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July 17, 2018

Via Electronic Filing

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street SW
Washington DC 20554

Re: GN Docket No. 17-183, *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*
Notice of *Ex Parte* Communication

Dear Ms. Dortch:

On behalf of the Fixed Wireless Communications Coalition (FWCC), pursuant to Section 1.1206(b) of the Commission's Rules, I am electronically filing this notice of an *ex parte* presentation in the above-referenced docket.

On Friday, July 13, 2018, representatives of the FWCC met with Commission representatives from the Office of Engineering and Technology, Wireless Telecommunications Bureau, and International Bureau to discuss the points summarized in the attached handouts, which reflect the views set out in the FWCC's pleadings in the above-referenced docket. A list of the meeting participants is also attached.

Respectfully submitted,

Cheng-yi Liu
Counsel for the Fixed Wireless
Communications Coalition

Attachments

cc: Meeting participants (*via email*)
Paul Margie, Counsel to Apple Inc., Broadcom Inc., Facebook, Inc., Hewlett Packard Enterprise, and Microsoft Corporation (*via email*)

MEETING PARTICIPANTS

FWCC

George Kizer, FWCC representative
Will Perkins, FWCC representative
Cheng-yi Liu, Fletcher, Heald & Hildreth, PLC

Federal Communications Commission

Julius Knapp (OET)
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Peter Daronco (WTB) *
Brian Wondrack (WTB) *
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Jeffrey Tignor (WTB) *
Thomas Derenge (WTB) *

* participated telephonically

Expanding Flexible Use in Mid-Band Spectrum
GN Docket No. 17-183

6 GHz RLAN Mitigation Issues

Fixed Wireless Communications Coalition

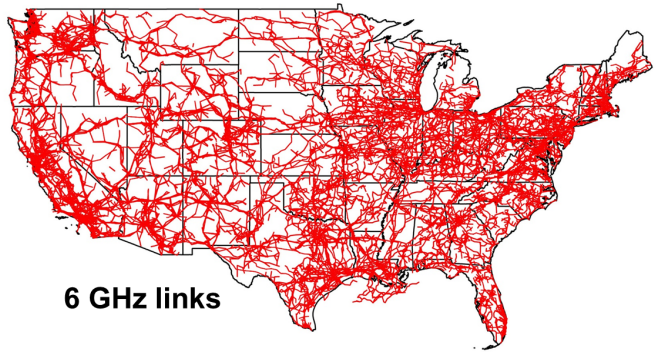
July 13, 2018

About the FWCC

- Companies, associations, individuals interested in terrestrial fixed microwave
- Formed in 1998, speaks for the fixed service community
- Active in 70+ FCC matters plus NTIA, FAA, GAO, courts
- Membership includes:
  - microwave equipment manufacturers
  - fixed microwave engineering / frequency coordination firms
  - licensees of fixed microwave systems (and/or associations)
  - communications service providers (and/or associations)
  - major users and/or associations
  - backhaul providers, communications carriers
  - telecommunications attorneys and engineers.

About 6 GHz Fixed Service Microwave

- 95,000+ U.S. links
- Carries safety-critical services, including:
  - synchronizing railroad trains
  - control of petroleum and natural gas pipelines
  - balance in the electric grid
  - backhaul to dispatch public safety and emergency vehicles



6 GHz links

- High reliability:
  - safety-related links: 99.9999% (30 seconds outage per year)
  - most others: 99.999% (5 minutes outage per year)
- 6 GHz is the only band available for links that must span tens of miles.

Claims from RLAN Group

- RLAN Group seeks to deploy 958,000,000 unlicensed RLANs at up to 3.4 watts
- … says interference into Fixed Service (FS) will be:
  - rare
  - easily controlled through mitigation
- In fact: interference will be frequent and pervasive
  - orders of magnitude worse than RLAN Group predicts
    (RLAN Group has not shown details of its analysis)
- Mitigation:
  - we suggest modifications to RLAN Group proposal.

FWCC Simulation of RLAN Interference

- FWCC simulation took most of its assumptions from the RLAN Group study
  - including device power and density
  - RLAN Group questioned a few other assumptions
    - those have only small effects
- Results on next slide …

Without Mitigation, Pervasive RLAN Interference to FS

Fade Margin Reduction Due to RLANs	Fraction of Microwave Receivers Affected	Likely Consequence
over 1 dB	nearly all	Note A
over 10 dB	over half	vulnerable to ordinary fades
over 20 dB	1 / 4	
over 30 dB	1 / 14	bit errors occur
over 40 dB	1 / 59	link fails *

Note A: all cases in table exceed the 1 dB interference criterion set by domestic and international standards (and adopted by RLAN Group)

Calculations use RLAN Group distribution of device powers.

* example: in Houston TX, 21 FS wideband FS receivers will fail.

Mitigation: Goals

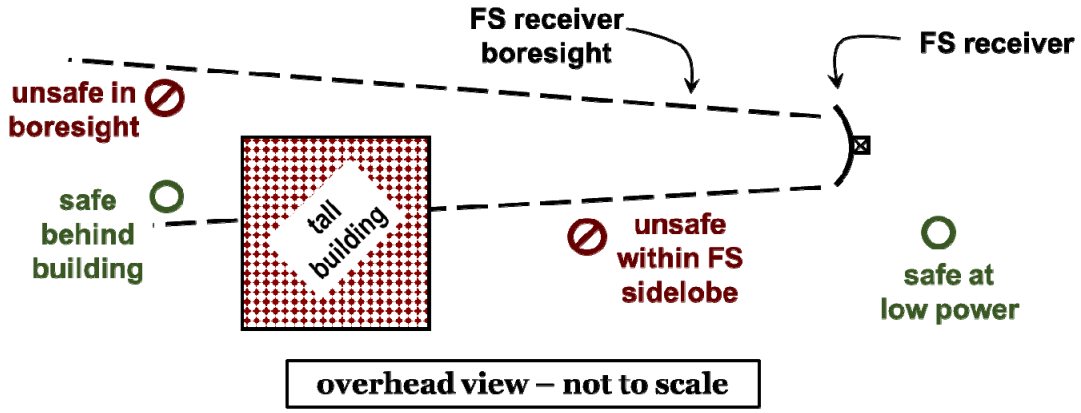
- Current reliability is:
  - 99.999% (5 minutes total outage per year)
  - 99.9999% (30 seconds total outage per year)
- Mitigation must limit additional outages to about 10% of these numbers:

  ~ 30 seconds or 3 seconds per year per FS receiver (without averaging over receivers).

RLAN Group Mitigation Proposals

- Outdoors:
  - each RLAN self-locates
  - each RLAN requests and receives permission from an automated coordination system to operate on particular frequencies
    - system based on ULS FS receiver data
  - permission expires after a fixed time and must be refreshed
- Indoors:
  - same automated coordination as outdoor RLANs above some (unspecified) power
  - no controls on devices below that power.

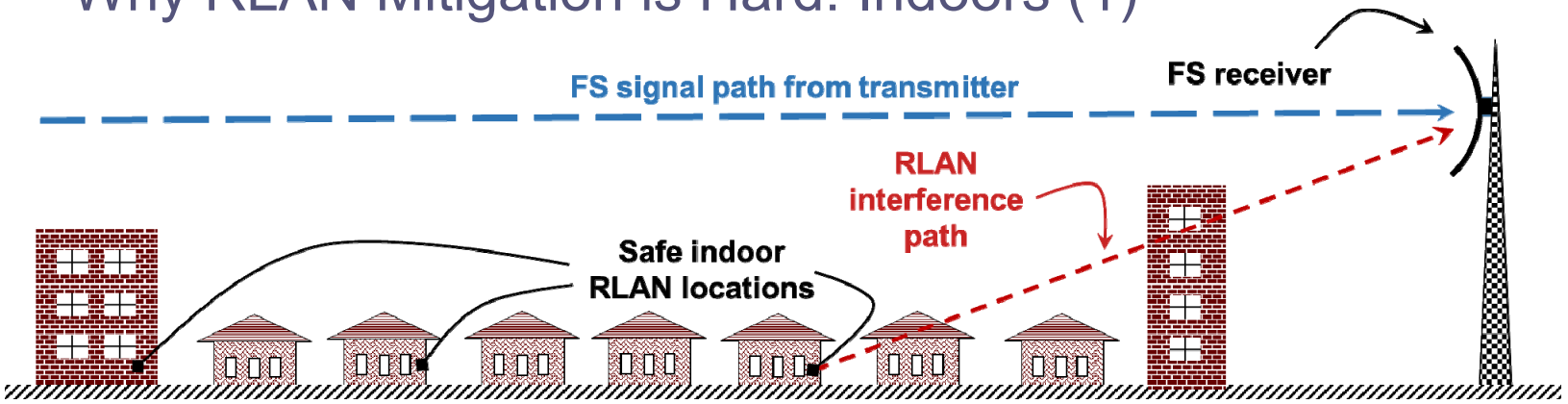
Why RLAN Mitigation is Hard: Outdoors



Safe and unsafe RLAN locations outdoors

- Safe RLAN location depends in complicated ways on:
  - angle and distance of RLAN relative to FS receive antenna
  - locations and heights of buildings, terrain features, etc.

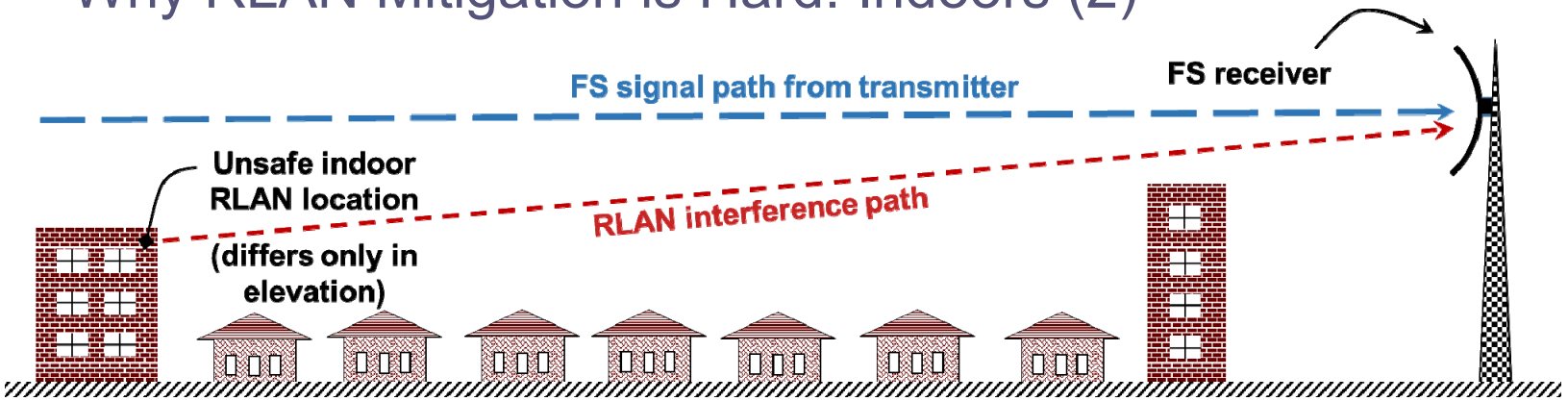
Why RLAN Mitigation is Hard: Indoors (1)



Safe RLAN locations inside buildings (not to scale)

- Some indoor RLAN locations are safe
  - depends on buildings, terrain, off-axis from FS receiver, etc.
  - but often depends on RLAN elevation (next slide).

Why RLAN Mitigation is Hard: Indoors (2)



Unsafe RLAN location in FS boresight
(not to scale)

- An indoor RLAN can be in FS receiver boresight
  - interference is certain.

Why RLAN Mitigation is Hard: Indoors (3)

- An indoor RLAN has no reliable way to know its own elevation
- At 1 km, through a 20 dB wall, RLAN in FS boresight causes fade margin reduction of **19.4 dB**
  - will disable link during moderate fade
  - fade margin reduction of 1 dB (RLAN Group criterion) **from 18.6 km away**
  - even lowest indoor power (18.5 dBm) will cause 1 dB interference through a 20 dB wall **from 11 km away**
    - much worse through glass
- RLAN Group puts 934 million devices indoors
  - with 95,000+ FS receivers, near-certain probability that some RLANs will be in boresight locations
- **All indoor RLANs need coordination.**

Mitigation Proposal

- Premise: RLAN cannot reliably determine outdoor clutter or indoor elevation
- Proposal: coordination system locks out an RLAN that is:
  - co-frequency or adjacent frequency to an FS receiver, and
  - within the 1 dB exclusion zone under line-of-sight assumptions at any elevation
- System assumes:
  - zero ground clutter
  - worst-case elevation at any RLAN location – regardless of whether the location has a building that tall (or any building).

Mitigation: Needed Conditions (1)

- An adequate coordination system will require:
  - prior authorization for all devices of any power, indoors and outdoors
  - interference criterion of 1 dB fade margin degradation (I/N = – 6 dB)
  - an RLAN's initial request for authorization made outside the 6 GHz bands
  - system assumes line-of-sight for every link*
  - system assumes worst-case elevation at any RLAN location regardless of building height (but accounts for curvature of the Earth)
  - complete, accurate, frequently updated FS receiver database
    - ULS is not adequate for this purpose, but suitable databases exist

(cont'd …)

* ITU-R Recommendation F.1706

Mitigation: Needed Conditions (2)

(… cont'd)

- periodic refresh of each RLAN authorization
  - mobile RLANs must refresh very frequently
  - an RLAN must shut down if its refresh does not succeed on schedule
- protection of adjacent channels in every case
  - and protection of second-adjacent channels where necessary
- when authorizing client through master, allowing for cases where the master at a safe location but the client is at an interfering location
- prohibition of operation on aircraft or drones
- successful testing of the coordination system under realistic conditions with participation of FS operators.

Mitigation: After the Fact

- RLAN Group proposal: RLANs transmit ID information so FS operators can identify and notify an interfering device
- Can't work:
  - FS operator cannot detect interference until after link fails
    - even then cannot tell if failure was due to deep fade, RLAN interference, or something else
    - (and FS cannot decode RLAN's ID information)
- RLAN Group must prevent interference from the start, not try to fix it afterward.

Mitigation: 6.425-6.524 MHz

- RLAN Group proposal: ban outdoor operations at 6.425-6.524 MHz
- Does not alleviate interference to FS, which does not use that band.

Comparison with Higher Ground

- RLAN Group mitigation proposals track those in the Higher Ground *Order**
  - but RLANs pose a far worse interference threat:

	Higher Ground	**RLANs**
Number of Devices	50,000	958,000,000
Areas of Major Use	lightly populated (fewer FS links)	heavily populated (most FS links)
Directional Antennas	max power upward (toward satellite)	max power horizontal (toward FS receivers)
Max Power	+39 dBm	+35.3 dBm

* 32 FCC Rcd 728 (2017)

Conclusions

- Task of mitigation: prevent RLANs from adding significantly to FS outages:
  - RLAN-caused outages can be no more than 30 seconds or 3 seconds per year for each FS receiver
- The only certain method:
  - lock out RLANs that threaten 1 dB or more interference to an FS receiver from the RLAN location at any elevation, without relying on ground clutter.

Thank you!

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