

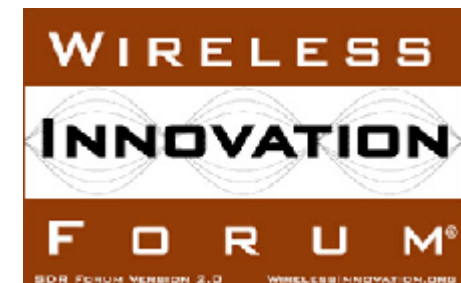
WinnComm 2019

# Unlicensed 6 GHz RLANs Incumbent Perspective

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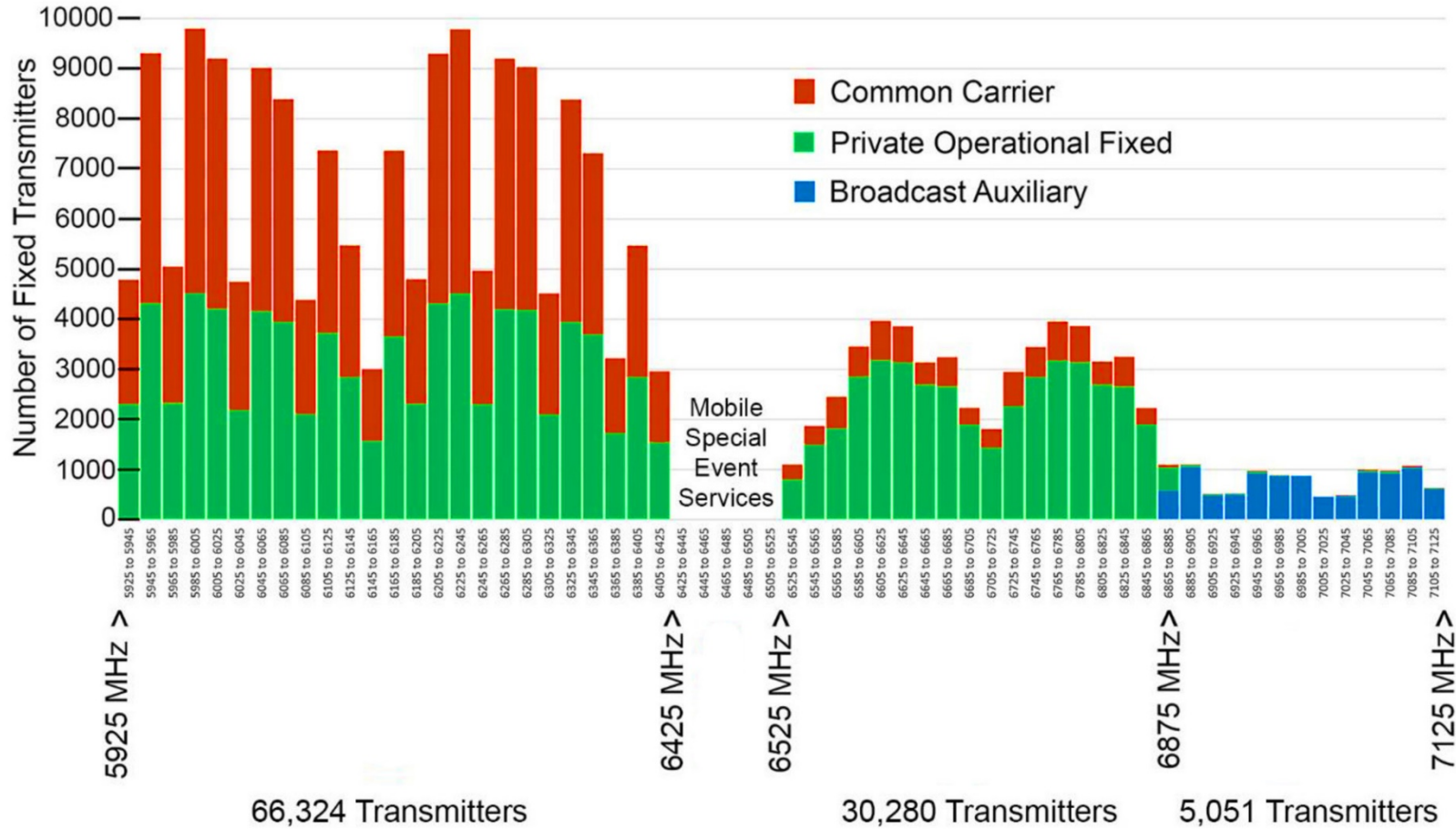


La Jolla, CA  
November 21, 2019





# 6 GHz in the United States



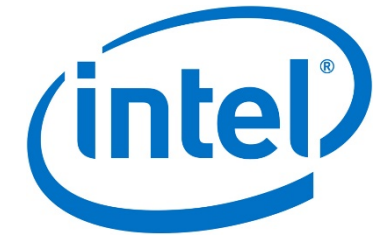
Existing Fixed Co-channel Transmitters and Proposed Allocations per 20 MHz

data and graph provided by Comsearch

# A Modest Proposal



In synchronization with current political thought, on **January 25, 2018**, Broadcom, Cisco, Facebook, Google, Hewlett Packard Enterprise, Intel, MediaTek, Microsoft and Qualcomm presented a proposal\* to the FCC proposing **the introduction of unlicensed Radio LANs (RLANs) into the 6 GHz bands** (referenced as RLAN)



\* Paul Margie, Expanding Flexible Use in Mid-Band Spectrum between 3.7 and 24 GHz, GN Docket No. 17-183, Harris, Wiltshire & Grannis, January 26, 2018 <[https://ecfsapi.fcc.gov/file/101261169015803/6%20GHz%20Ex%20Parte%20\(Bureaus\).pdf](https://ecfsapi.fcc.gov/file/101261169015803/6%20GHz%20Ex%20Parte%20(Bureaus).pdf) >



# The RLAN Consortium's Proposal

The proposal introduces 958,062,017 ( $\approx$  one billion) unlicensed devices spread across the United States in urban, suburban and rural areas by 2025 (RLAN pages 12 and 13).

Peak transmitter EIRPs range for 18.5 dBm to 35.3 dBm (RLAN page 18).

Channel bandwidths range from 20 MHz to 160 MHz (RLAN page 24). Since only one channel is used, the modulation is assumed to be Time Domain Duplex (TDD) instead of Frequency Division Duplex (FDD) universally used by the fixed point to point service (FS).

# The FCC Speaks



On October 24<sup>th</sup>, 2018, the FCC released a Notice of Proposed Rulemaking (NPRM), Unlicensed Use of the 6 GHz Band, ER Docket 18-295 (FCC 18-147, referenced as “FCC”)

<<https://docs.fcc.gov/public/attachments/FCC-18-147A1.pdf>>

This NPRM, based upon input from the RLAN consortium as well as the fixed point to point community, proposes to introduce unlicensed radio LAN operation into 6 GHz.

# Proposed for the United States

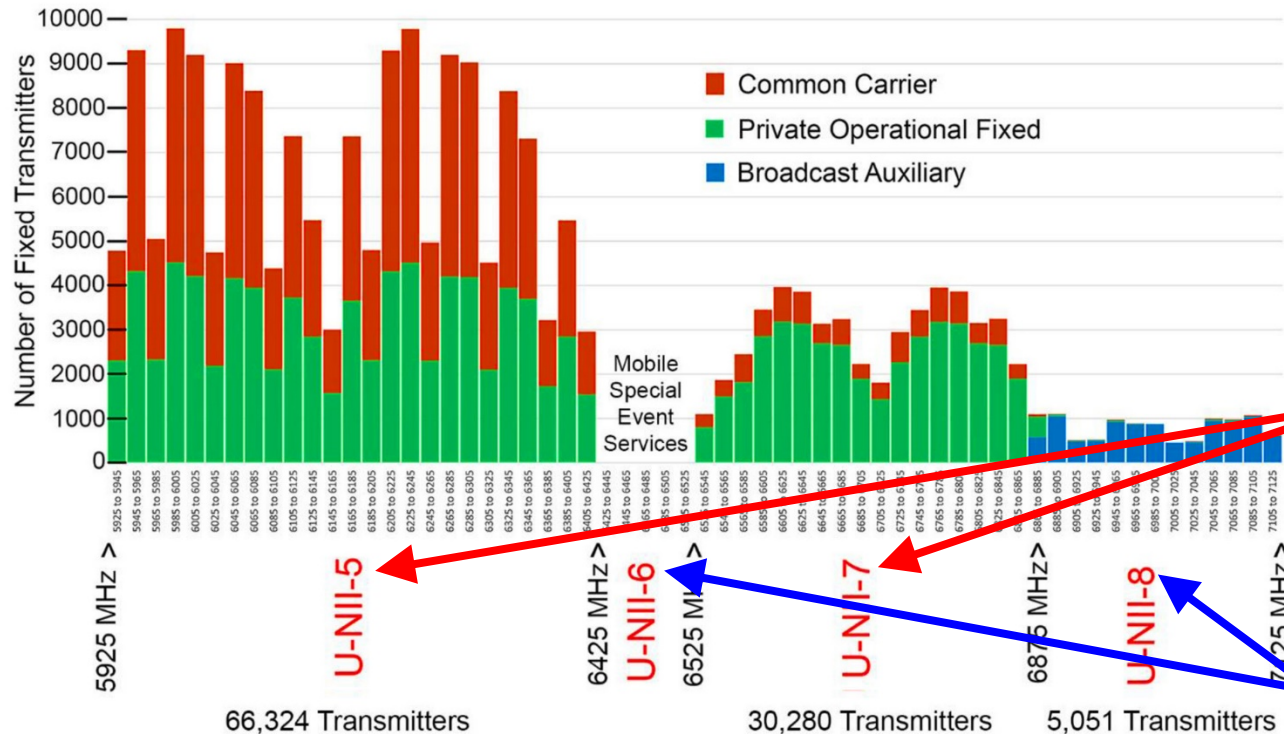
Currently the following unlicensed bands are defined (FCC Rules, Part 15):

U-NII-1:	5.150–5.250 GHz
U-NII-2A:	5.250–5.350 GHz
U-NII-2B:	5.350–5.470 GHz
U-NII-2C:	5.470–5.725 GHz
U-NII-3:	5.725–5.850 GHz
U-NII-4:	5.850–5.925 GHz

The NPRM proposes the following **new unlicensed bands** (FCC pages 5 and 29):

U-NII-5: 5.925–6.425 GHz	Access Point EIRP maximum = 36 dBm
U-NII-6: 6.425–6.525 GHz	Access Point EIRP maximum = 30 dBm
U-NII-7: 6.525–6.875 GHz	Access Point EIRP maximum = 36 dBm
U-NII-8: 6.875–7.125 GHz	Access Point EIRP maximum = 30 dBm
<i>All Bands</i>	<i>Client Device EIRP maximum = 24 dBm</i>

# Proposed Unlicensed Frequency Allocations



Existing Fixed Co-channel Transmitters and Proposed Allocations per 20 MHz

data and graph provided by Comsearch

An Automated Frequency Coordination (AFC) function is proposed for all outdoor and some indoor devices (FCC page 7).

Standard Power Access Points can operate only on frequencies in the U-NII- 5 and -7 bands determined by an AFC (FCC page 9).

Low-Power Access Points can operate on any frequency in the UNII-6 and -8 bands (FCC page 9).



# The RLAN Consortium's Revised Proposal

## Unlicensed RLANs Everywhere

This year the RLAN proponents changed\* their proposal to suggest **deploying RLANs with no AFC control in all the FS bands**. These would transmit anywhere, anytime, at power levels up to 30 dBm EIRP for indoor devices and 14 dBm EIRP for outdoor device.

The FWCC is concerned that an RLAN could be located within an FS receiver's main beam, close to the antenna, lacking ground clutter, and either outdoors or inside a building with inadequate wall attenuation.

The RLAN coalition counters that this will be rare and if it does, the FS fade margin will absorb the interference and harmful interference will not occur unless the link fails - a rare event.

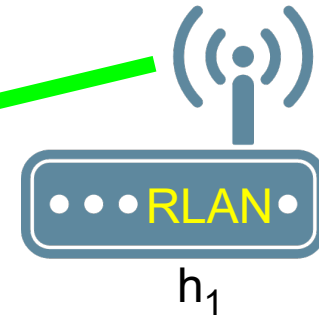
\*Letter from Paul Margie, Counsel to Apple Inc., et al., to Marlene Dortch, Secretary, FCC, attachment at 8 (filed April 26, 2019).

# Different Views of Interference

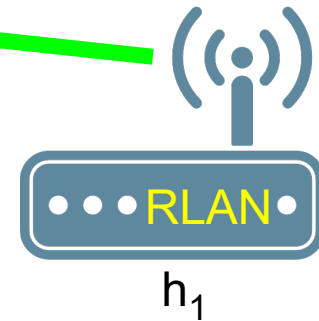
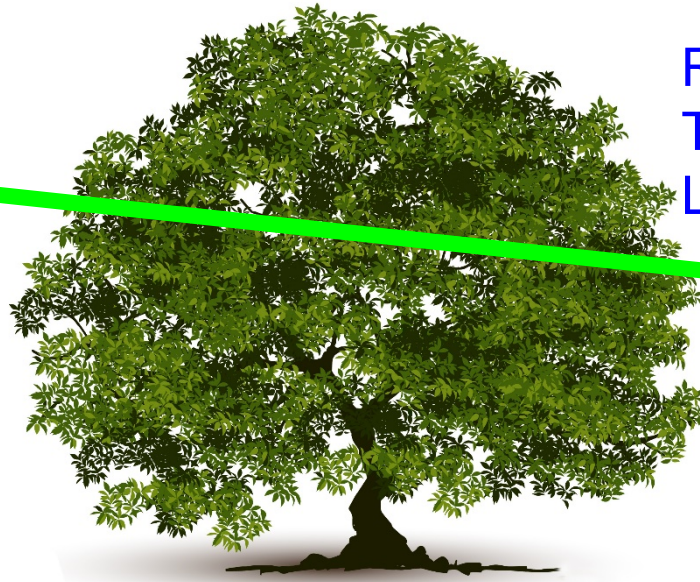
Fixed Service  
Receive Antenna



FWCC  
Rare Line of Sight Path  
Shorter than Breakpoint



RLAN Proponents  
Typical Clutter Dominated Path  
Longer than Breakpoint

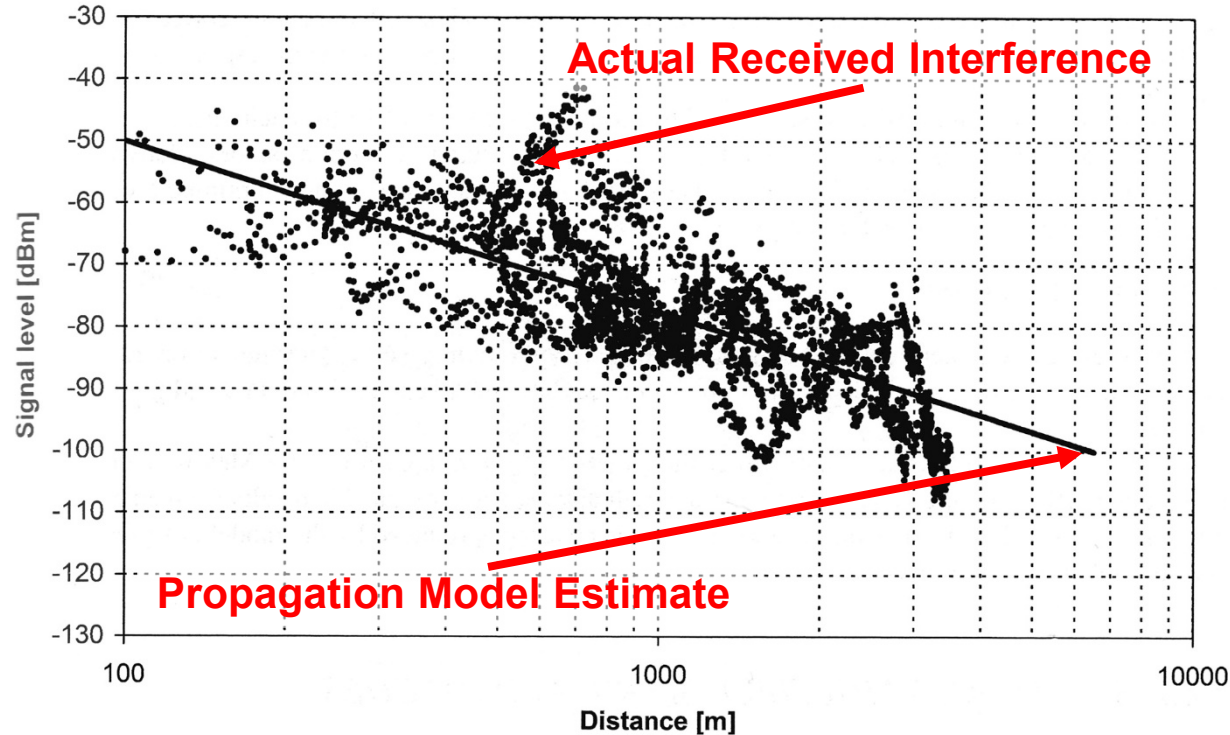


**Reality: atypical clutter-free paths will cause harmful interference**

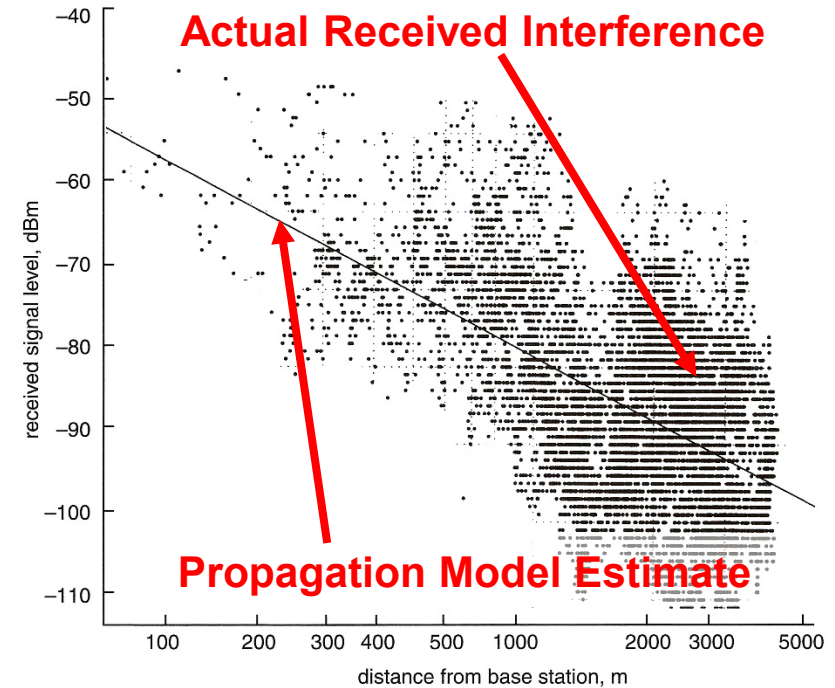
$$\text{Breakpoint} \approx 4 (h_1 - \text{clutter}) (h_2 - \text{clutter}) / \lambda$$

$\lambda$  = free space wavelength

# Topics Requiring Further Discussion



Typical Drive Test Sample (major German city at 2.160 GHz)  
Figure 5.17, page 107, *Understanding UMTS Radio Network Modelling, Planning and Automated Optimisation*  
M. Nawrocki, M. Dohler and A. Aghvami, John Wiley and Sons, West Sussex, 2006



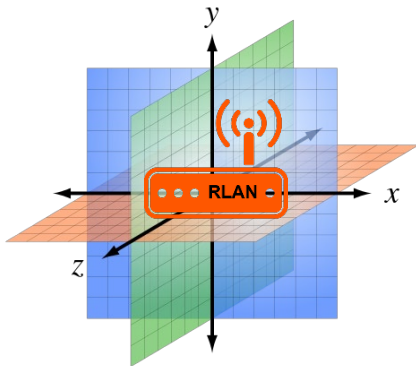
Measurements taken in a suburban area  
Figure 11.5, page 190, *Propagation of Radiowaves, 2nd Edition*  
Les Barclay, Editor, IEE, London, 2003

Propagation along clutter dominated paths will be challenging to predict.  
Propagation models alone are not adequate.

# Topics Requiring Further Discussion



Where am I?



BEL varies from 2 to >40 dB

Old or new construction significantly different

Reflections, resonances and window and wall composition significant

Building Entry Loss (BEL) will vary widely – as will potential interference  
RLAN physical location significantly affects interference

# Topics Requiring Further Discussion

## Interference Mitigation



Unexpected circumstances are inevitable. RLAN transmitters will be numerous and typically invisible. How will you find the interfering one?

How many AFC systems will have to be queried to determine who controls the interfering transmitter?

Will **Interference Bounty Hunter** become a new job description?



# Topics Requiring Further Discussion

## Harmful Interference Criteria

Fixed Service Long Term aggregate interference criterion<sup>1</sup> is  $I/N = -6$ .

The original RLAN proposal<sup>2</sup> cited  $I/N = -6$  dB as the criterion seventeen times.

The RLAN coalition now claims<sup>3</sup> C/I analysis would be more appropriate.

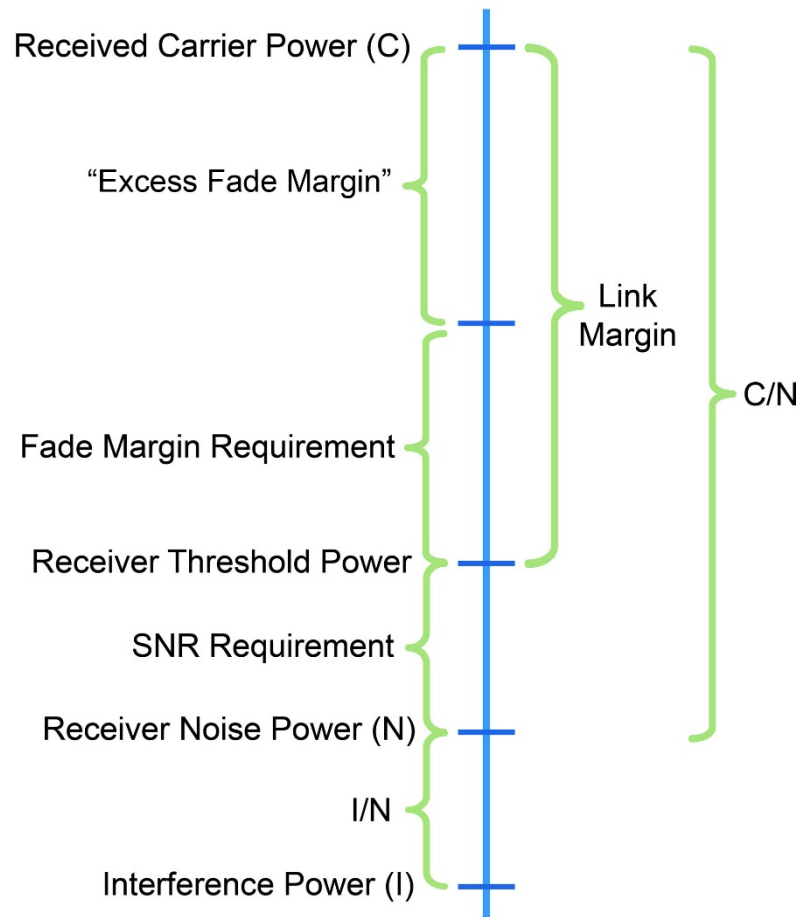
<sup>1</sup>ANSI/TIA-10-2019 Standard, Interference Criteria for Microwave Systems, 2019, page 38, Para. 4.4, Digital Threshold to Interference (T/I) Criterion **and** ITU-R Recommendation F.758-6, System parameters and considerations in the development of criteria for sharing or compatibility between digital fixed wireless systems in the fixed service and systems in other services and other sources of interference, Table 4, page 19.

<sup>2</sup>Paul Margie, Expanding Flexible Use in Mid-Band Spectrum between 3.7 and 24 GHz, GN Docket No. 17-183, Harris, Wiltshire & Grannis, January 26, 2018

<sup>3</sup>Letter from Apple Inc. *et al.*, to Marlene H. Dortch, Secretary, FCC (Sept. 25, 2019), page 8.

# Topics Requiring Further Discussion

## C/I Analysis



The RLAN consortium now proposes the use of C/I analysis rather than I/N.

The C/I approach is to estimate "required" link ("fade") margin based upon an assumed path availability.

The "required" fade margin is subtracted from the estimated link margin. The result is the "excess" link margin.

Of course, this process requires some assumptions. The unknown user's design requirements are the most critical.

# Topics Requiring Further Discussion

## C/I Analysis and the AFC

The Automatic Frequency Coordination (AFC) process is a misnomer. No coordination is proposed.

The process is actually Automatic Frequency Assignment (AFA). The license holder does not get a vote in the process.

The C/I process makes a determination of the user's "required" fade margin using an as yet undefined method.

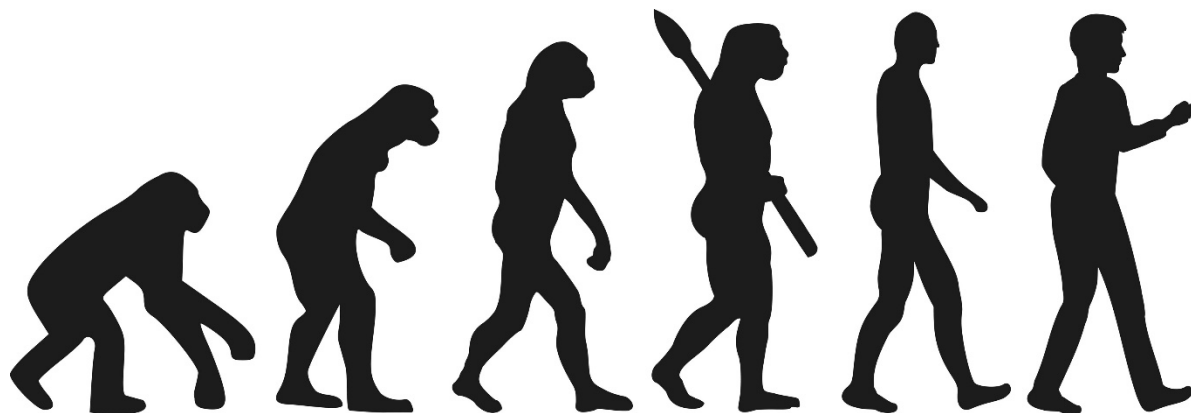
Interference is allowed to limit the path fade margin to the "required" amount [C/N becomes C/(I+N)].

Will the AFC do the appropriate thing ?





# Evolution ?



Today we stand at the threshold of significant change.

If we are successful, we will make a major step in the evolution of frequency management

Let us strive to be successful!

# WinnComm 2019

Questions or Comments ?



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