

CISCO *Live!*



#CiscoLive



The bridge to possible

7 Ways to Fail on Wi-Fi 6E

Yes... you can also fail on new tech...

@Steven_Heinsius & @theJasonGrant

Leading the Global Solution Specialists team for Access Networking

BRKEWN-1742



#CiscoLive



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Cisco Webex App

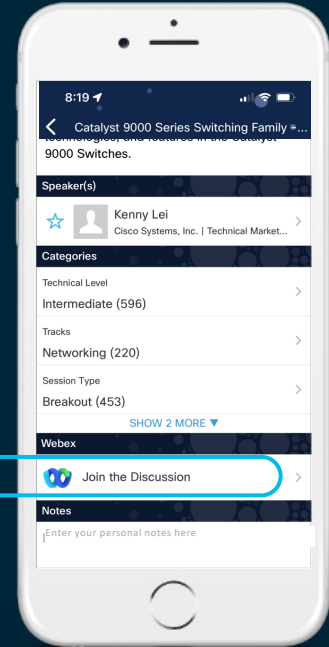
Questions?

Use Cisco Webex App to chat with the speaker after the session

How

- 1 Find **BRKEWN-1742** in the Cisco Live Mobile App
- 2 Click “Join the Discussion”
- 3 Install the Webex App or go directly to the Webex space
- 4 Enter messages/questions in the Webex space

Webex spaces will be moderated by the speaker until June 17, 2022.



<https://cislive.ciscoevents.com/cislivebot/#BRKEWN-1742>

Today's agenda

Introductions

Let's start with... Why?

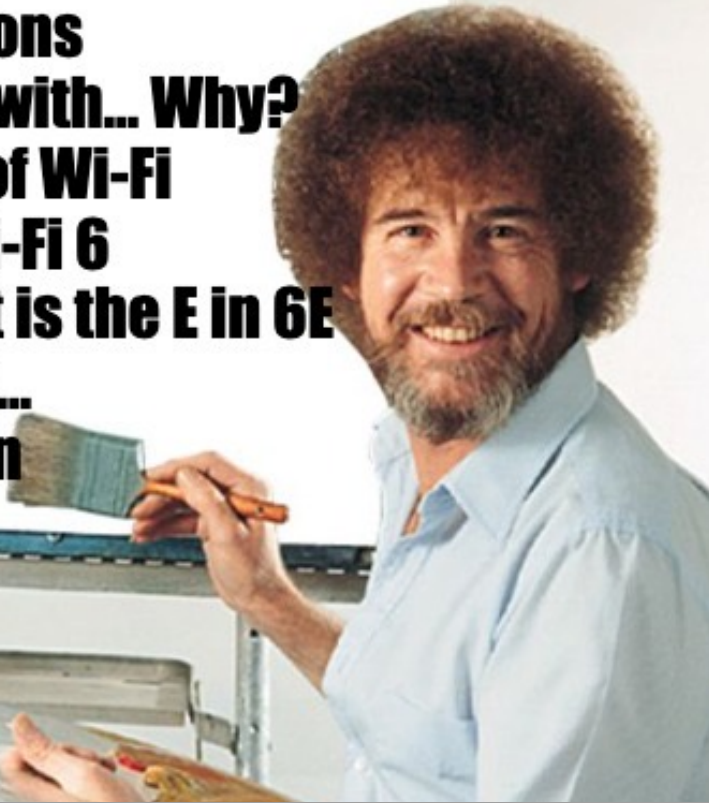
Evolution of Wi-Fi

What is Wi-Fi 6

Then, what is the E in 6E

A few Fails...

Conclusion



About @Steven_Heinsius

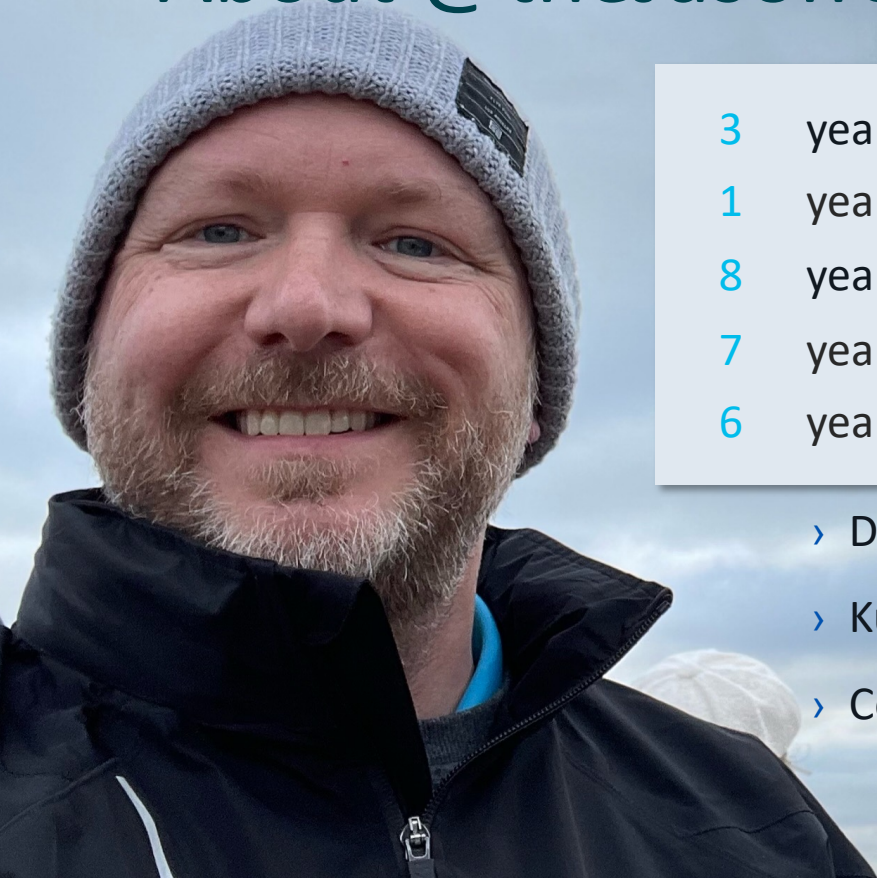
- 3 Years as an End User
- 5 Years as a Partner
- 6 Years as a Distributor
- 12 Years at Cisco
- 17 Years Instructor

- › Dad
- › Scuba diving
- › Runner
- › Snow boarding
- › Cook
- › Singer
- › Mountain biking
- › Wi-Fi enthusiast

- › YouTube Channel
'The Basement Series'



About @theJasonGrant



- 3 years end user
- 1 years as a Cisco SE
- 8 years security & wireless specialist
- 7 years EN (and DNA) specialist
- 6 years global sales enablement

- › Dad
- › Soccer ref
- › Kung-fu
- › Road-tripper
- › Cook
- › Wi-Fi enthusiast
- › YouTube Channel
'The Basement Series'



Simon Says...

“Let’s start with...



Cisco *live!*

February 15 - 19, 2016 • Berlin, Germany

How it all began...

IF YOU
... **THINK** ...
HIRING A
PROFFESIONAL
— IS —
EXPENSIVE
WAIT 'TILL
• **YOU HIRE** •
— **AN AMATEUR** —

There's  Ways to Fail

- Learn how **NOT** to #Fail
- It will be educational
- It will be interactive
- It will be fun

“ I don't care *how* you remember it,
as long as you remember it”

Steven Heinsius



Applicable to Wi-Fi 6(E)?

Contact us for the handout

@Steven_Heinsius

@theJasonGrant

Checklist

#20

Steven's Famous
Twenty Fails



Fail #1

Forget about those Channels

Channel Best Practices:

- Only 1, 6 and 11 on 2.4GHz
- Use 5 GHz as much as possible
- Lower # channels for Voice environments (36 - 64)
- Enable the DCA
- Enable Dynamic Bandwidth Selection
- Use the RRM algorithms
- Don't use "Maximum Power"...

Steven's simple Rule:
"Lead with a Channel Plan"

Fail #2

Maximum Power!

Power Best Practices:

- Do NOT use 100% power
- Use the RRM with max set to 17dbm and min 5dbm
- Enable Event Driven RRM with Rogue Contribution (level 3 for example)
- Keep Rogue Duty cycle to max 80%
- Create Smaller cells

RRM best practices

- RRM settings to suite for most deployments (High Density is a special case)
- Design for most radios set at mid power level (level 3 for example)
- RRM does NOT replace the site survey and doesn't create spectrum

Steven's simple Rule:
"Too much power isn't good... for anyone"

Fail #3

Design for 2.4 only...

Design Best Practices

- Design your network for 5 GHz
- If possible take out 2.4 GHz entirely
- Use "Flexible Radio Assignment" (FRA) in new AP's
- Don't buy "Single Radio AP's"
- Don't buy "Single Radio Clients"
- Try to migrate legacy clients as soon as possible
- They degrade the quality of your network
- If you can't migrate them, give them a separate SSID

Steven's simple Rule:
"Start with 5 GHz on the test, and have FRA & RRM do the rest"

Fail #4

Placements
Really? Does it matter?

Placement & Positioning Best Practices:

- AP Horizontal (Vertical Polarization)
- Below obstructions
- Minimal one meter (3ft) away from obstructions (Personal zone)
- The correct antennae
- Access Points minimal three meter (10ft) away from each other
- Not too high (after 4 meter (14ft) high special implementations)
- Don't put behind a metal cage
- Use Outdoor AP's for Outdoor Coverage...

Steven's simple Rule:
"Location, Location, Location"

Fail #5

I am secure

Security best practices:

- WPA2 is the bare minimum (with CCMP. Don't use TKIP)
- WPA2 Personal (PSK) is for... personal
- WPA2 Enterprise (802.1X) for businesses
- Use Role Based Access (RBA) with for instance ISE
- Use a Wireless Intrusion Prevention (wIPS) solution
- Use VPN on Public Wireless Connections

Steven's simple Rule:
"Security is a Process, not a Product"

Fail #6

Hype Versus Reality

Hype versus reality best practices:

- Transition to 802.11ax with your normal upgrade cycle
- Upgrade to the best Access Points that fits your need
 - Look at Cisco's "value add features"
 - CleanAir, ClientLink, ATF, Optimized Roaming, Offchannel RRM, Zero-Wait DFS etc.
- Our 9120 & 9130 already outperform the Wi-Fi 6 AP's for competitors
- Max flexibility and resiliency with Flexible Radio Assignment
- Dynamic Bandwidth Selection (DBS)
- Location Based Services with Wi-Fi based angle of arrival with Airont 4800
- Industry leadership with Nbase-T (mGig)
- Cisco Embedded WLC for smaller deployments (<100 AP's)
- Completely ready for the Digital Network Architecture and Software Defined Access

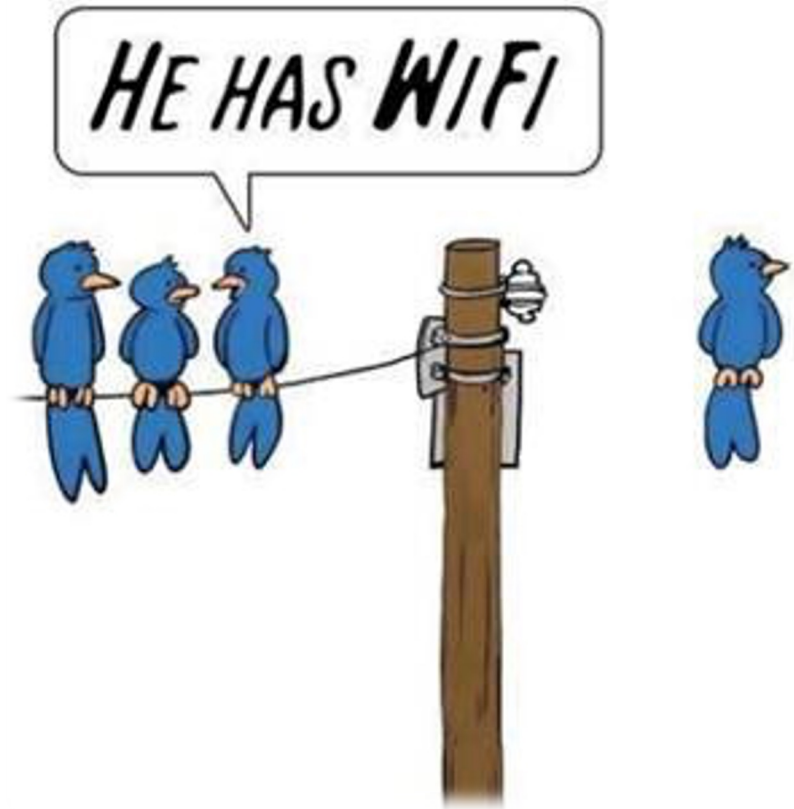
Steven's simple Rule:
"Wave 6 is nice... but the magic is in the HDX"

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@Steven_Heinsius

The basics

- The history of Wi-Fi
- Evolution of Wi-Fi
- Frequency & Channels
- Understanding Modulation & DRS
- Wi-Fi 6



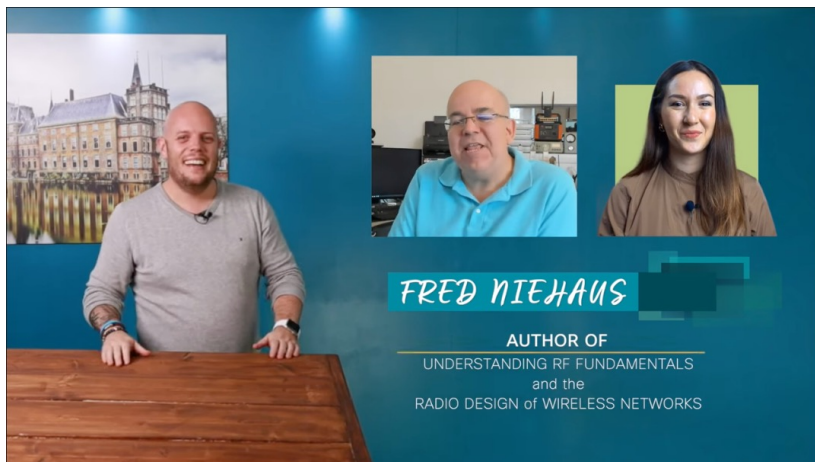


FRED NIEHAUS

AUTHOR OF
UNDERSTANDING RF FUNDAMENTALS
and the
RADIO DESIGN of WIRELESS NETWORKS

TSB

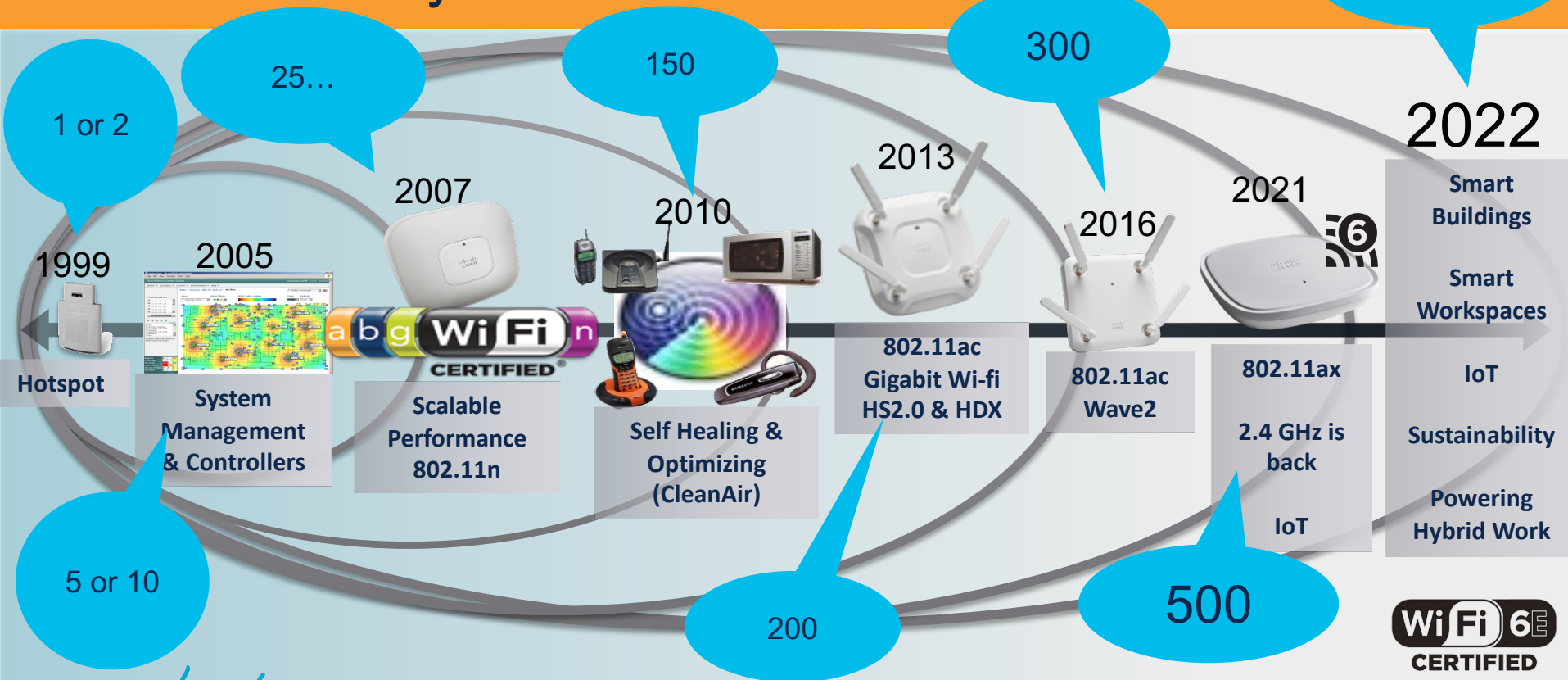
The History of Wi-Fi with Fred Niehaus (parts 1 & 2)



Evolution of Wi-Fi

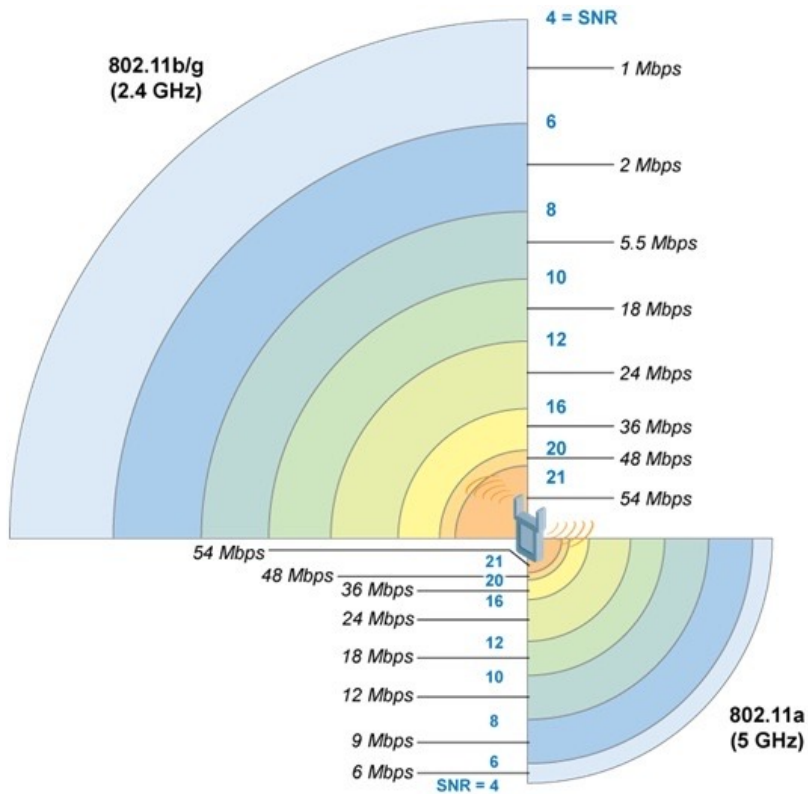


Let's say a 100 Employee Company... how many devices on the Wireless Network?









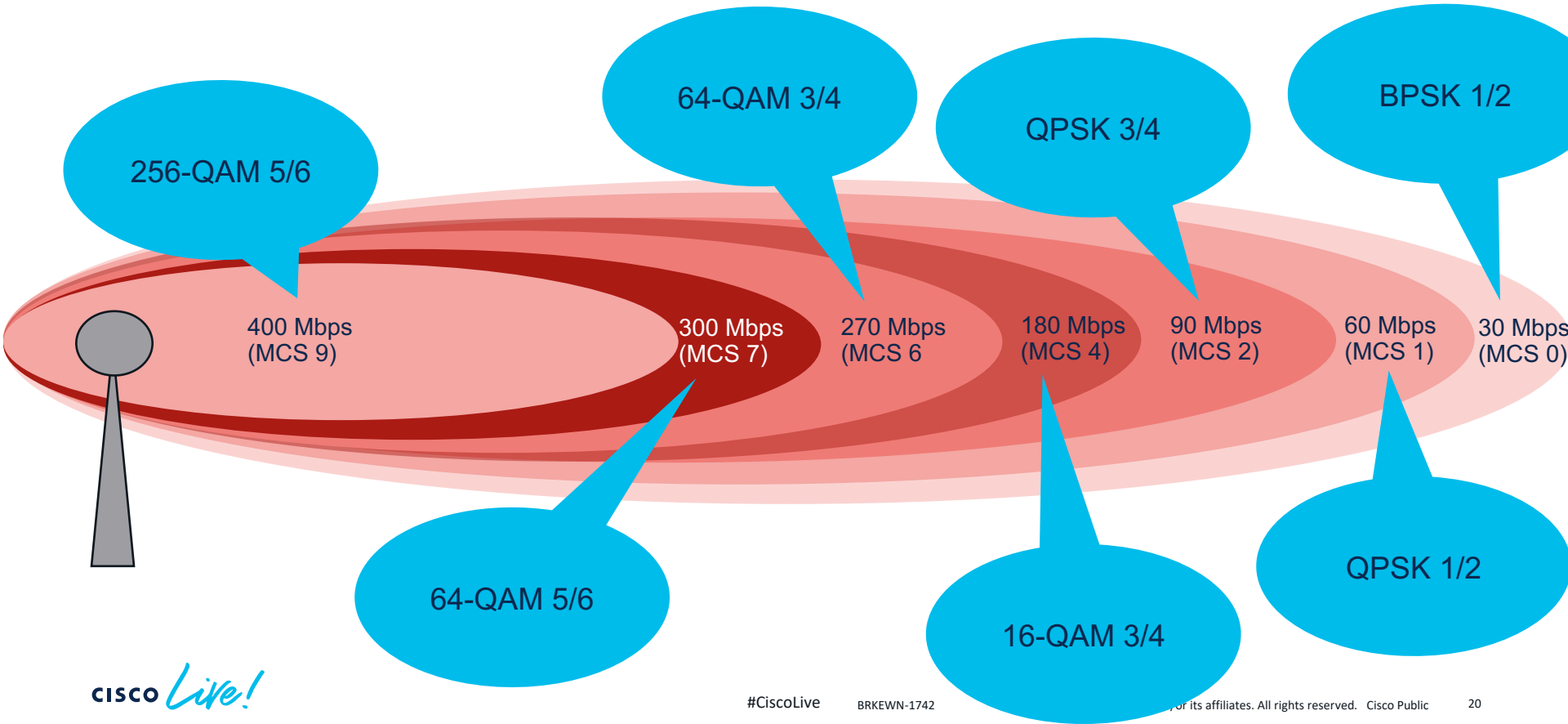
Modulation

Renai_129



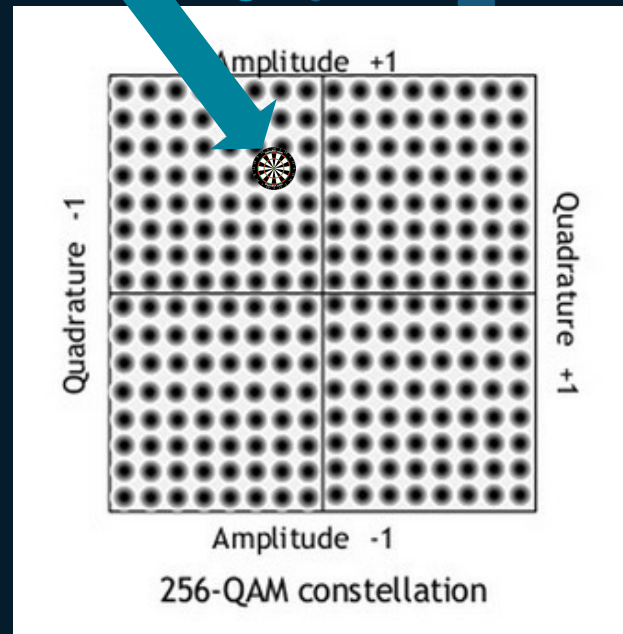
Dynamic Rate Switching (DRS) & Modulation

(given 802.11ac / VHT - 2 spatial streams, 40 MHz channels & 400 MS GI)



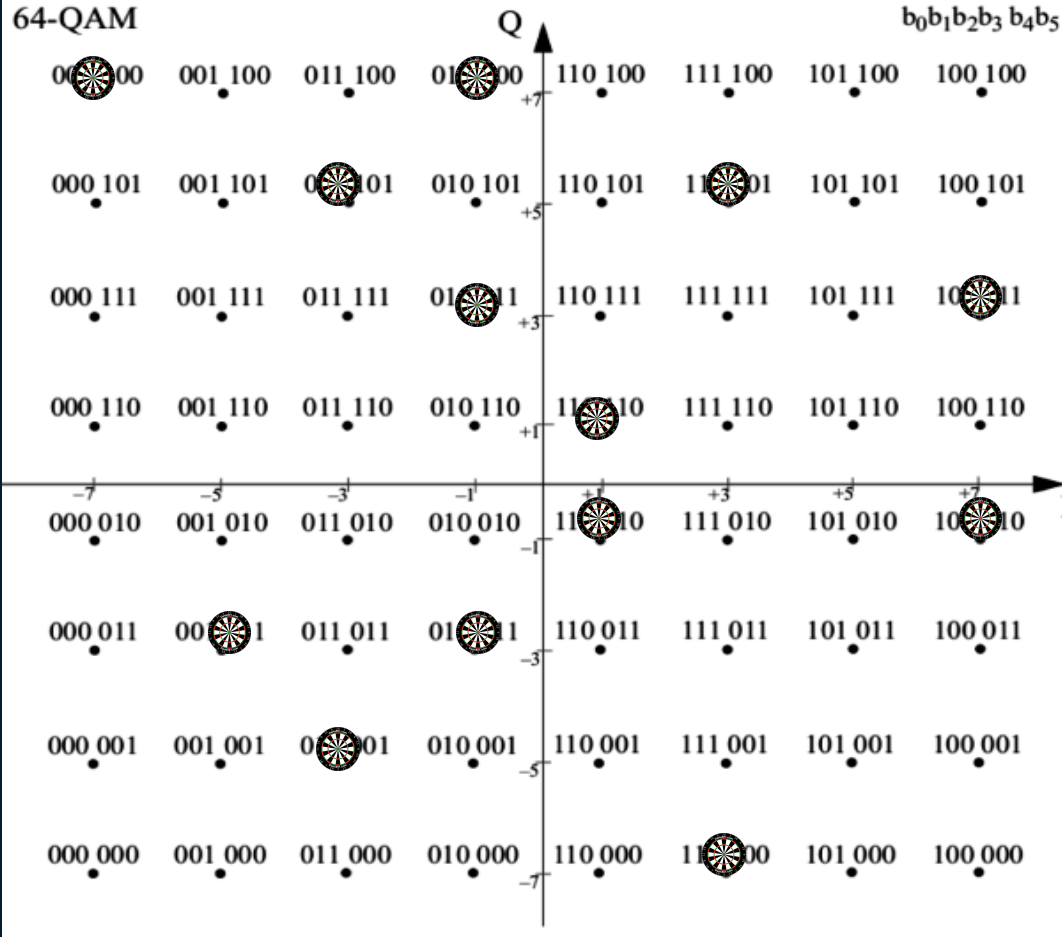
Modulation

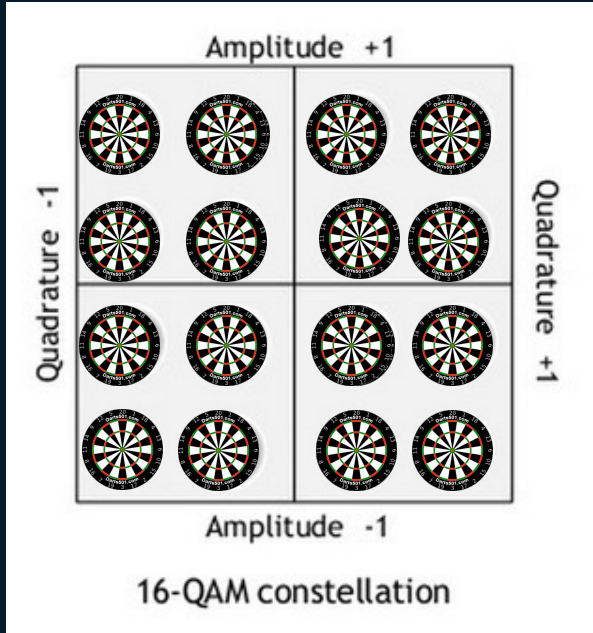
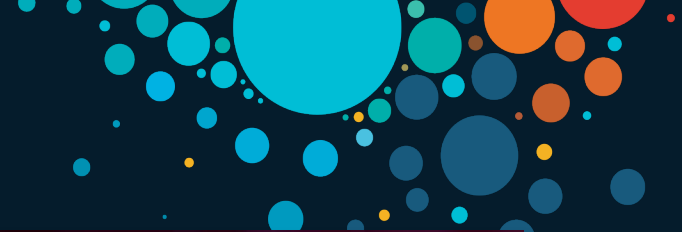






64-QAM



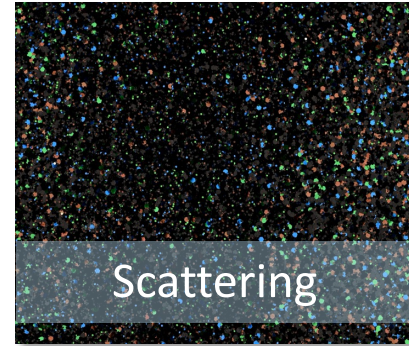


Get It?

A man with a shaved head, wearing a bright green polo shirt, is captured in a moment of intense celebration. His mouth is wide open in a shout, and his fists are clenched in a triumphant gesture. The shirt features a yellow 'betfair' logo on the left chest and a 'Masters' logo on the right. The background is blurred, showing spectators and a red pillar. A white speech bubble with the word 'AWESOME!' is positioned in the upper right corner.

AWESOME!

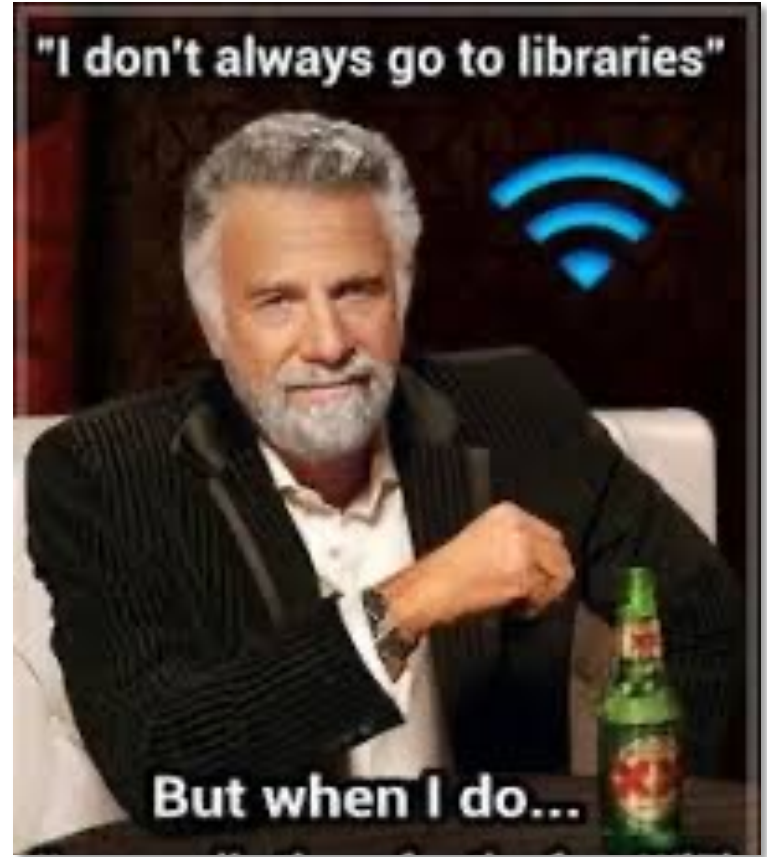
What else happens in the air?

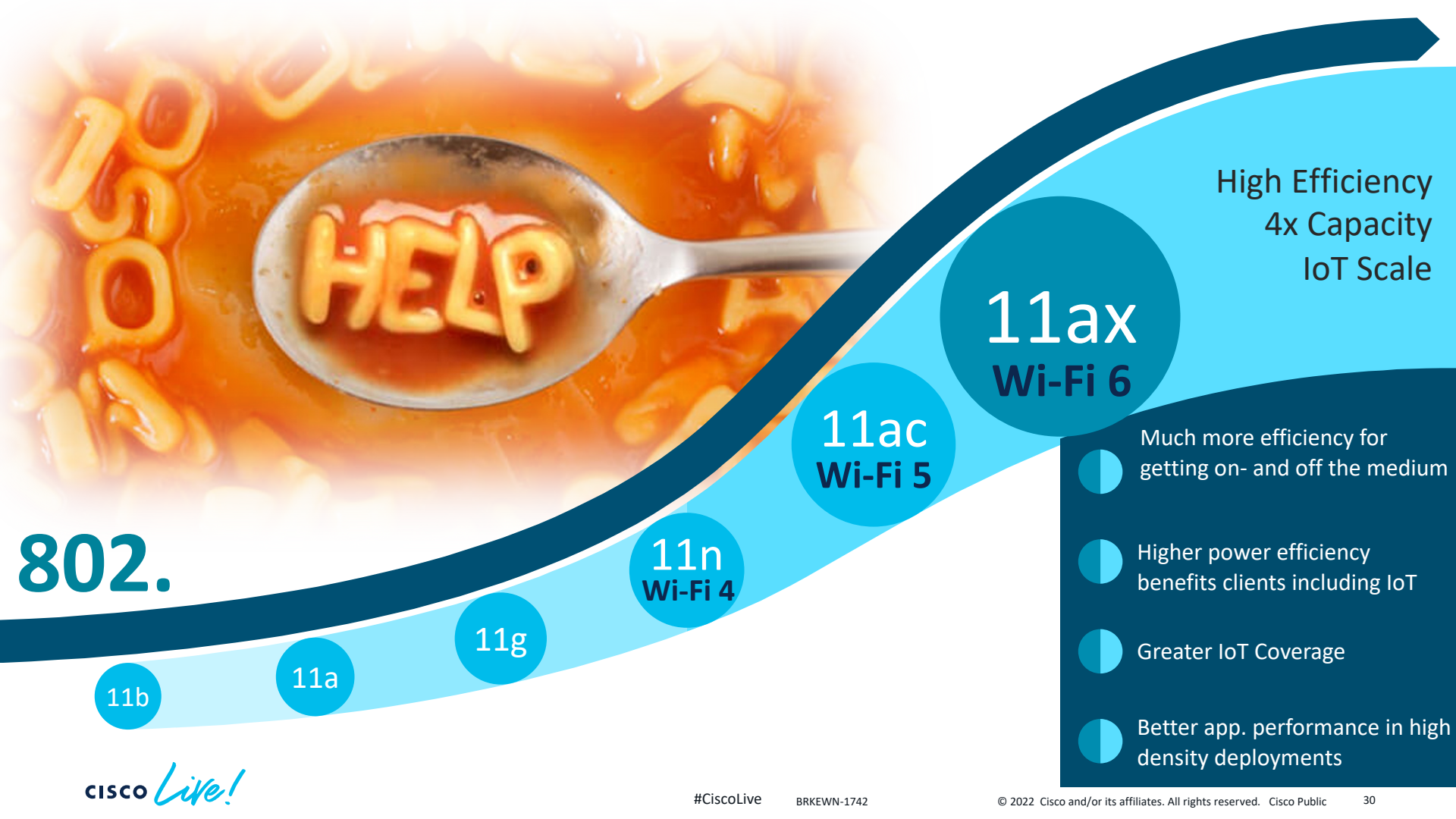


More challenges in Wi-Fi

- Slow
- Can't connect
- Can't roam
- Not secure
- BYOD
- Guest networks
- Coverage
- Interference
- Changing environments
- Internet of Things
- 99.999% of availability
- Primary access method

What is Wi-Fi 6







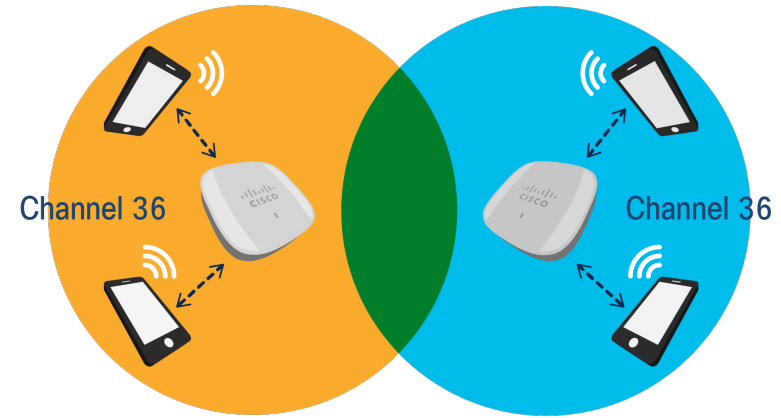
- **802.11ax**
- **BSS Coloring**
- **OFDMA**
- **Multi-user MIMO**
- **1024 QAM**
- **Target Wake Time**

802.11ax



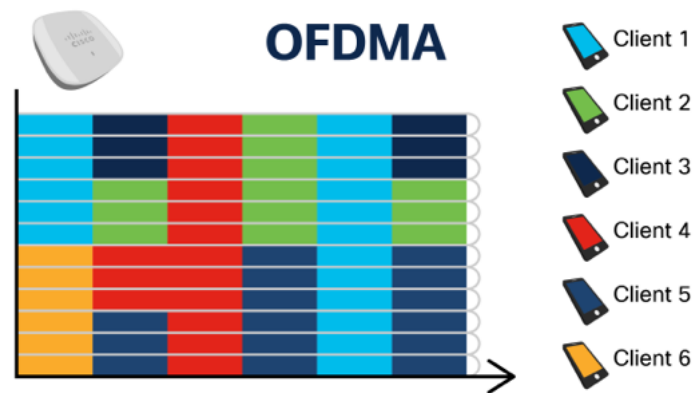
- The **Art** known as Wi-Fi 6
- Latest Generation of Wi-Fi
- 2.4 GHz is back
- 5 GHz is leading
- Expanded to 6 GHz
- Fastest ramping tech so far
- Not about more speed
- **It's about More Efficiency**

BSS Coloring



- It's a numbering bit
- Not actually a color
- Reduce co-channel interference
- Increase channel re-use factor of 8

Orthogonal Frequency Division Multiple Access

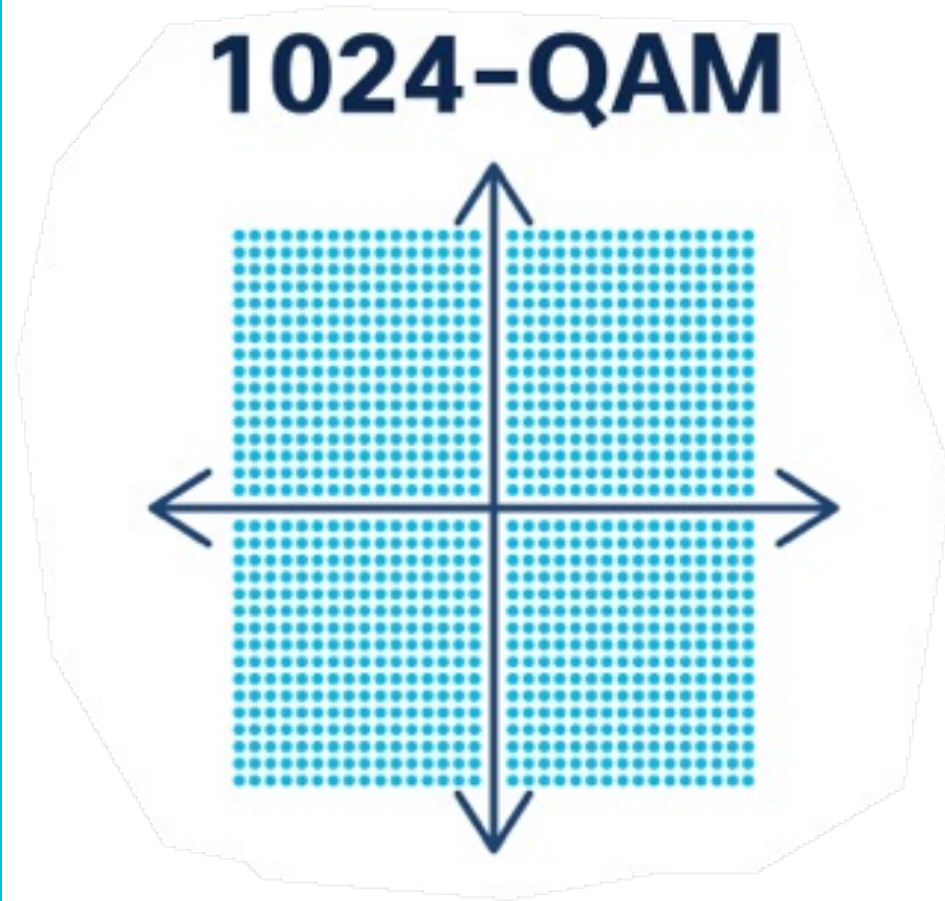


- Multiuser version of OFDM
- Developed for LTE (4G / 5G)
- Channel is divided in smaller allocations called **Resource Units**
- Thanks to these smaller frames an **AP** *can send data to many more clients* at the same time

Multi-User

Multiple In Multiple Out





TWT

More efficiency & Better Battery Life

Target Wake Time



A decorative graphic in the top right corner consisting of a cluster of circles in various colors (blue, green, orange, red, yellow) and sizes, with some smaller circles scattered to the left.

Then... what is the **E** in 6**E**?

The **E** is for
Evolution
Efficiency
Experience
Extra Bandwidth

It's all the goodness of 802.11ax
*Now available on a **dedicated** 500 MHz (ETSI) or*
*1200 MHz (!!!) (US) **6 GHz** Spectrum*

A decorative graphic in the top right corner consisting of a dense cluster of circles in various sizes and colors, including shades of blue, green, orange, and red. Some circles are solid, while others are semi-transparent, creating a layered effect. The circles vary in size, with some being quite large and others being small dots.

Time for some Fails...

So, 20 Fails...



But only 45 minutes...

so we decided to focus on the Wi-Fi 6(E) important

Fail 1:

You missed all the previous episodes...





Watch us grow!





Work from Home

#7WTF –
The Work from Home Edition
can be found here...



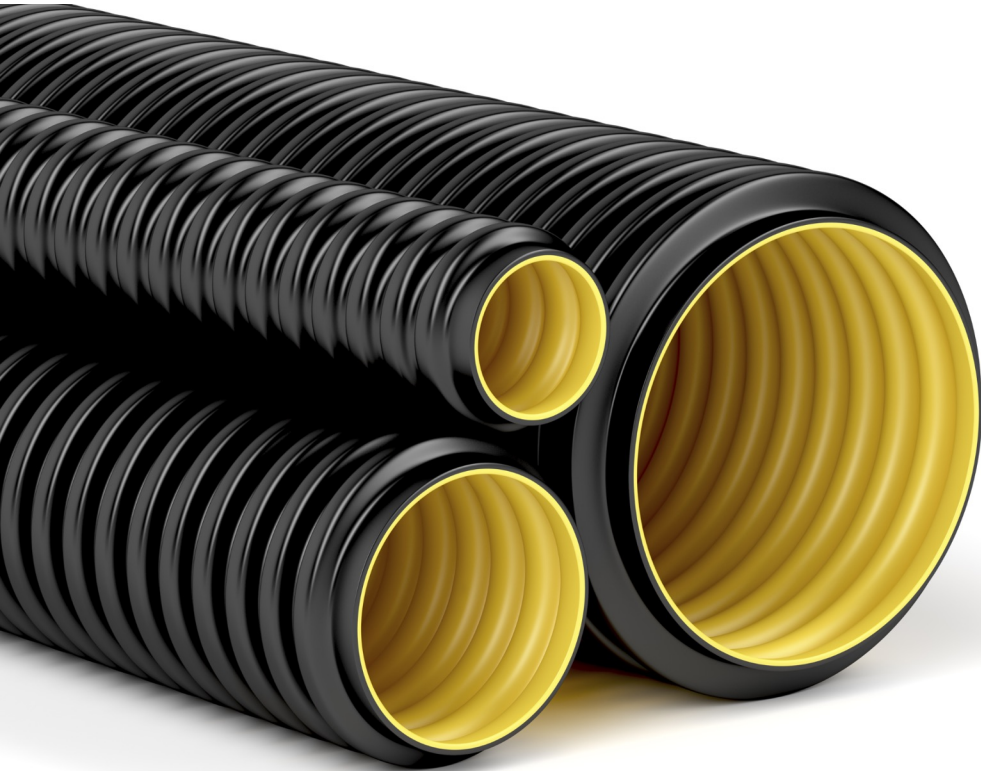
Simple Rule:

*“Never stop learning,
But make sure you have fun”*

Fail 2:

Give me
Wider Channels





Wider Channels

Unlicensed Spectrum Used by Wi-Fi

Number of Channel
channels Size

2.4 GHz

3	20 MHz	1 2 3
1	40 MHz	1

2.4 GHz band: used by 802.11n (Wi-Fi 4), 802.11ax (Wi-Fi 6), and by Bluetooth, ZigBee, and proprietary wireless connectivity technologies

5 GHz

25	20 MHz	1 2 3 4 5 6 7 8
12	40 MHz	1 2 3 4
6	80 MHz	1 2
2	160 MHz	1

5170 MHz - 5330 MHz

9	10	11	12	13	14	15	16	17	18	19	20
5	6	7	8	9	10						
3	4	5									
2											

5490 MHz - 5730 MHz

21	22	23	24	25
11	12			
6				

5735 - 5835 MHz

5 GHz band: used by 802.11n (Wi-Fi 4), 802.11ac (Wi-Fi 5), 802.11ax (Wi-Fi 6), and to a lesser extent by cellular in unlicensed (LWA, MultiFire)

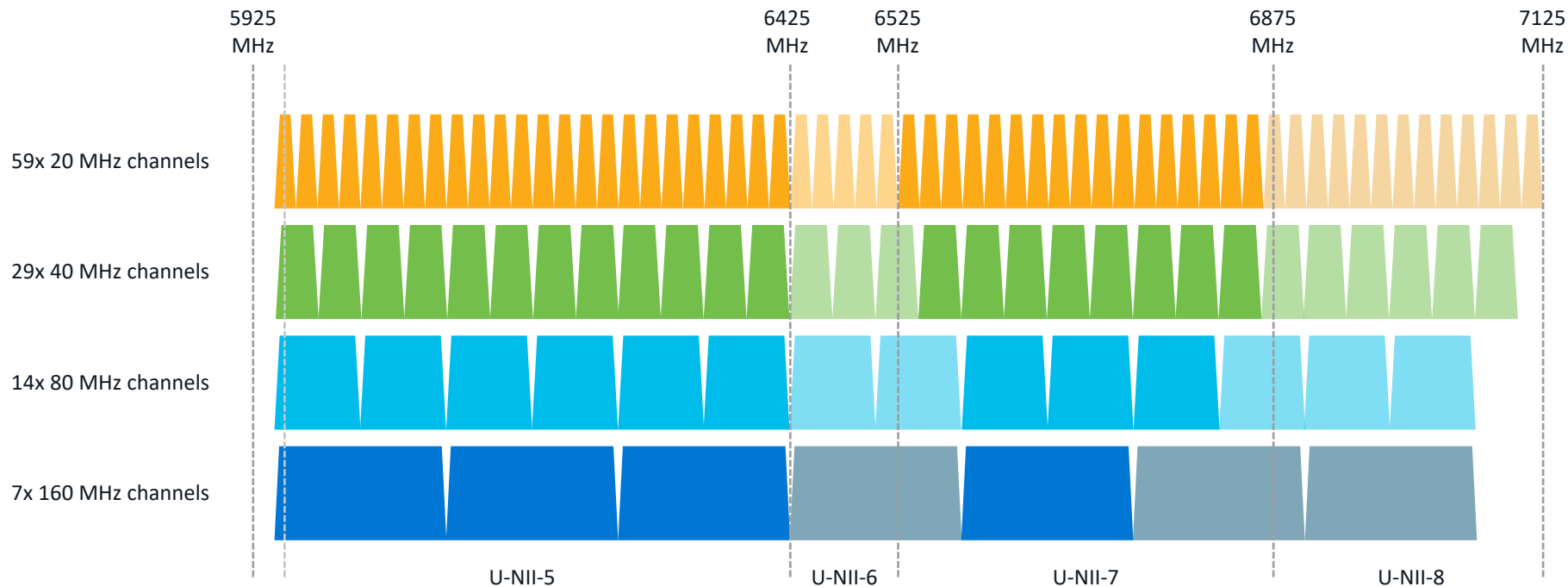
6 GHz

59	20 MHz	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59
29	40 MHz	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
14	80 MHz	1 2 3 4 5 6 7 8 9 10 11 12 13 14
7	160 MHz	1 2 3 4 5 6 7

5925 - 7125 MHz

Note: Grey areas denote spectrum that uses DFS (Dynamic Frequency Selection) to avoid military radar, weather radar, and satellite communication.

The new 6 GHz band... !!!



Standard for 2.4 GHz



Standard for 5 GHz



Standard for 6 GHz



Simple Rule:

*“40 for 5, 80 for 6,
But whatever you do, never mix”*

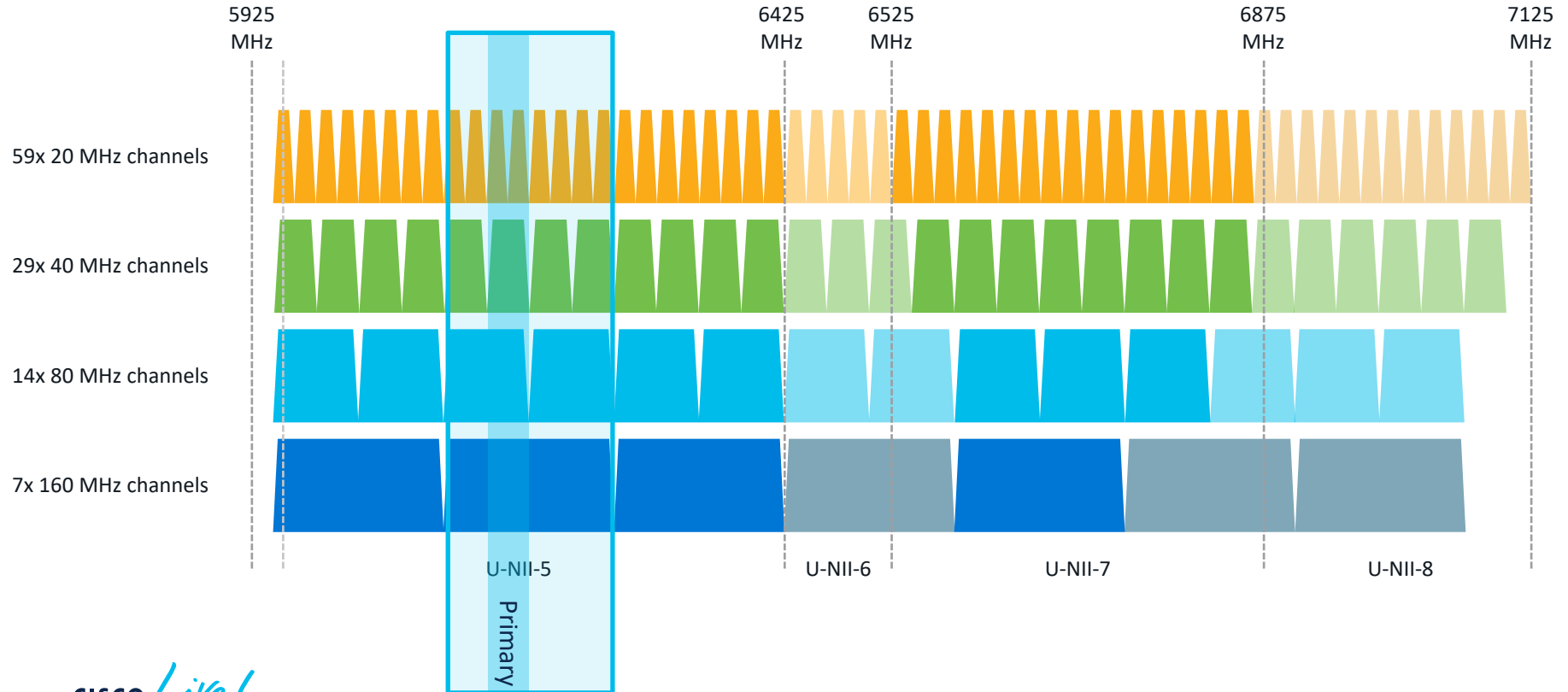


Fail 3:

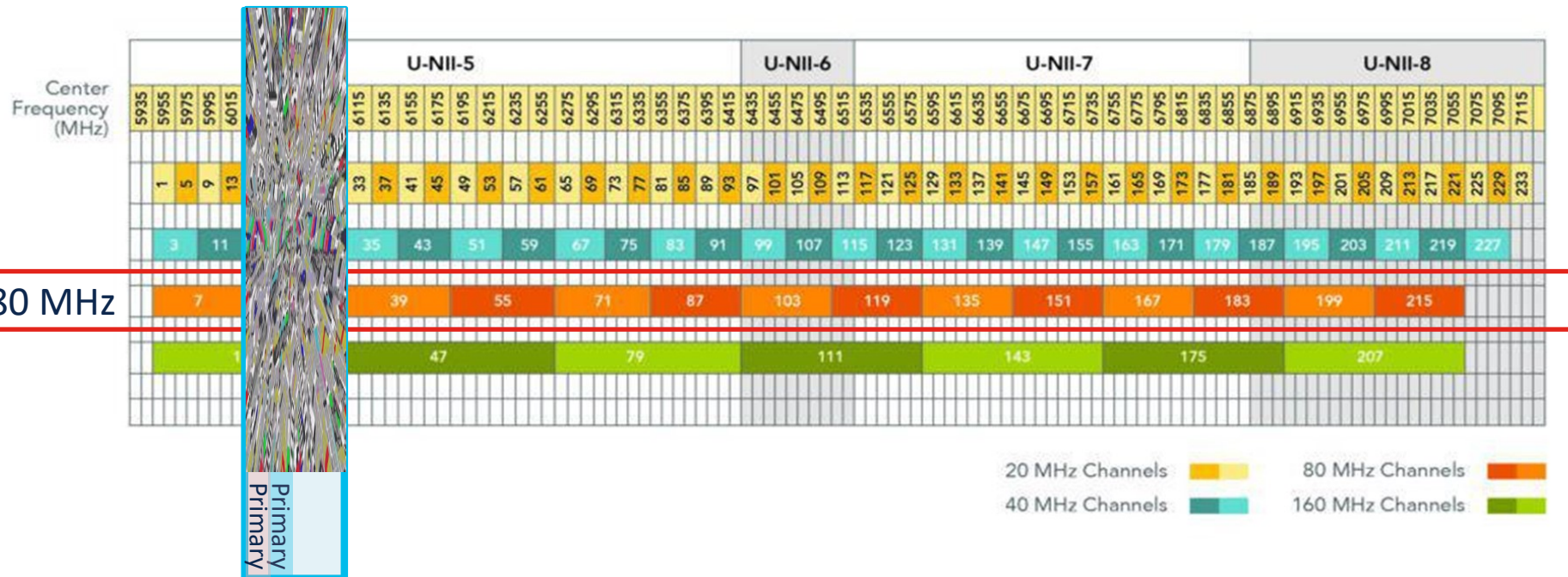
Not aligning
Primary and Secondary



The new 6 GHz band : Wi-Fi 6 and later



Agenda



Simple Rule:

“Don’t mess with the defaults”



Fail 4:

Placements...
Really ?

Does it still matter
where you put those AP's?





Channel bonding...



Wireless Stacking



Low & Slow...



Who needs
brackets...



Who needs
brackets...





When you did the survey...

BEFORE

When they go live...



Outdoor Wi-Fi...



Placement & Positioning best practices

- ✓ AP **Horizontal** (vertical Polarization)
- ✓ Below obstructions
- ✓ Minimal **one meter (3ft) away** from obstructions (Fresnel zone)
- ✓ The correct antennas, only 1 type of antenna
- ✓ Access Points minimal **three meter (10ft) away** from **each other**
- ✓ **Not too high** (after 4 meter (14ft) high special implementations)
- ✓ Don't put behind a **metal cage**
- ✓ Use **Outdoor** AP's for **Outdoor** Coverage...

Simple Rule:

*“Like in Real Estate
– Location, Location, Location”*



Fail 5:

Hype versus Reality



When 802.11ac Wave 2
was announced...



4x4:4

Much More
Bandwidth
>2 Gig

256
QAM

It was all about...

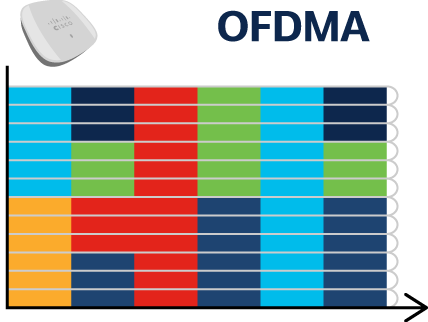
160 MHz
wide
channels

Multi-
User
MIMO

But now...



OFDMA

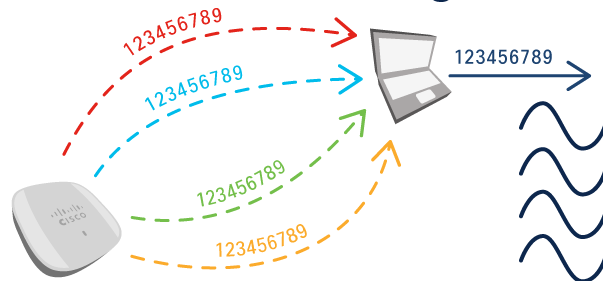


- Client 1
- Client 2
- Client 3
- Client 4
- Client 5
- Client 6

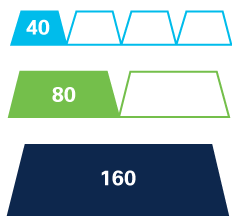
MU-MIMO



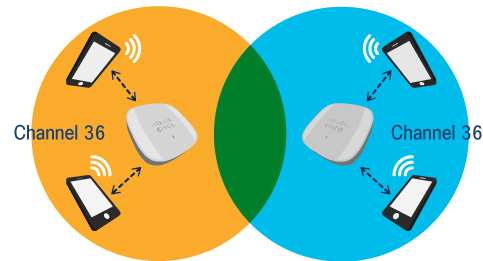
Beamforming



160 MHz Channels



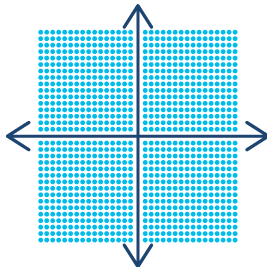
BSS Coloring



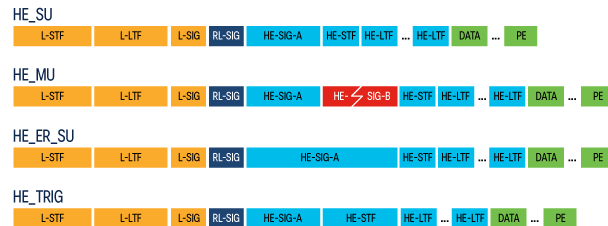
Target Wake Time



1024-QAM



Longer Symbol Time



Cisco Catalyst 916x portfolio



Catalyst 9162

	Tx	Rx
2.4 GHz	2	2
5 GHz	2	2
6 GHz	2	2



- 2.5Gbps mGig Uplink
- PoE+ and UPoE compliant
- IoT Radio
- CleanAir Pro Radio



Catalyst 9164

	Tx	Rx
2.4 GHz	2	2
5 GHz	4	4
6 GHz	4	4



- 2.5Gbps mGig Uplink
- PoE+ and UPoE compliant
- IoT Radio
- CleanAir Pro Radio



Catalyst 9166

	Tx	Rx
2.4 GHz	4	4
5 GHz	4	4
6 GHz	4	4



- 5Gbps mGig Uplink
- PoE and UPoE+ compliant
- IoT Radio
- CleanAir Pro Radio
- XOR radios (low band/high band)
- Environmental sensors



And let me show you what happens in the Air...



"If you can't understand the RF, if you can't understand what's going on in your environment, then you can't get to this next generation of applications and services. And in fact, even as we develop the next technologies, *the visibility that Ekahau gives us is fundamental to taking us into the future.*"



Matthew MacPherson
Wireless CTO, Cisco

Awesome Swag.
Awesomer Wi-Fi!
Booth #2937



Simple Rule:

*“Now more than ever,
you need the smartest Chipset”*



Fail 6:

Listen

to the Architect



So I was told...

Access Points are ugly....

And what do you do with things that are Ugly?

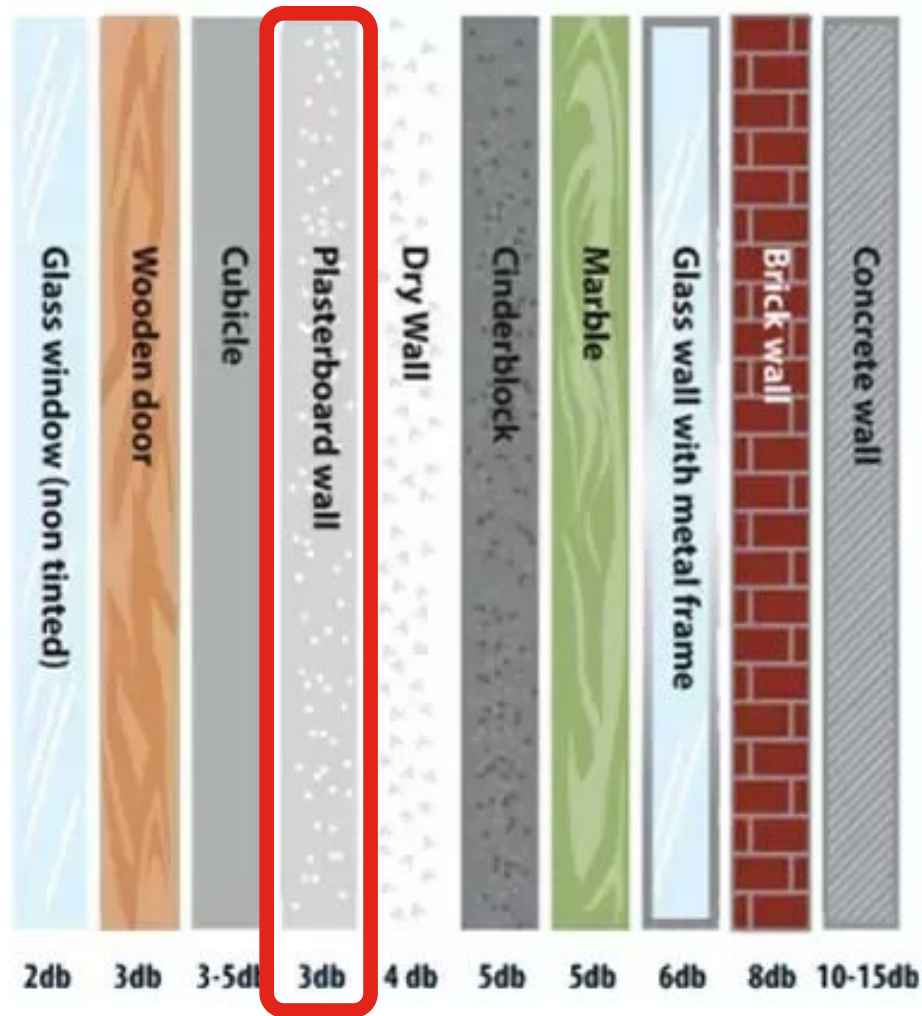


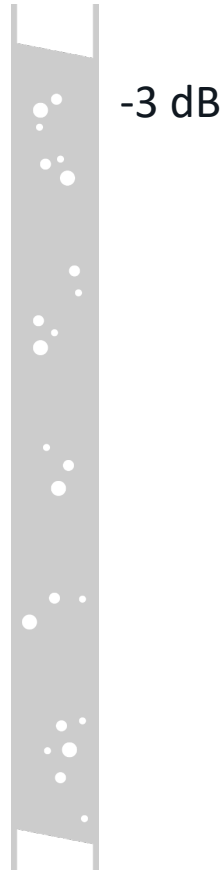


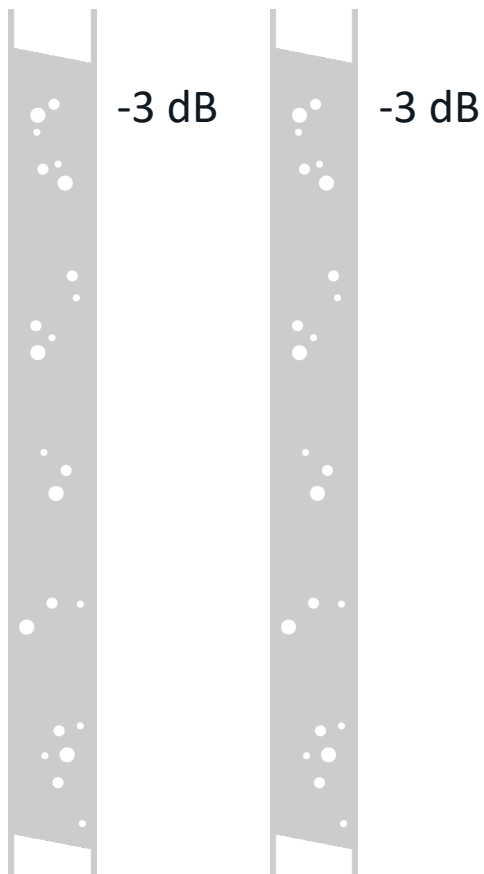
With Wi-Fi...

Put your AP's where your clients are





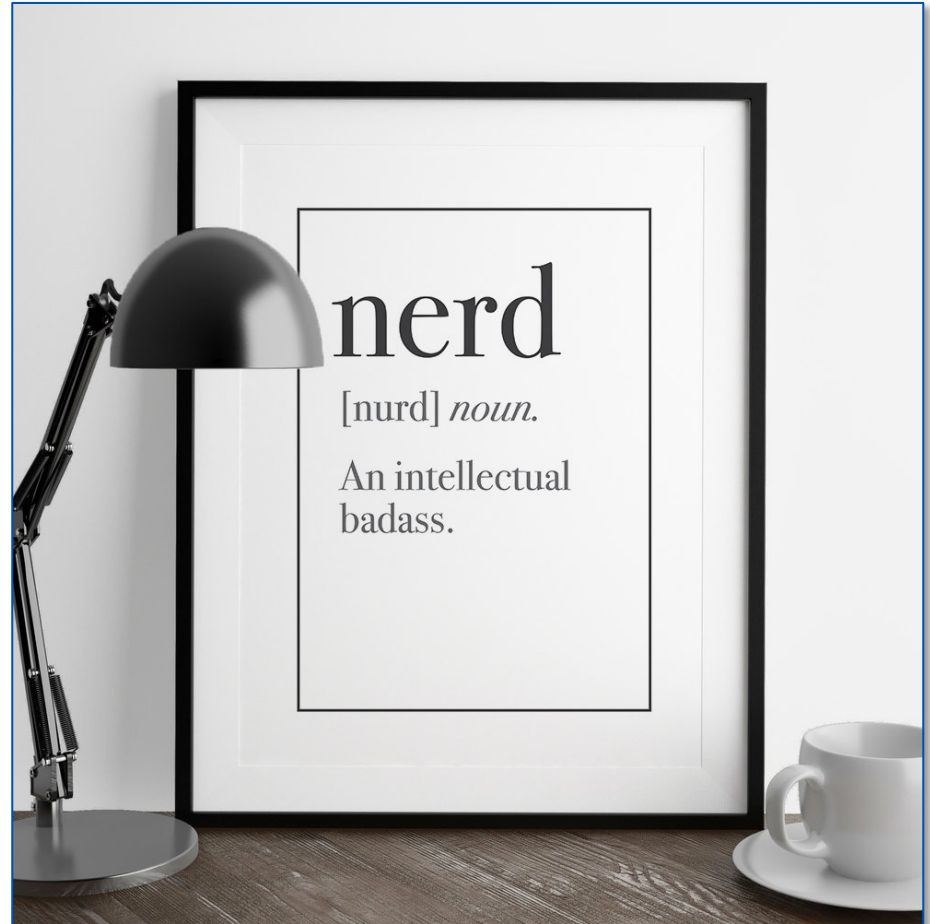





RF Mathematics

Rules of 10 and 3

- 3 dB gain = $\text{mW} * 2$
- 3 dB loss = $\text{mW} / 2$
- 10 dB gain = $\text{mW} * 10$
- 10 dB loss = $\text{mW} / 10$



70% of the clients in your
network are?



Maximum transmission on Wi-Fi?

$25 \text{ mW} = 14 \text{ dBm}$

So...

(RF Mathematics continued...)

Max ETSI transmission is 100 mW.
that is 20 dBm

20 dBm 100 mW

17 dBm 50 mW

14 dBm 25 mW

11 dBm 12.5 mW

8 dBm 6.25 mW

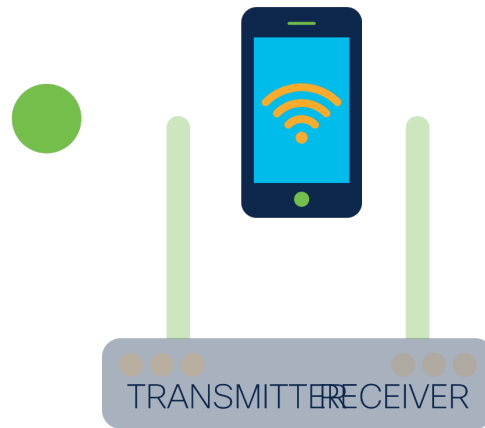
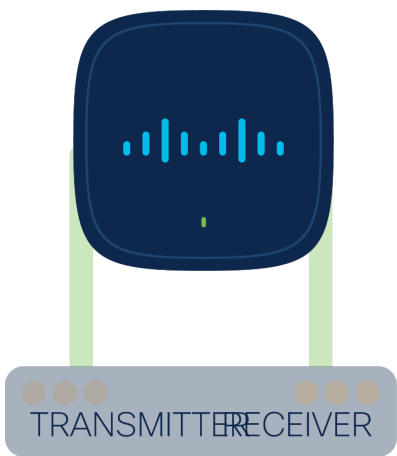
5 dBm 3.12 mW

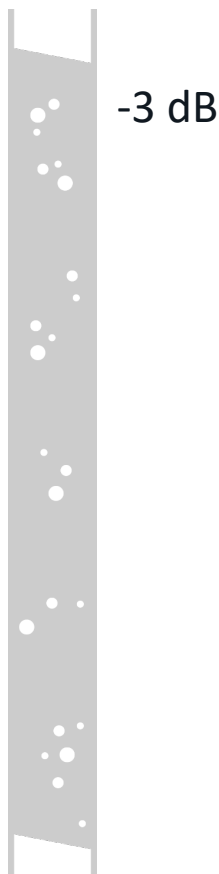
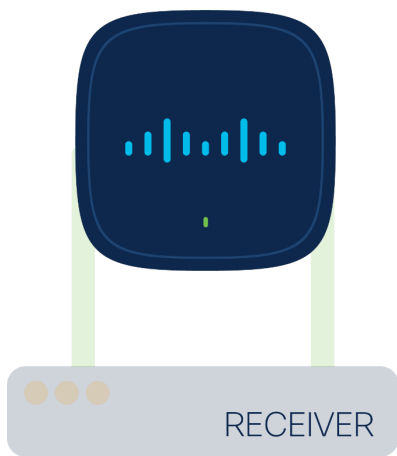
2 dBm 1.6 mW

0 dBm 1 mW









So...



AP



/...



What about these?

Why don't you hide them?
“Then they don't work...”

AHA!

Introducing...

The “Peep Hole AP”







So ...



Visit Oberon at **#2337** on the World of Solutions

CISCO *Live!*

#CiscoLive

BRKEWN-1742

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99

Oberon Model 3032 NetPoint™ Wi-Fi Bollard



Visit Oberon at **#2337** on the World of Solutions

Simple Rule:

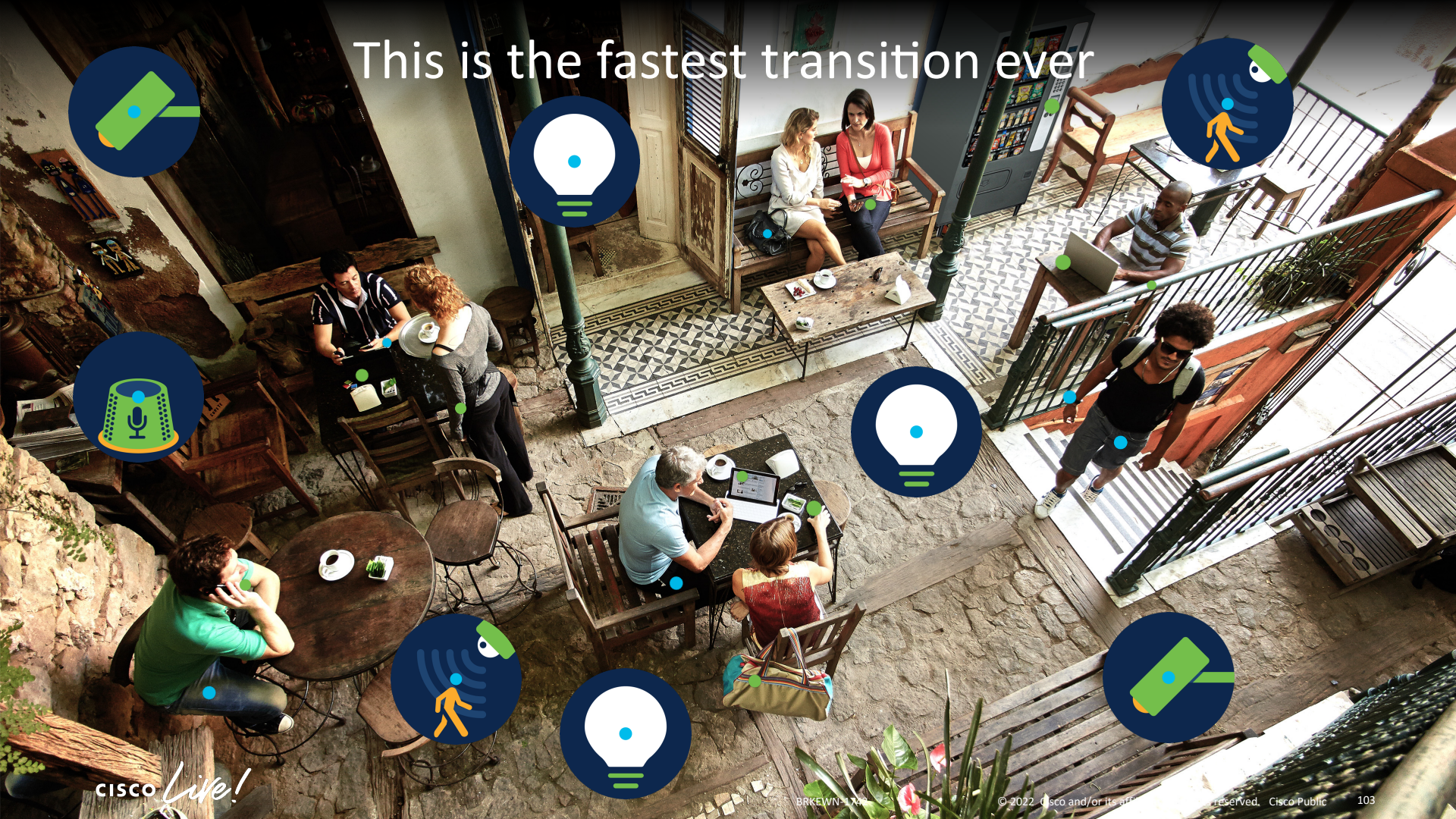
*“Can you read the Logo?
Then you are probably good to go”*

Fail 7

I'll wait
for the next upgrade



This is the fastest transition ever





Simple Rule:

*“Don’t wait till tomorrow,
with what you can do today”*

Conclusion



Wi-Fi 6E is here

It's real

It's happening

And it benefits us all



Give you up

802.11ax



Make you Cry



Let you down

Wi-Fi



Say Goodbye



Run Around

THAT



Tell a Lie



Desert you

WILL



Hurt you

NEVER

Rick axLey

Thank you
&
Steven Heinsius
Jason Grant



Rick axLey

Technical Session Surveys

- Attendees who fill out a minimum of four session surveys and the overall event survey will get Cisco Live branded socks!
- Attendees will also earn 100 points in the Cisco Live Game for every survey completed.
- These points help you get on the leaderboard and increase your chances of winning daily and grand prizes.



Cisco learning and certifications

From technology training and team development to Cisco certifications and learning plans, let us help you empower your business and career. www.cisco.com/go/certs

Pay for Learning with Cisco Learning Credits

(CLCs) are prepaid training vouchers redeemed directly with Cisco.



Learn

Cisco U.
IT learning hub that guides teams and learners toward their goals

Cisco Digital Learning
Subscription-based product, technology, and certification training

Cisco Modeling Labs
Network simulation platform for design, testing, and troubleshooting

Cisco Learning Network
Resource community portal for certifications and learning



Train

Cisco Training Bootcamps
Intensive team & individual automation and technology training programs

Cisco Learning Partner Program
Authorized training partners supporting Cisco technology and career certifications

Cisco Instructor-led and Virtual Instructor-led training
Accelerated curriculum of product, technology, and certification courses



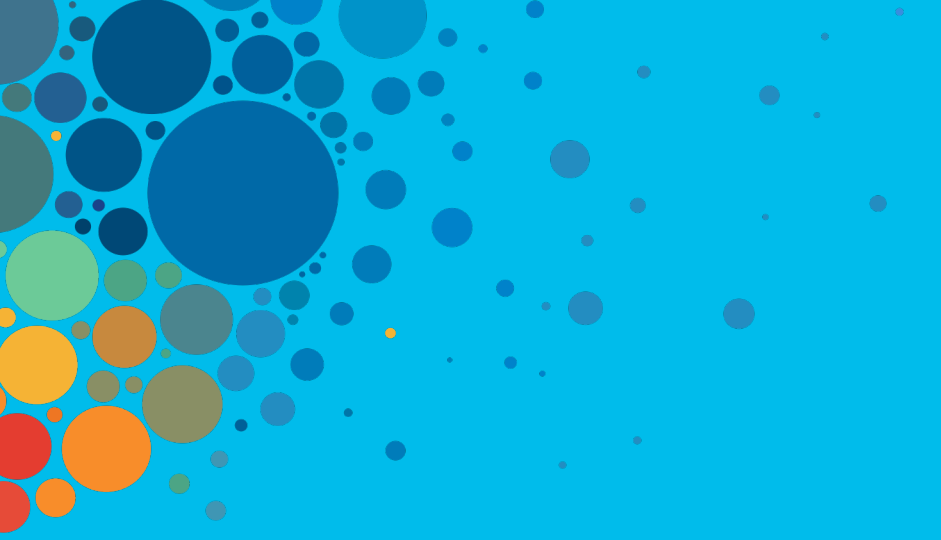
Certify

Cisco Certifications and Specialist Certifications
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