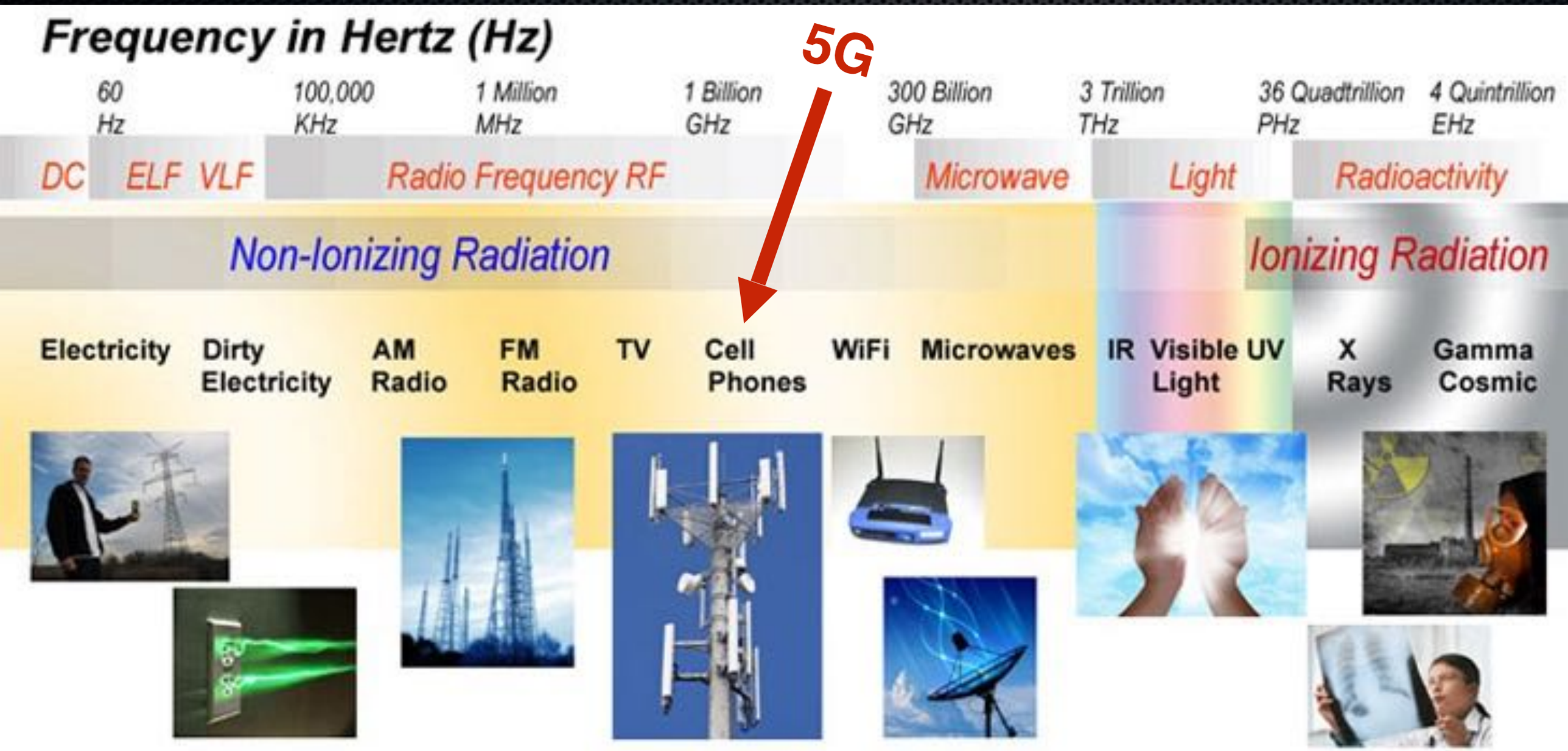
Frequency


Frequency in Hertz (Hz)
5G
60 Hz
100,000 KHz
1 Million MHz
1 Billion GHz
300 Billion GHz
3 Trillion THz
36 Quadtrillion PHz
4 Quintrillion EHz
DC
ELF VLF
Radio Frequency RF
Microwave
Light
Radioactivity
Non-Ionizing Radiation
Ionizing Radiation
Electricity
Dirty Electricity
AM Radio
FM Radio
TV
Cell Phones
WiFi
Microwaves
IR
Visible UV Light
X Rays
Gamma Cosmic

So Why Do We Care?

- 5G False Advertising (5Ge)
- 5G Devices >2years
- 5G Infrastructure >5 years
- Wi-Fi Handoff

What does
Good Wi-Fi
mean in 2019?

MACTECH PRO EVENTS

Planning Checklist

- Requirements Gathering
  - Kick-off meeting to discuss requirements
  - Confirm services
    - Capabilities of internal/external groups involved
- Create project plan to document
  - Collect all related information
- Collect a Site Survey questionnaire
- Collect a floor plan for all areas that require WiFi

Planning Checklist

- WiFi Site Design
  - Perform a Predictive Site Survey
  - Create a Budget
  - Quote Pre-deployment Site Survey / APaoS survey
  - Conduct on site survey to determine AP counts and locations
  - Generate WiFi design report with AP locations, equipment needed
  - Finalize level of effort / quote for installation and equipment
  - Have project discussion meeting to confirm timeline for install

Planning Checklist

- Configuration & Installation
  - Order equipment and material needed for installation
  - Plan any upgrades / changes needed to prepare for installation (cabling, IP addresses, switches, POE, power, etc)
  - Configure equipment on site or off site
  - Install WiFi equipment
  - Document as-built network

Planning Checklist

- Service Turn Up & Acceptance
  - Service turn up
  - Post deployment verification WiFi survey
  - Tune WiFi network as needed
  - Application / use case testing
  - Final documentation of network settings and equipment configuration
  - WiFi network acceptance by owners / customers
  - Training WiFi network owners / operators on equipment

Resources

- Wi-Fi 6
- PC Magazine: What is 5G
- SSID Overhead Calculator
- mcsindex.com
- Cisco Wireless High Client Density Design Guide

Questions?

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MacAdmin Slack: @jackdaniyel

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