What you thought you know about Wi-Fi, but don’t…

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wirelessLAN PROFESSIONALS

Wi-Fi Design Day – London
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WI-FI DESIGN DAY

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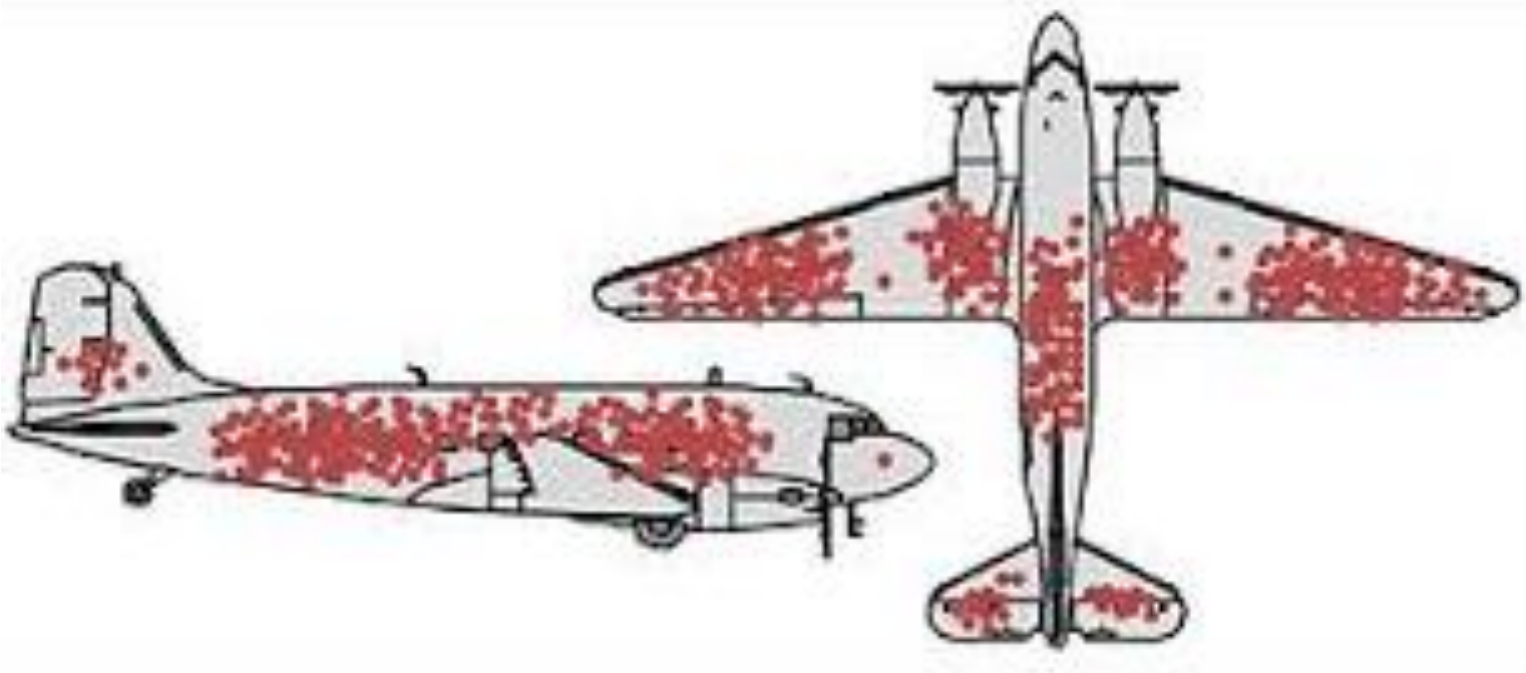
coun·ter·in·tu·i·tive

ˌkoun(t)ərinˈt(y)o͞oədiv/
adjective

adjective: **counter-intuitive**
contrary to intuition or to common-sense expectation (but often nevertheless true).

Where to armor a warplane?



PRINCIPLE 1

SIMPLE

Simplicity isn't about dumbing down, it's about prioritizing. (Southwest will be THE low-fare airline.) What's the core of your message? Can you communicate it with an analogy or high-concept pitch?

PRINCIPLE 2

UNEXPECTED

To get attention, violate a schema. (The Nordie who ironed a shirt…) To hold attention, use curiosity gaps. (What are Saturn's rings made of?) Before your message can stick, your audience has to want it.

PRINCIPLE 3

CONCRETE

To be concrete, use sensory language. (Think Aesop's fables.) Paint a mental picture. ("A man on the moon…") Remember the Velcro theory of memory—try to hook into multiple types of memory.

PRINCIPLE 4

CREDIBLE

Ideas can get credibility from outside (authorities or anti-authorities) or from within, using human-scale statistics or vivid details. Let people "try before they buy." (Where's the Beef?)

PRINCIPLE 5

EMOTIONAL

People care about people, not numbers. (Remember Rokia.) Don't forget the WIIFY (What's In It For You). But identity appeals can often trump self-interest. ("Don't Mess With Texas" spoke to Bubba's identity.)

PRINCIPLE 6

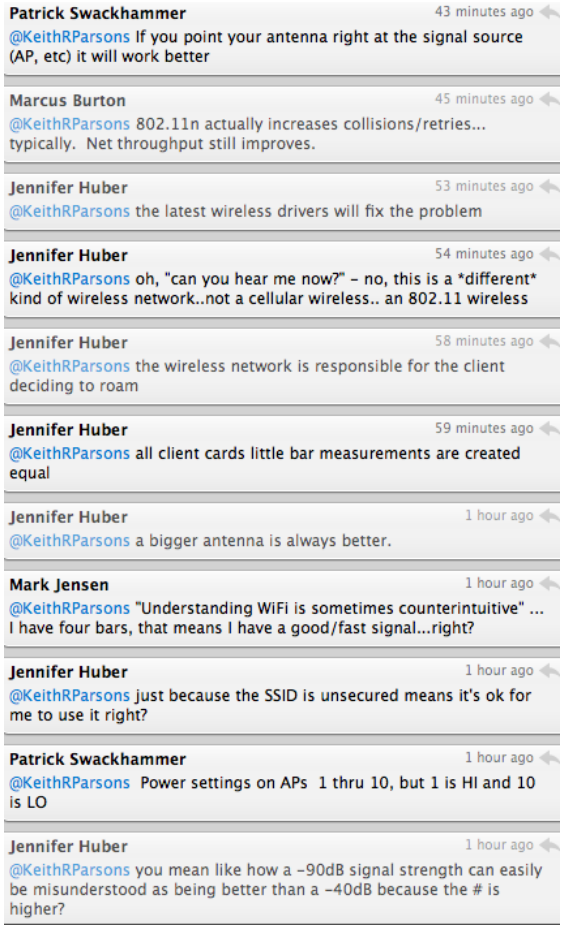
STORIES

Stories drive action through simulation (what to do) and inspiration (the motivation to do it). Think Jared. Springboard stories (See Denning's World Bank tale) help people see how an existing problem might change.

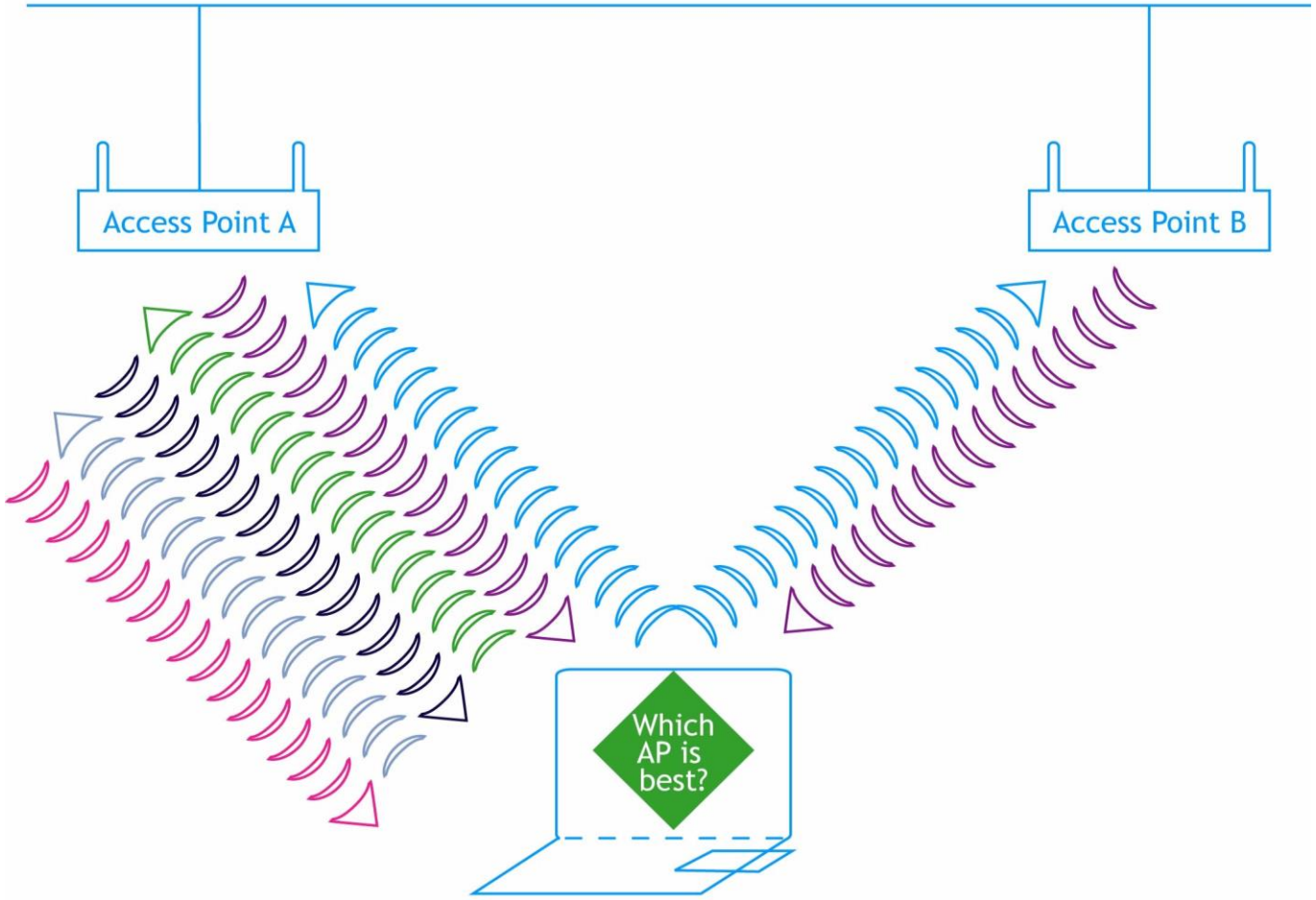
S

What are vulnerabilities of Wi-Fi?

WI-FI DESIGN DAY



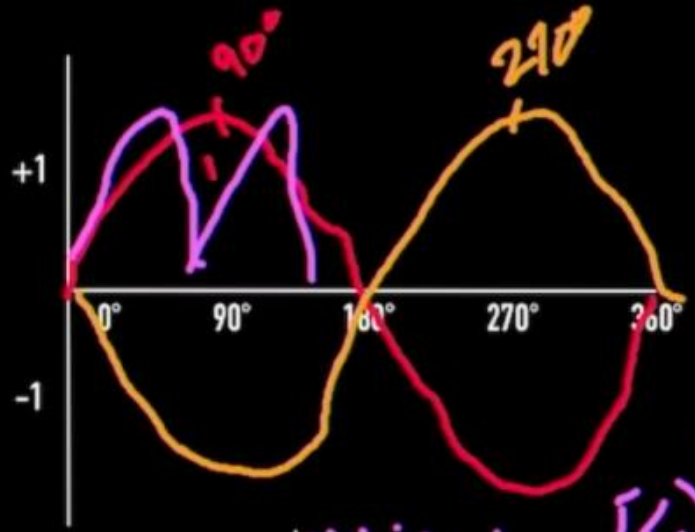
What are some examples of Wi-Fi being Counter Intuitive?

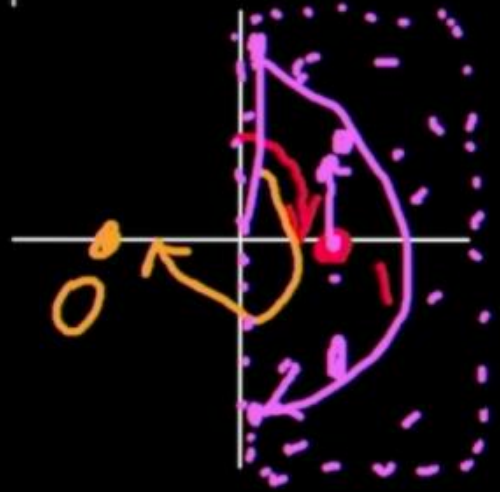


Binary

BPSK	
0	-sin
1	sin

1 | 3π





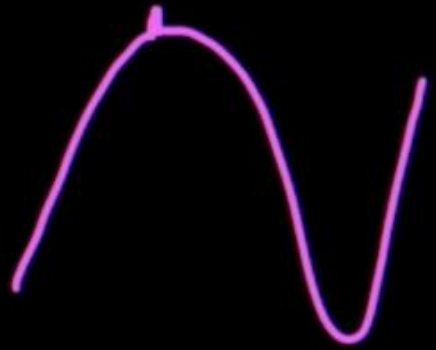
EVM
Error
Vector
Magnitude

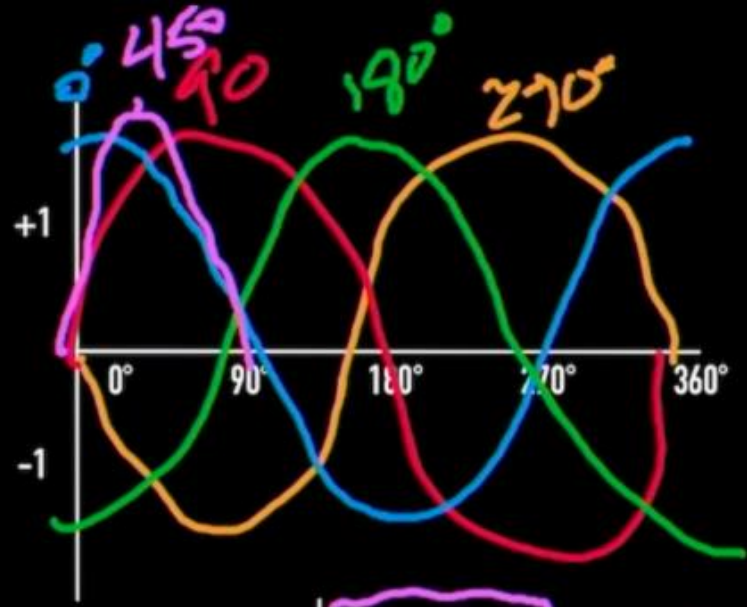
QPSK

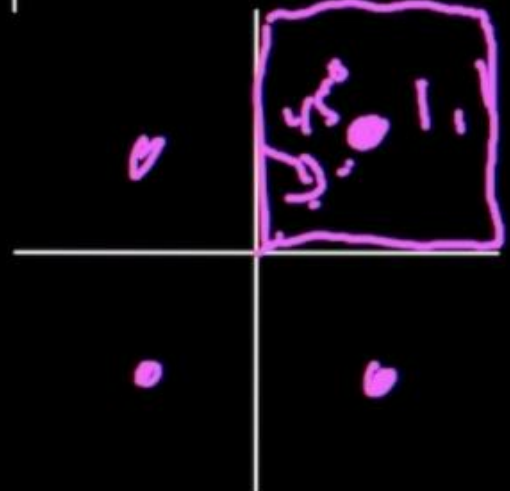
-cos	00 -sin
-cos	01 sin
cos	10 -sin
cos	11 sin

Q

11 · cos+sin







EVM

1/2

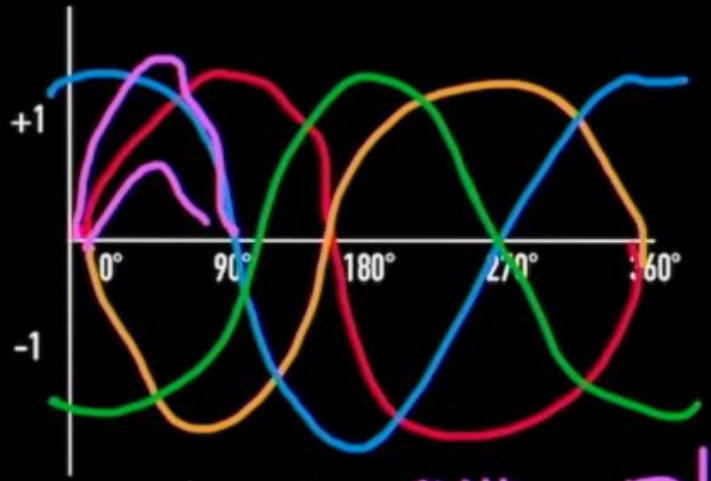
16-QAM
0000
....
....
....
....
1111

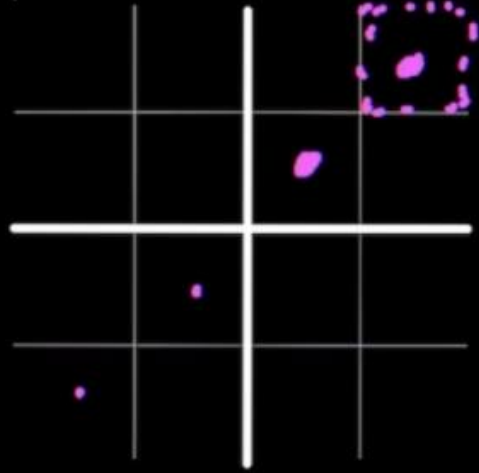
*Add Amplitude

Q Amplitude

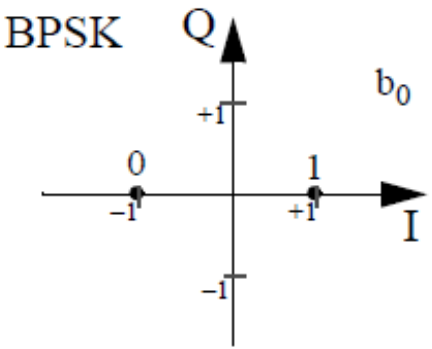
16-

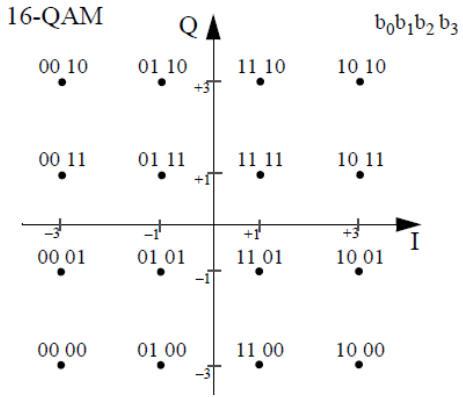
4-Bit

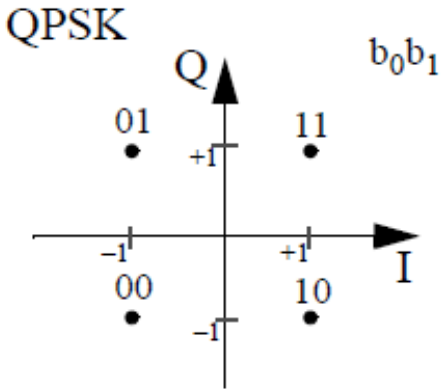


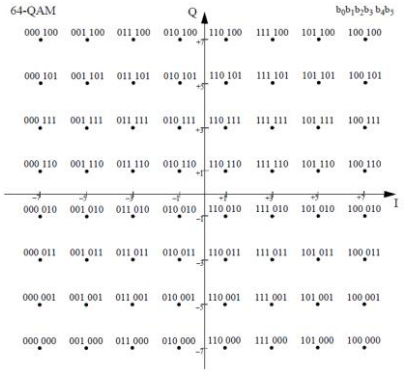


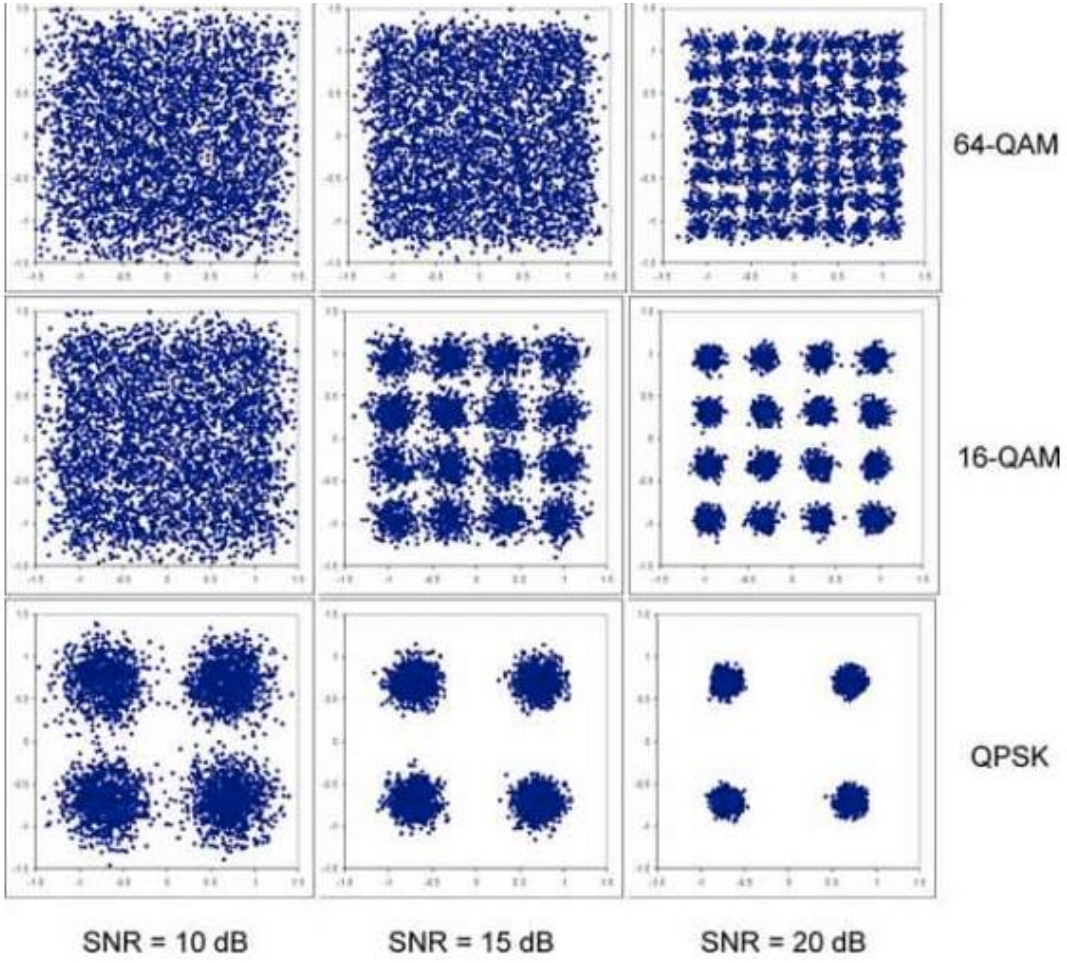
EVM

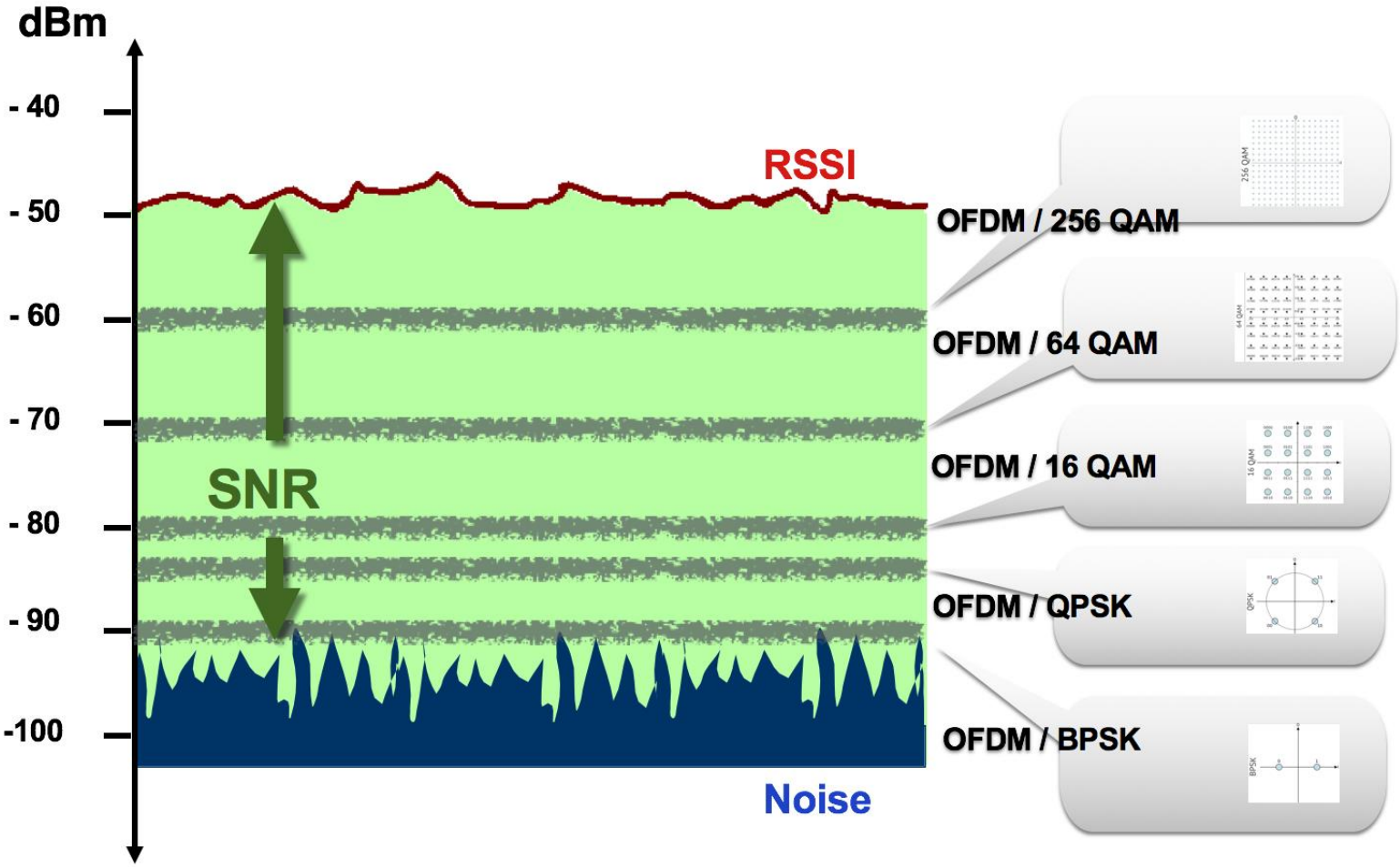




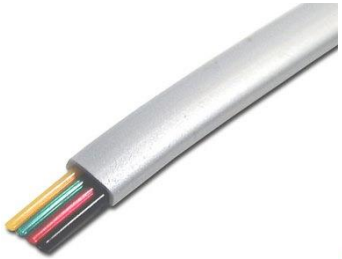


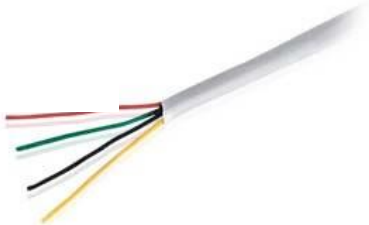


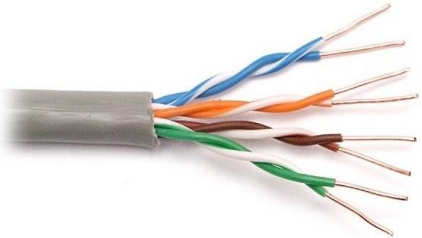


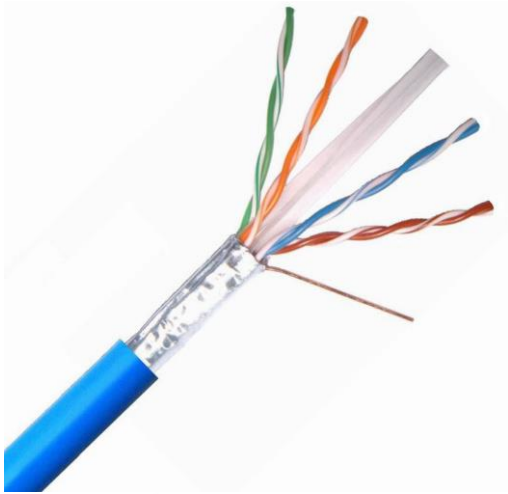


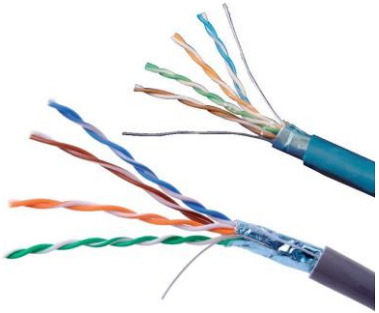
Evolution in Cabling











MCS Index - 802.11n and 802.11ac

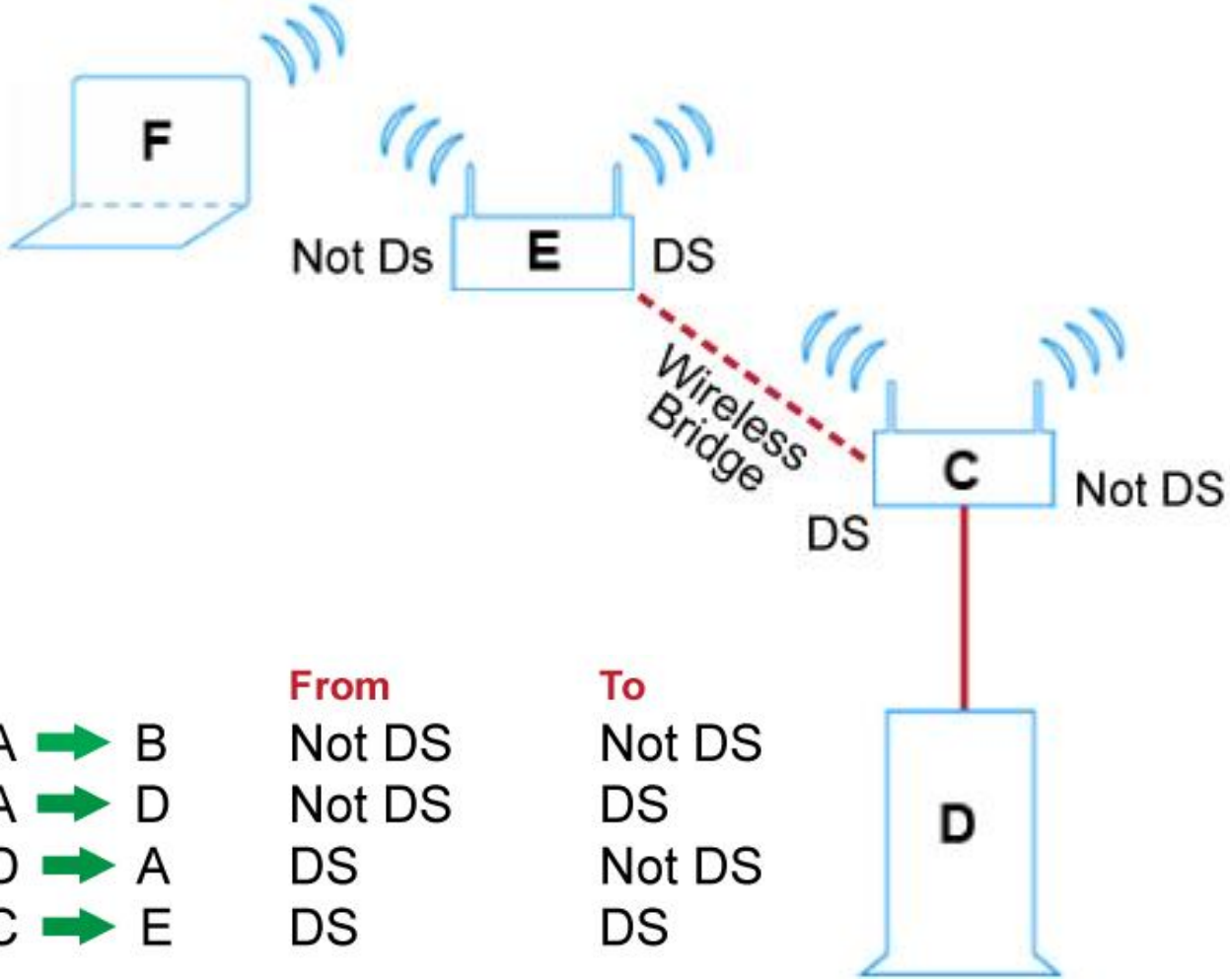
802.11n | 802.11ac

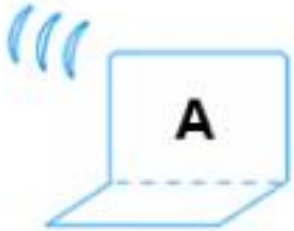
HT MCS Index	VHT MCS Index	Spatial Streams	Modulation	Coding	20MHz Data Rate No SGI	20MHz Data Rate SGI	40MHz Data Rate No SGI	40MHz Data Rate SGI	80MHz Data Rate No SGI	80MHz Data Rate SGI	160MHz Data Rate No SGI	160MHz Data Rate SGI
0	0	1	BPSK	1/2	6.5	7.2	13.5	15	29.3	32.5	58.5	65
1	1	1	QPSK	1/2	13	14.4	27	30	58.5	65	117	130
2	2	1	QPSK	3/4	19.5	21.7	40.5	45	87.8	97.5	175.5	195
3	3	1	16-QAM	1/2	26	28.9	54	60	117	130	234	260
4	4	1	16-QAM	3/4	39	43.3	81	90	175.5	195	351	390
5	5	1	64-QAM	2/3	52	57.8	108	120	234	260	468	520
6	6	1	64-QAM	3/4	58.5	65	121.5	135	263.3	292.5	526.5	585
7	7	1	64-QAM	5/6	65	72.2	135	150	292.5	325	585	650
	8	1	256-QAM	3/4	78	86.7	162	180	351	390	702	780
	9	1	256-QAM	5/6	n/a	n/a	180	200	390	433.3	780	866.7
8	0	2	BPSK	1/2	13	14.4	27	30	58.5	65	117	130
9	1	2	QPSK	1/2	26	28.9	54	60	117	130	234	260
10	2	2	QPSK	3/4	39	43.3	81	90	175.5	195	351	390
11	3	2	16-QAM	1/2	52	57.8	108	120	234	260	468	520
12	4	2	16-QAM	3/4	78	86.7	162	180	351	390	702	780
13	5	2	64-QAM	2/3	104	115.6	216	240	468	520	936	1040
14	6	2	64-QAM	3/4	117	130.3	243	270	526.5	585	1053	1170
15	7	2	64-QAM	5/6	130	144.4	270	300	585	650	1170	1300
	8	2	256-QAM	3/4	156	173.3	324	360	702	780	1404	1560
	9	2	256-QAM	5/6	n/a	n/a	360	400	780	866.7	1560	1733.3

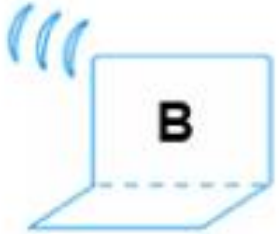
802.11ac - VHT MCS, SNR and RSSI

VHT MCS	Modulation	Coding	20MHz				40MHz				80MHz				160MHz			
			Data Rate		Min. SNR	RSSI	Data Rate		Min. SNR	RSSI	Data Rate		Min. SNR	RSSI	Data Rate		Min. SNR	RSSI
			800ns	400ns			800ns	400ns			800ns	400ns			800ns	400ns		
1 Spatial Stream																		
0	BPSK	1/2	6.5	7.2	2	-82	13.5	15	5	-79	29.3	32.5	8	-76	58.5	65	11	-73
1	QPSK	1/2	13	14.4	5	-79	27	30	8	-76	58.5	65	11	-73	117	130	14	-70
2	QPSK	3/4	19.5	21.7	9	-77	40.5	45	12	-74	87.8	97.5	15	-71	175.5	195	18	-68
3	16-QAM	1/2	26	28.9	11	-74	54	60	14	-71	117	130	17	-68	234	260	20	-65
4	16-QAM	3/4	39	43.3	15	-70	81	90	18	-67	175.5	195	21	-64	351	390	24	-61
5	64-QAM	2/3	52	57.8	18	-66	108	120	21	-63	234	260	24	-60	468	520	27	-57
6	64-QAM	3/4	58.5	65	20	-65	121.5	135	23	-62	263.3	292.5	26	-59	526.5	585	29	-56
7	64-QAM	5/6	65	72.2	25	-64	135	150	28	-61	292.5	325	31	-58	585	650	34	-55
8	256-QAM	3/4	78	86.7	29	-59	162	180	32	-56	351	390	35	-53	702	780	38	-50
9	256-QAM	5/6			31	-57	180	200	34	-54	390	433.3	37	-51	780	866.7	40	-48
2 Spatial Streams																		
0	BPSK	1/2	13	14.4	2	-82	27	30	5	-79	58.5	65	8	-76	117	130	11	-73
1	QPSK	1/2	26	28.9	5	-79	54	60	8	-76	117	130	11	-73	234	260	14	-70
2	QPSK	3/4	39	43.3	9	-77	81	90	12	-74	175.5	195	15	-71	351	390	18	-68
3	16-QAM	1/2	52	57.8	11	-74	108	120	14	-71	234	260	17	-68	468	520	20	-65
4	16-QAM	3/4	78	86.7	15	-70	162	180	18	-67	351	390	21	-64	702	780	24	-61
5	64-QAM	2/3	104	115.6	18	-66	216	240	21	-63	468	520	24	-60	936	1040	27	-57
6	64-QAM	3/4	117	130.3	20	-65	243	270	23	-62	526.5	585	26	-59	1053	1170	29	-56
7	64-QAM	5/6	130	144.4	25	-64	270	300	28	-61	585	650	31	-58	1170	1300	34	-55
8	256-QAM	3/4	156	173.3	29	-59	324	360	32	-56	702	780	35	-53	1404	1560	38	-50
9	256-QAM	5/6			31	-57	360	400	34	-54	780	866.7	37	-51	1560	1733.3	40	-48

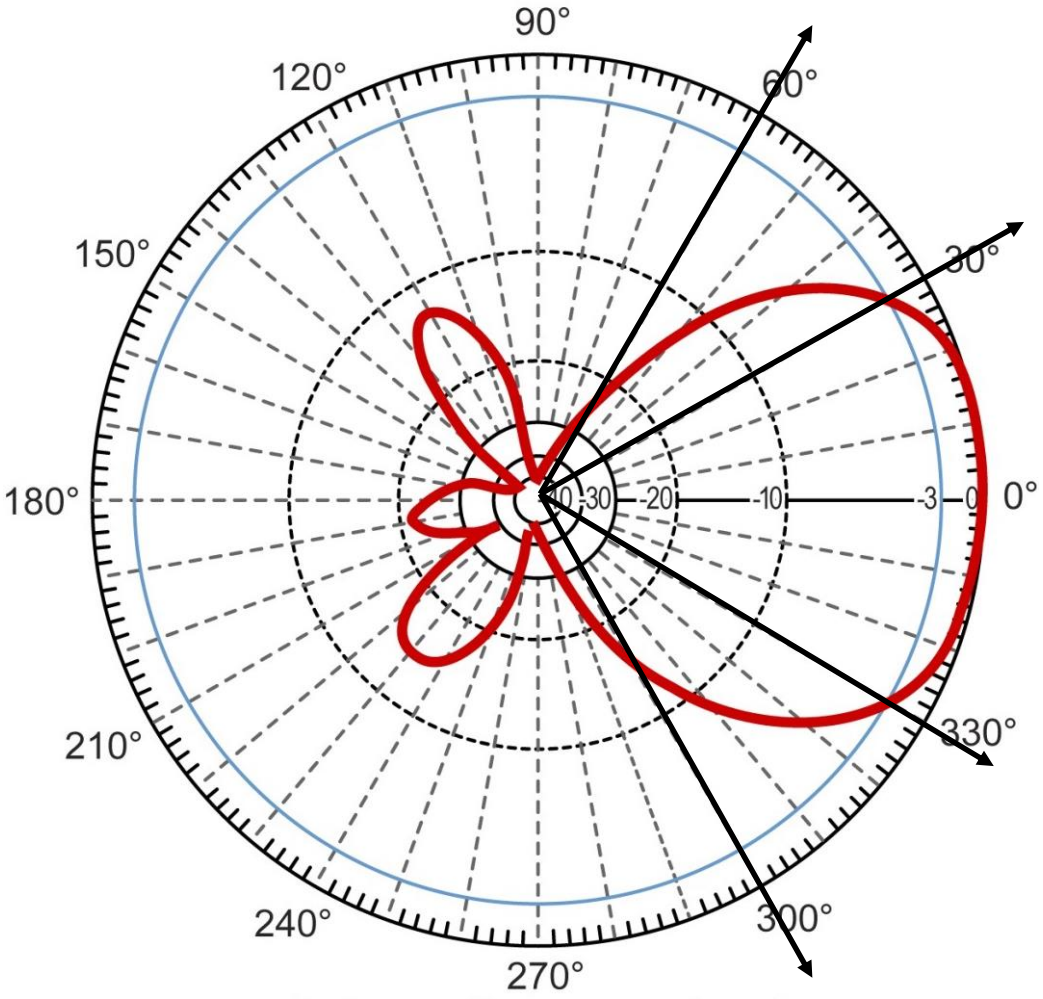
Client Analogy

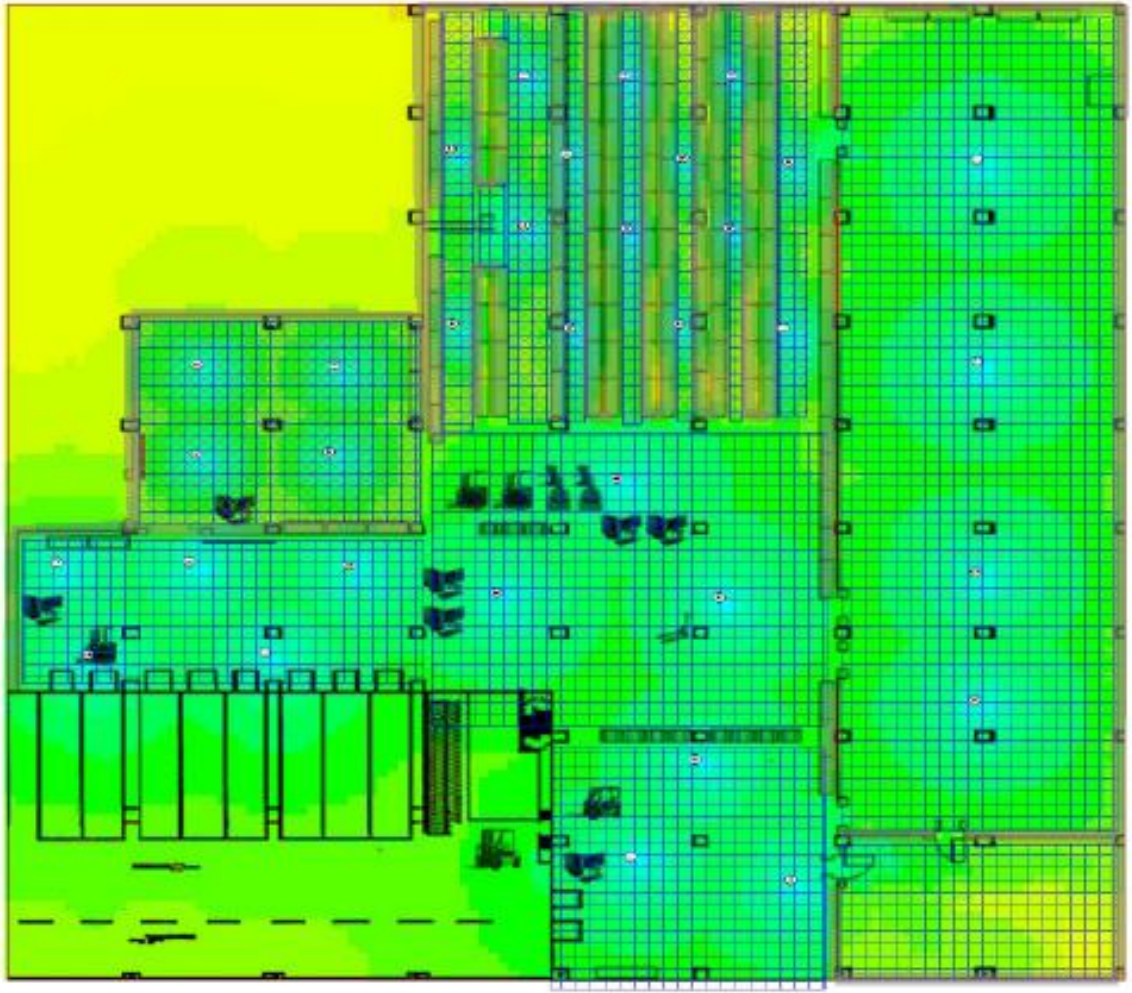


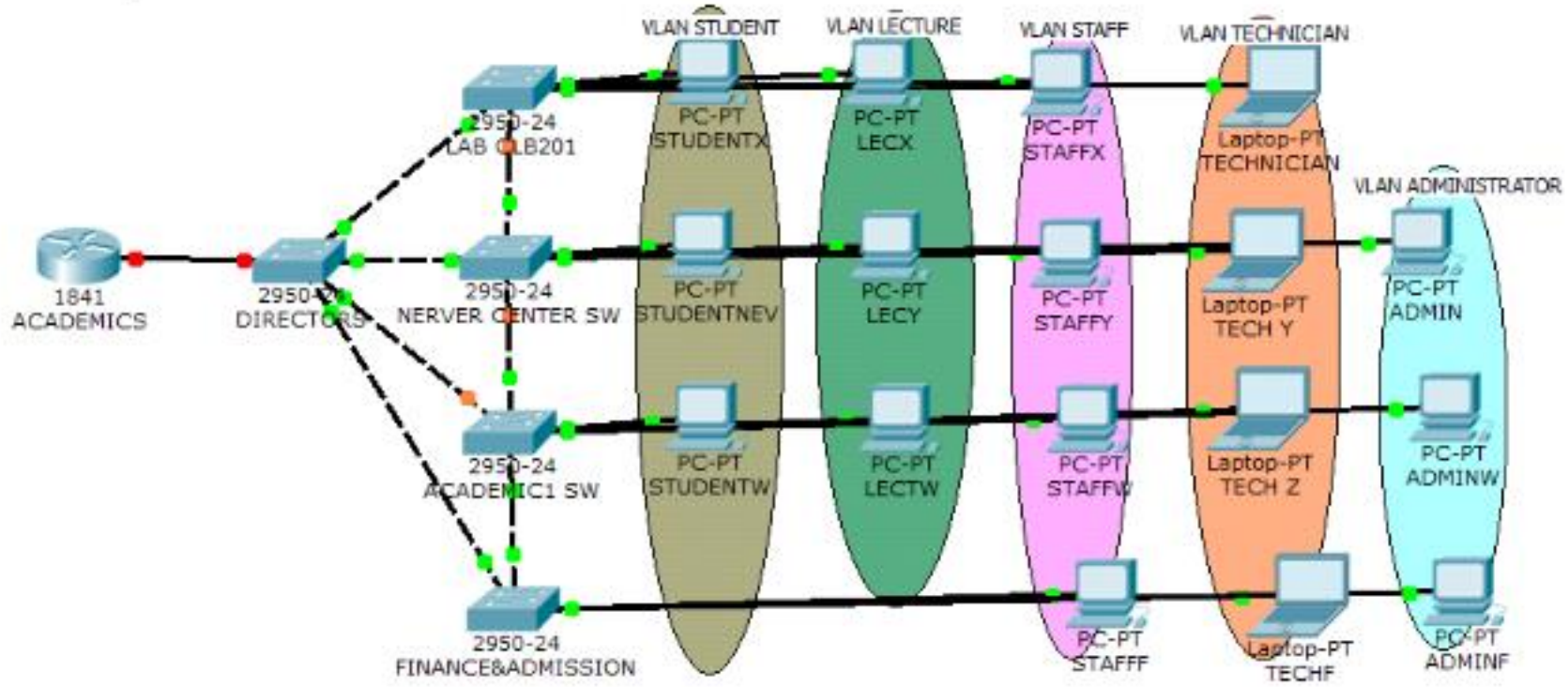




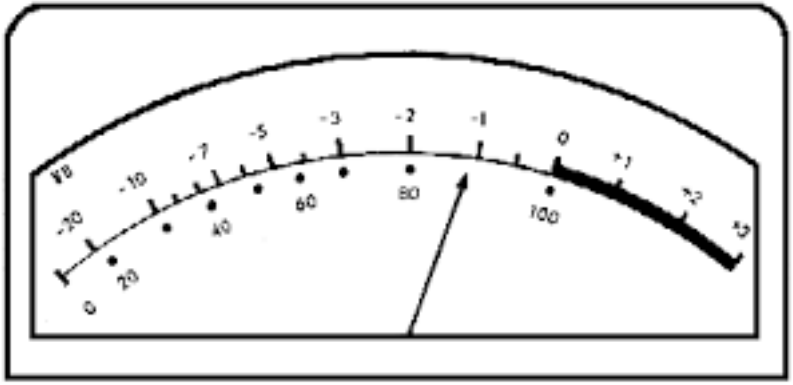
	From	To
A → B	Not DS	Not DS
A → D	Not DS	DS
D → A	DS	Not DS
C → E	DS	DS



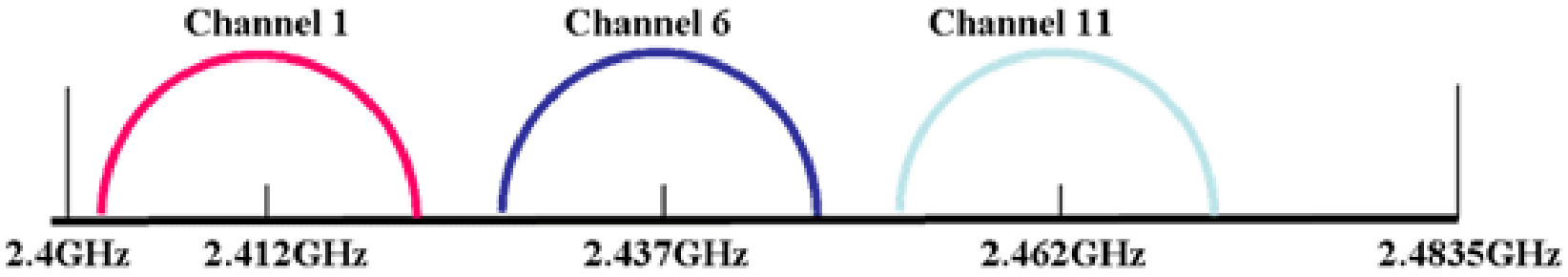




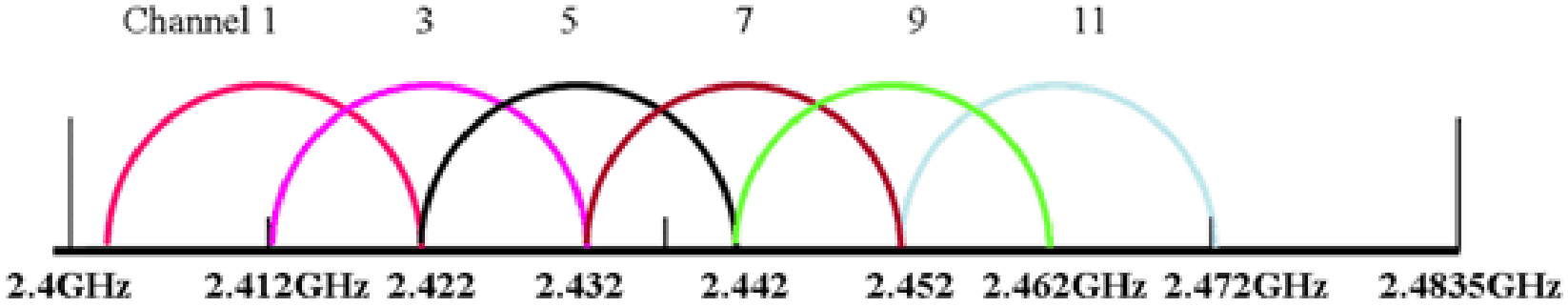

More bars in more places
at&t



DSSS First Set: 3 non-overlapping channels:

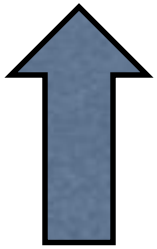


DSSS Second Set: 6 half-overlapping channels



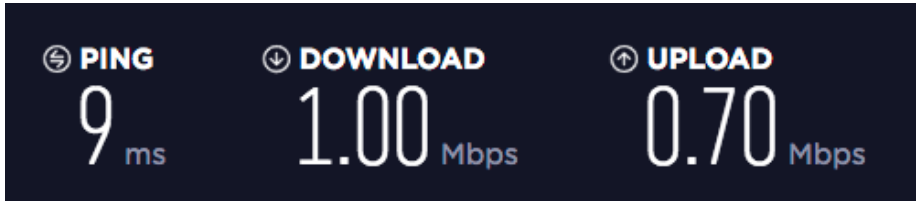
Rate Limiting…

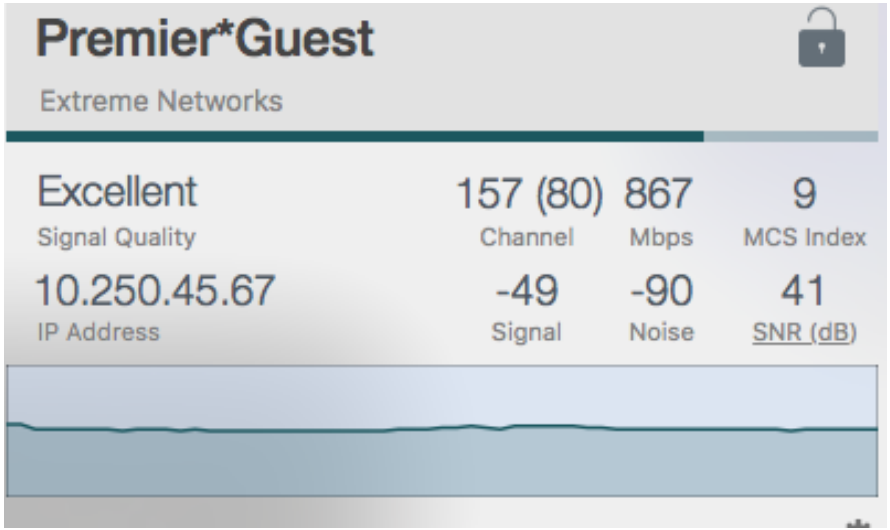
Rate Limit – DOWN
Network Utilization – UP



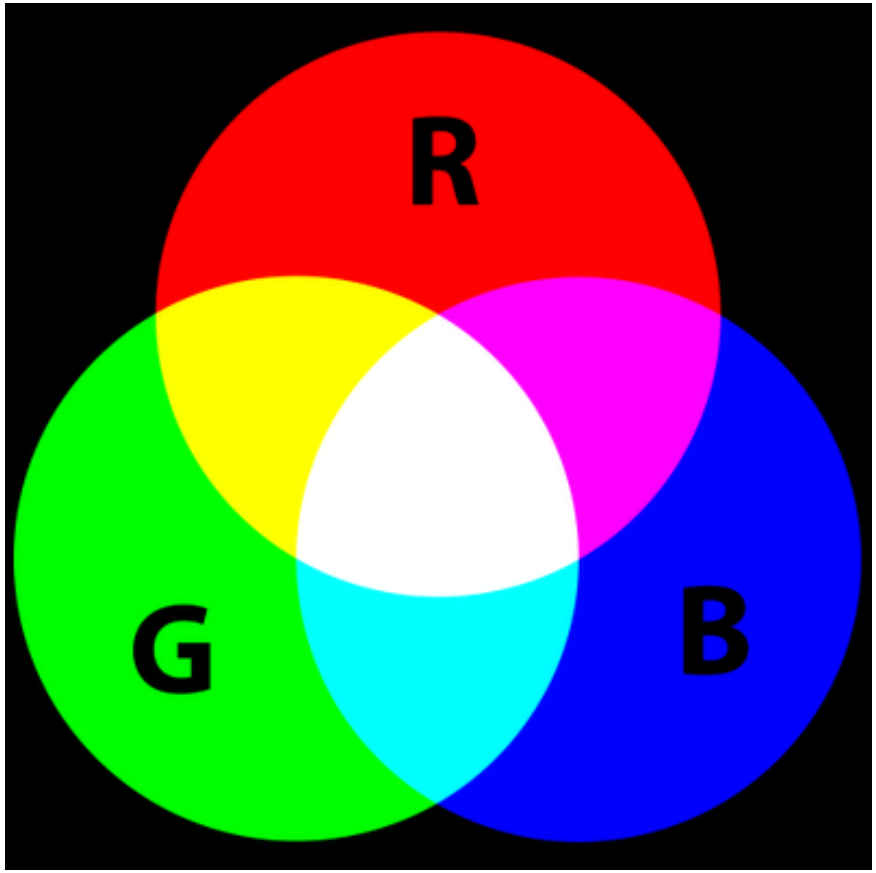
Rate Limit – UP
Network Utilization – DOWN

When Wi-Fi Problems Aren't…





- Add more overhead, decrease throughput
- More RSSI the better
- Survey is Green!
- 30° antenna covers 30°
- VLANs on Wireless LANs separate collision domains
- The Noise function in Wireless NICs will show us ambient RF issues
- We need a different SSID for each purpose in our network, our system supports up to 16
- If you point your antenna right at the signal source it will work better
- We designed our Wireless LAN for Voice, Video, Data, Bar-Code Scanners, and Location Tracking
- 802.11n actually typically decreases collisions and retries to get higher throughput
- Multipath is good /Multipath is bad
- We use Windows Zero Config, it gives us everything we need


R
G
B

- The latest wireless drivers is all you need to fix the problem
- The wireless network is responsible for clients deciding to roam
- PoE is just PoE – they are all the same
- They wouldn't have let us configure AP to Channel 2 if it wasn't alright
- APs are just wireless switches
- We've got great (-65dBm) RSSI everywhere, Voice over IP will run fine Those little bar measurements actually reflect reality
- Bigger is better with respect to antennas
- I have four bars, I have good signal, right?
- Its better to have our APs using all channels than 'sharing' only 1, 6, and 11
- The SSID is unsecure so I can use it right?
- AP Power settings from 1 through 10, from LOW to HI, right?
- -90dBm is stronger than -40dBm — 90 is bigger than 40!
- Mb or MB what's the difference... They mean the same thing
- APs route packets on the network

- I turned on QoS so our voice will work on our WLAN
- All our APs are on one channel *(OK – perhaps Fortinet/Meru…)*
- All our APs are on 1, 6, and 11 only
- We like to use channels 1-13 to get more throughput
- IEurope, we use 1, 7, and 13 to stay away from the 1, 6, and 11 folks
- Using Wireless Range Extenders we'll share our throughput more
- We have to buy all our equipment from the same vendor
- We can force our neighbors to go to different channels and turn down their power
- More power, more throughput
- We had a problem in this one location, so we added APs to fix it
- Getting RF coverage is hard to do

How to Engage with Community

1. Get on Twitter or Slack
2. Ask for Help with Specific Issue
3. Report Back and Give Thanks
4. Write a Blog and Share Your Experience

lmgtfy

New Tweet Tweet

Looking for some help finding a document showing Sweep Times for a Cognio Spectrum Expert card for blog post. Just a link/URL would be fine.

Spectrum Analysis Device Comparison

		Ekahau Sidekick	Cisco/Cognio CleanAir	Netscout Spectrum XT	Metageek DBx
Frequencies	2.4GHz	2.400-2.495	2.400-2.500	2.402-2.494	2.400-2.495
	5GHz	5.000-5.950	4.900-5.900	5.160-5.835 4.910-4.990	5.150-5.850
Resolution Bandwidth	2.4GHz	39KH	78.125KHz	156.3KHz	214KHz
	5GHz	39KHz	78.125KHz	156.3KHz	464KHz
Sweep Time	2.4GHz	1.8µsec	20µsec	64µsec	507µsec
	5GHz	1.8µsec	20µsec	64µsec	1587µsec
MSRP		$2,995	$3,500 (back w/PC Card)	$3,700	$500

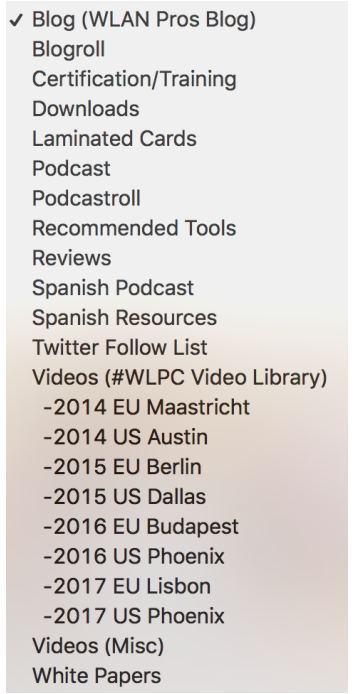
Rinse, Repeat

More Information

CWNP for Vendor-Neutral Training

Wireless LAN Professionals Website
http://WLANPros.com

Get involved in Twitter Community
Vendor Specific Training
Other WLAN Blogs



That’s All Folks!

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WI-FI DESIGN DAY