HWG | HARRIS, WILTSHIRE & GRANNIS LLP

July 31, 2019

Ex Parte

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

Re: *Unlicensed Use of the 6 GHz Band*, ET Docket No. 18-295; *Expanding Flexible Use in Mid-Band Spectrum between 3.7 and 24 GHz*, GN Docket No. 17-183

Dear Ms. Dortch:

On July 29, 2019, representatives from Apple Inc., Broadcom Inc., Cisco Systems, Inc., Facebook, Inc., Google LLC, Harris, Wiltshire and Grannis LLP, Hewlett Packard Enterprise, Intel Corporation, Marvell Semiconductor, Inc., and Qualcomm Incorporated met with representatives of the FCC's Office of Engineering and Technology. We discussed the attached presentation.

Pursuant to the FCC's rules, I have filed a copy of this notice electronically in the above referenced dockets. If you require any additional information, please contact the undersigned.

Sincerely,

Paul Margie
Counsel to Apple Inc., Cisco Systems, Inc., Facebook, Inc., Google LLC, Hewlett Packard Enterprise, and Microsoft Corporation

Cc: Meeting Participants

MEETING PARTICIPANTS

Julius Knapp (FCC OET)
Aspasia Paroutsas (FCC OET)
Bahman Badipour (FCC OET)
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Yash Patel, Qualcomm Incorporated
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* Participated via telephone

Lidar Study of
High-Rise Buildings in
Fixed Service 3dB Beams in
New York Metropolitan Area

Summary

- Low Power Indoor (LPI) and Very Low Power (VLP) are device classes that are vital to the future viability of the 6 GHz band.
- Incumbents have repeatedly argued that all RLANs must be AFC controlled (and consequently LPI/VLP are not feasible) because of the risk of RLANs in high-rise buildings protruding into FS main beams.
- To investigate this claim, the RLAN Group conducted a detailed geospatial analysis using high-resolution aerial USGS Lidar data for 1,000 square miles of the NYC metro area that contains 292 FS receivers serving unique one-way paths.
- Our analysis shows that the high-rise building risk is extremely low because:
  - Only 17.4% of all one-way FS paths in the Lidar footprint (51 out of 292 total paths) experience a high-rise building of 50 meters or greater height protruding into a 3dB main beam.
  - The median distance from an FS receiver to a building protrusion is over 11 kilometers. In no case did a protrusion beyond 6 kilometers result in an I/N exceedance.
  - For just 2.7% of paths (8 out of 292) , an RLAN at the first protrusion may have a slight exceedance over -6 dB I/N after considering typical Low Power Indoor (LPI) losses. Free space path loss was used for this analysis.
  - The 51 paths with building protrusions have a median C/N of 67 dB. Small exceedances above -6 dB I/N will not cause harmful interference to these links.
- The Commission should allow LPI across the entire 6 GHz band and VLP as we have proposed in U-NII-5, U-NII-7 and the lower 100 MHz of U-NII-8.

High-Rise Buildings with RLANs <u>Above</u> the Clutter Line Can Only Protrude into FS Main Beam in Two Ways

Path Clearance Planning

FS main beam paths are typically cleared **<u>in the azimuth plane</u>** out to several miles for **<u>most or all of the 3dB beamwidth</u>**. This has been hand validated for 292 unique one-way FS paths in the NY metro area.

Scenario #1
Incidental Protrusion

Building exceeding clutter line **<u>and</u>** beyond the initial path clearance zone is erected before or after FS link put into service

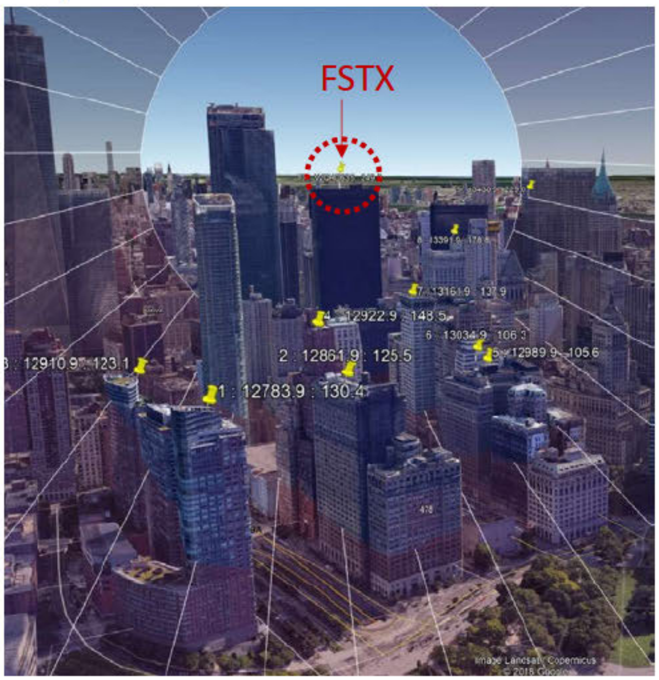
Scenario #2
Engineered Protrusion

FS transmitter is located on a building. FS receiver is intentionally pointed at building

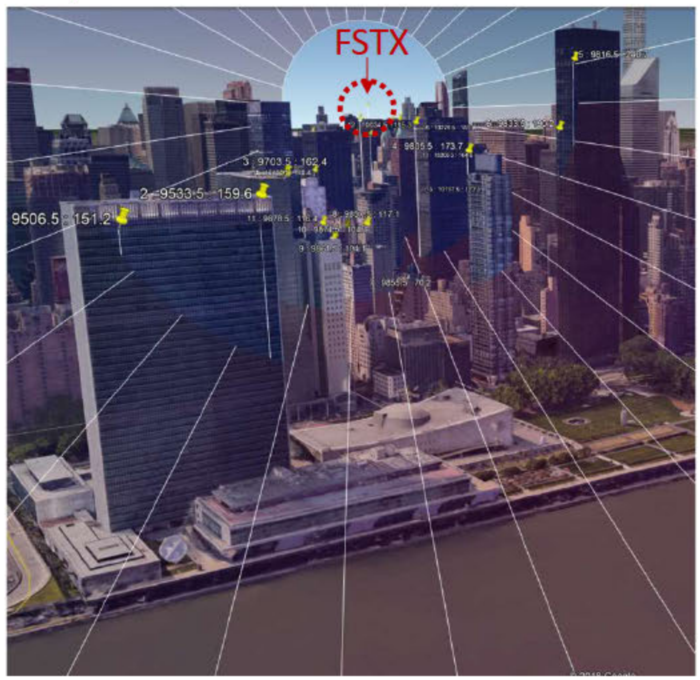
Incidental building protrusions often cluster near an Engineered FS transmitter in urban areas since high-rise buildings are zoned together.

Typical Examples of Engineered FSTX Sites Clustered with Incidental Building Protrusions

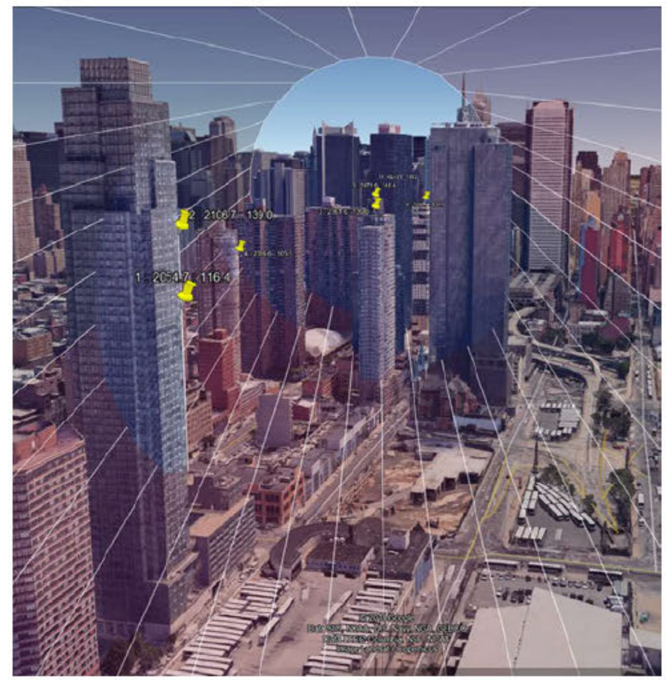
WQHC635 – Liberty Plaza (13.5 km)
FSTX @ 240m AGL
1st protrusion @ 12.8 km



WNTB247 Brooklyn-Midtown (11.3km)
FSTX @ 218m AGL
1st protrusion @ 9.5 km



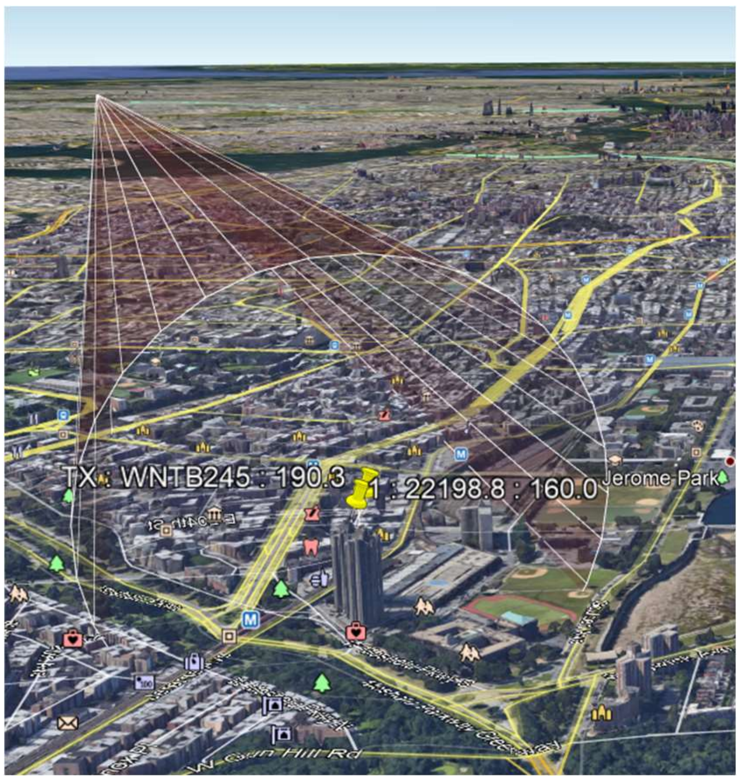
KEH21 New Jersey-Midtown (2.6 km)
FSTX @ 149m AGL
1st protrusion @ 2.0 km



Cone shape denotes actual 3 dB beamwidth down the FS receiver boresight based on ULS data.

Typical Examples of Standalone Engineered Building Protrusions in Suburban Areas Above Clutter Line

WNTB245 Brooklyn-Bronx (22.3km)
148m AGL FSTX

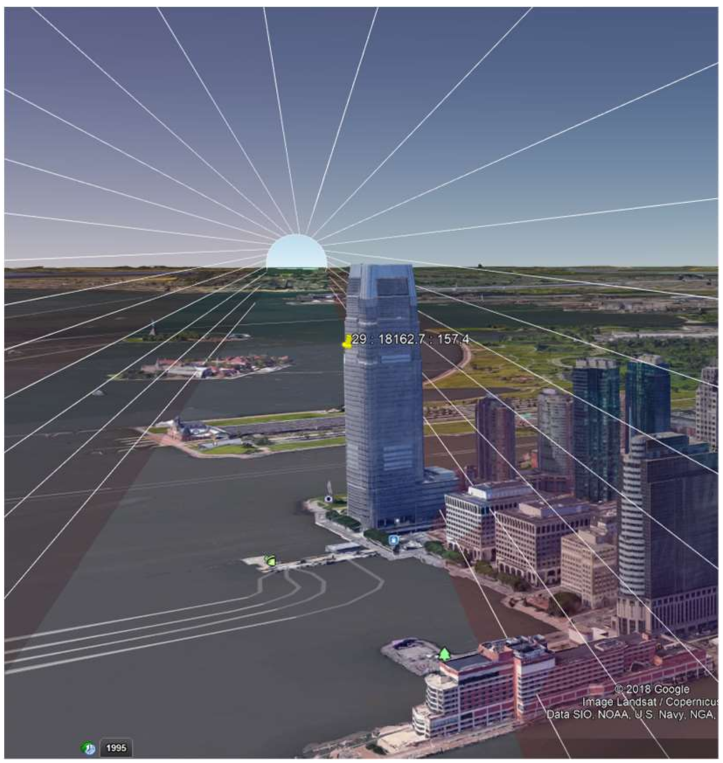


WQUD773 Brooklyn-Bronx (21.8km)
90m AGL FSTX

Cone shape denotes actual 3 dB beamwidth down the FS receiver boresight based on ULS data.

Typical Examples of Incidental Protrusions Along FS Path

WNTV637 & WQGE857
Staten Island-GW Bridge (32.4 km)
Goldman Sachs Building @ 18 km

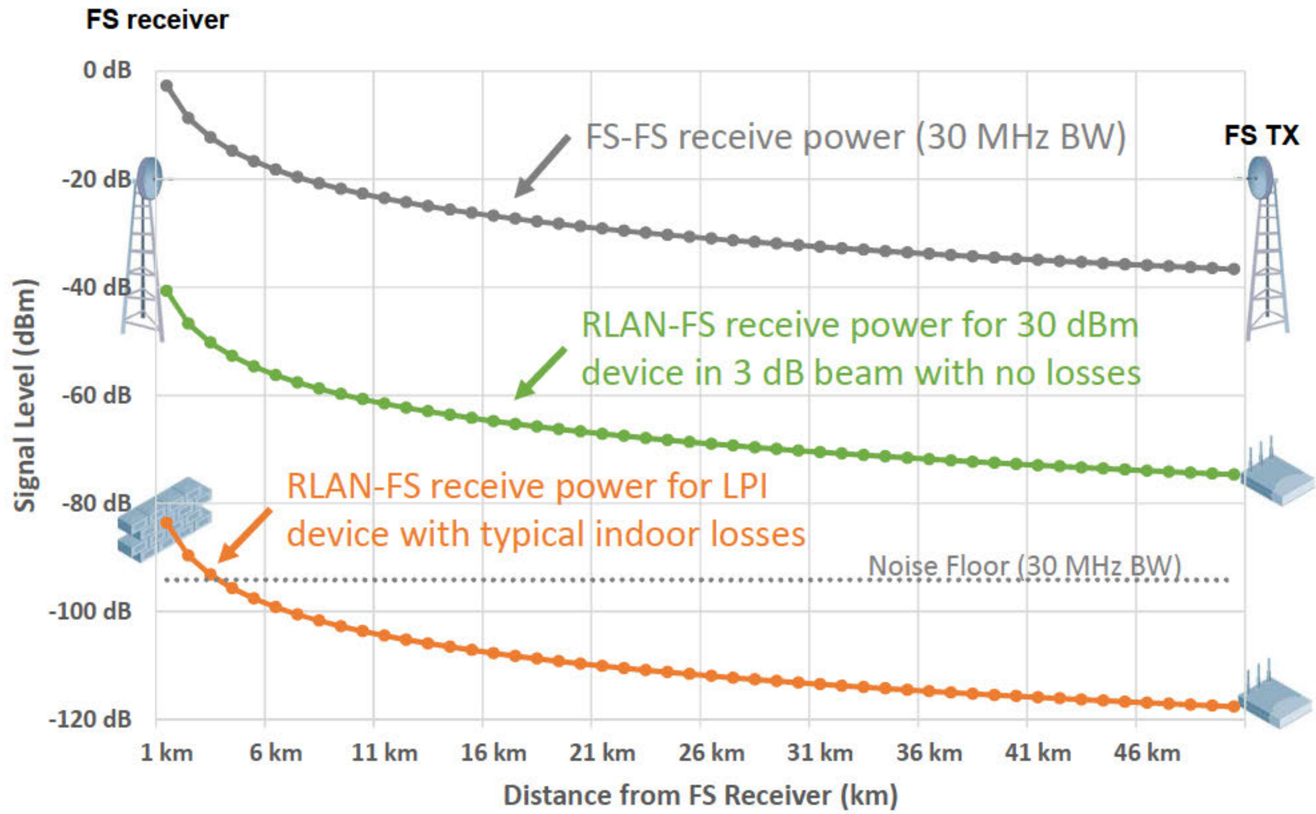


WPNA240
Stamford-Empire State Building (34.6 km)
Residential 90m cluster @ 19-20 km

Cone shape denotes actual 3 dB beamwidth down the FS receiver boresight based on ULS data.

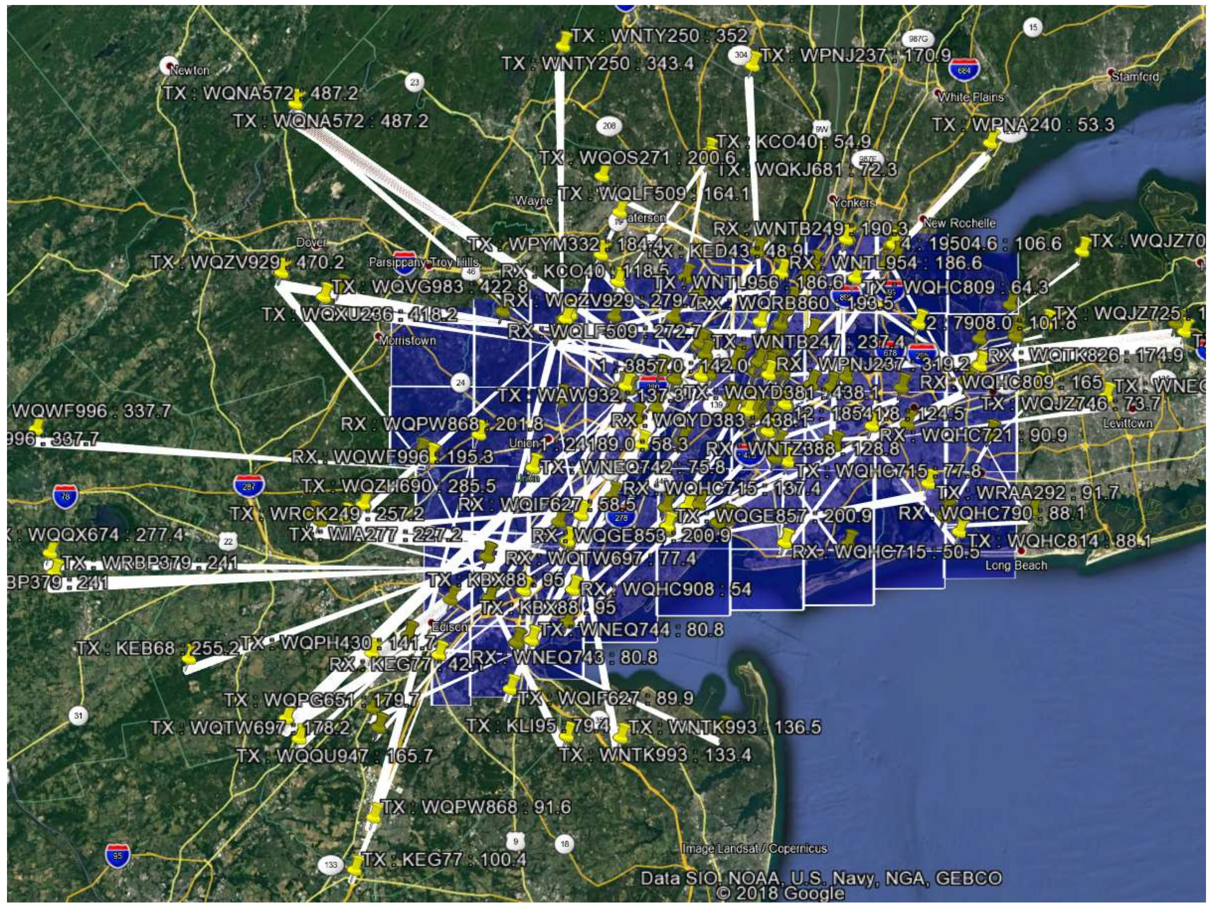
Typical Indoor RLAN Power Levels and RLAN-FS Path Losses from High-Rise Buildings Mitigate Interference Risk Beyond 7 Kilometers

- Numerous filings in the record document that virtually all high-rise buildings are thermally efficient (30 dB BEL) for structural reasons
- We have repeatedly documented losses that apply to LPI/ VLP indoor scenario including:
    - Polarization mismatch – 3 dB
    - FS feeder loss – 2 dB
    - Bandwidth mismatch – 5 dB *(typical)*
    - FS off-axis rejection - *Varies*
    - RLAN antenna mismatch – 5 dB *(typical)*
- Even ignoring the fact that RLANs typically operate well below maximum EIRP, they only exceed the noise floor to 3 km, and exceed -6 dB I/N within about 7 km.
- So how many high-rise buildings occur in FS main beams within 7 km of receivers?



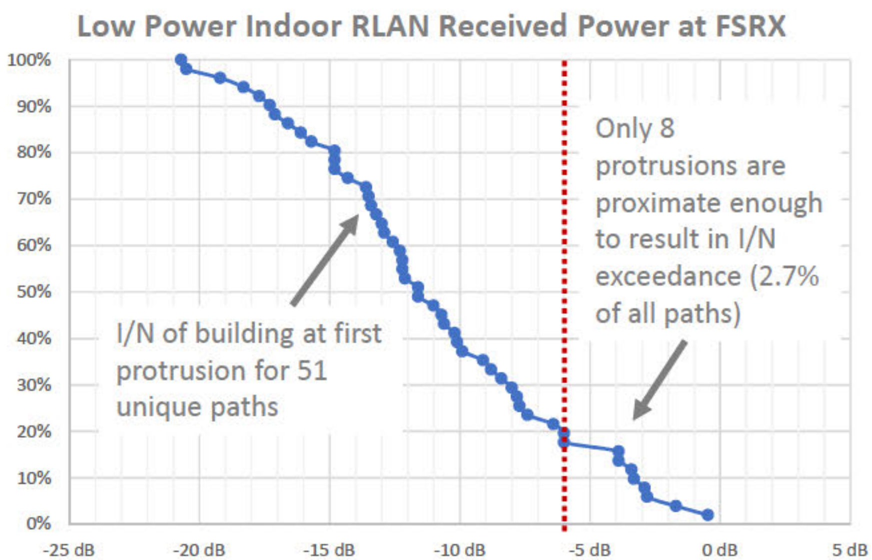
Goals of Lidar Study of High-Rise Buildings in NYC Metro

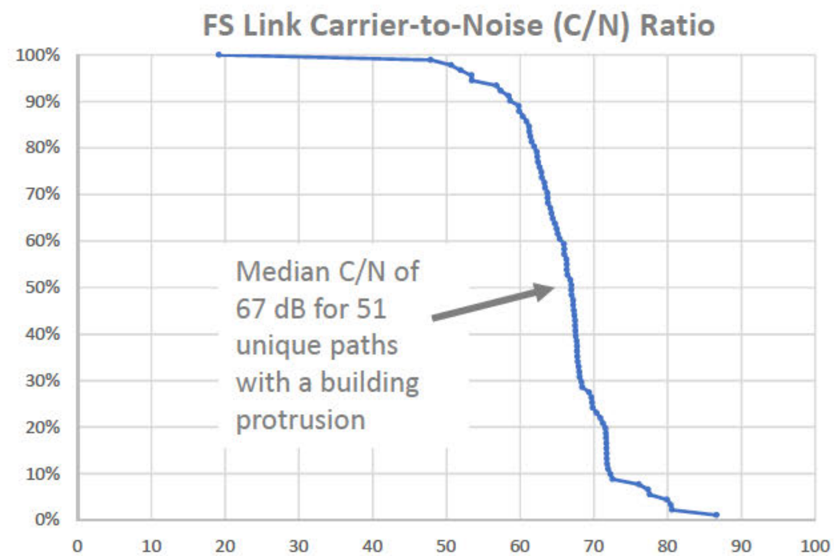
- Quantify number of FS main beam (3 dB) protrusions from high-rise buildings of 50m or greater height anywhere on FS paths
- Validate FS engineer path clearing practices for FS main beams
- Demonstrate that USGS 1 meter airborne Lidar data is an effective tool to analyze these geometries
    - Blue rectangles show area of USGS Lidar coverage for NYC metro area
    - Lidar separates ground clutter from underlying terrain for over 1,000 square miles of NY metro area
- Total of 292 FS receivers in Lidar coverage serving unique one-way paths
    - Many sites have multiple receivers
    - ULS data from 1/23/2019



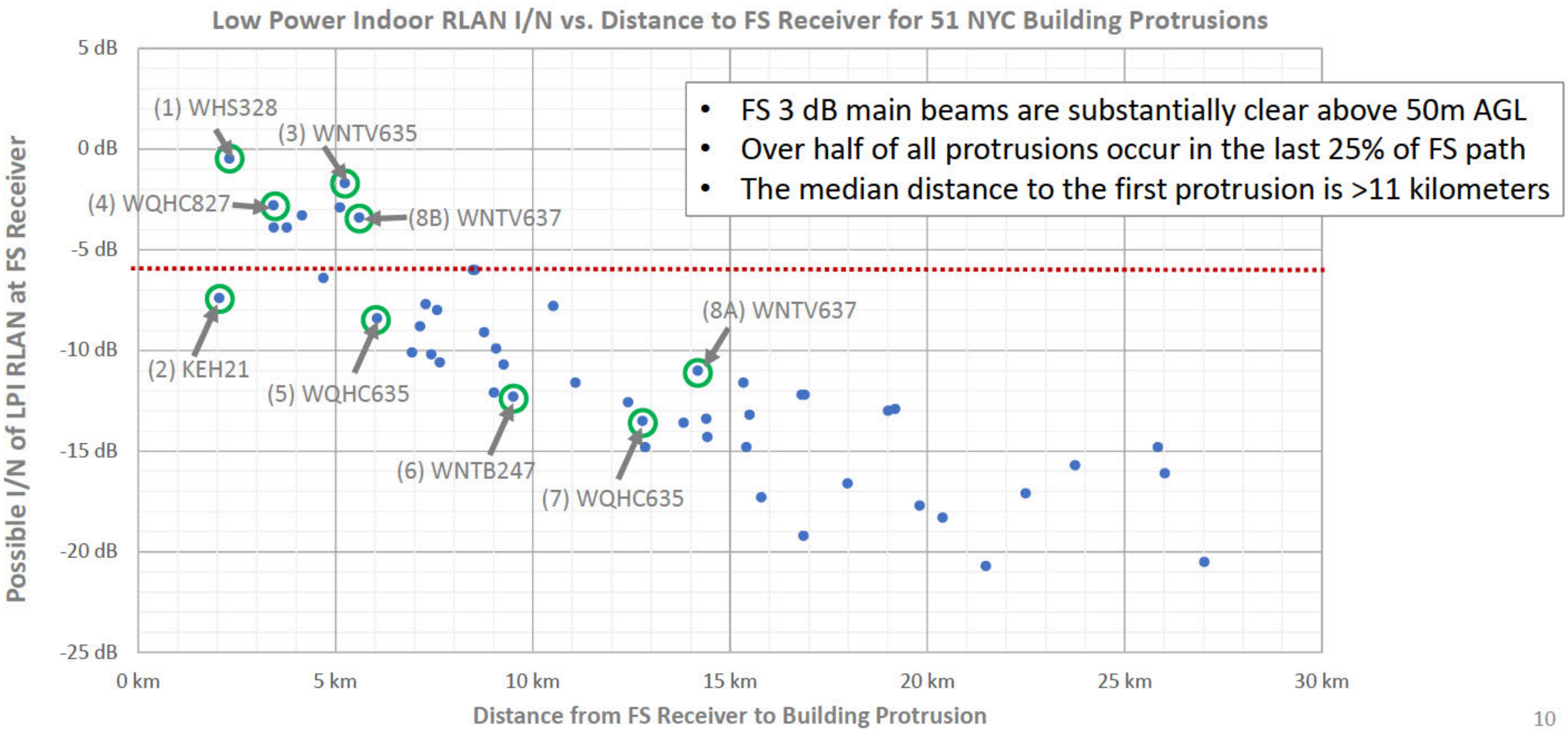
RLANs in High-Rise Buildings in New York City Do Not Pose a Harmful Interference Risk to FS Receivers

- A Low Power Indoor RLAN at the first protrusion may only result in a slight exceedance of -6 dB I/N on 8 out of 292 paths (2.7%)
  - Interference would only occur for RLANs that are (1) co-channel; and (2) in transmit phase of duty cycle.
- The 51 paths with protrusions have a **median C/N of 67 dB.** Small exceedances above -6 dB I/N will not cause harmful interference to these links.



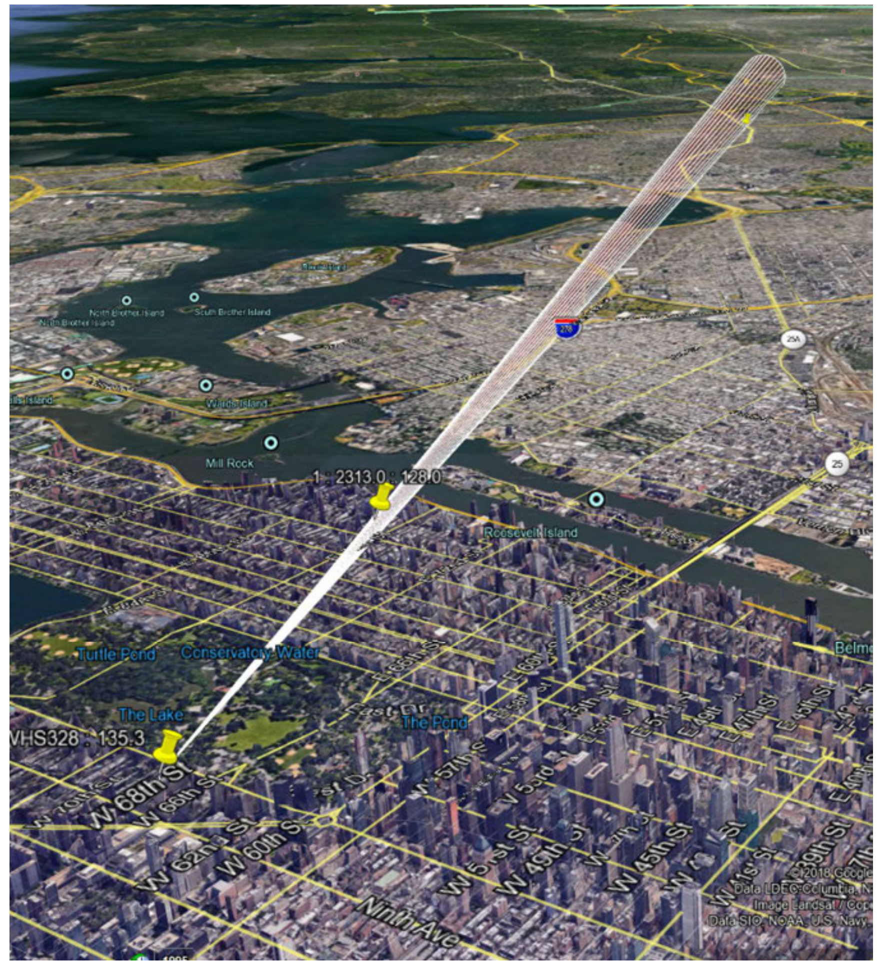


High-Rise Buildings RLANs Pose No Harmful Interference Risk Because Most Building Protrusions Occur at Long Range (Beyond 6 km) and Interference Decreases with Distance

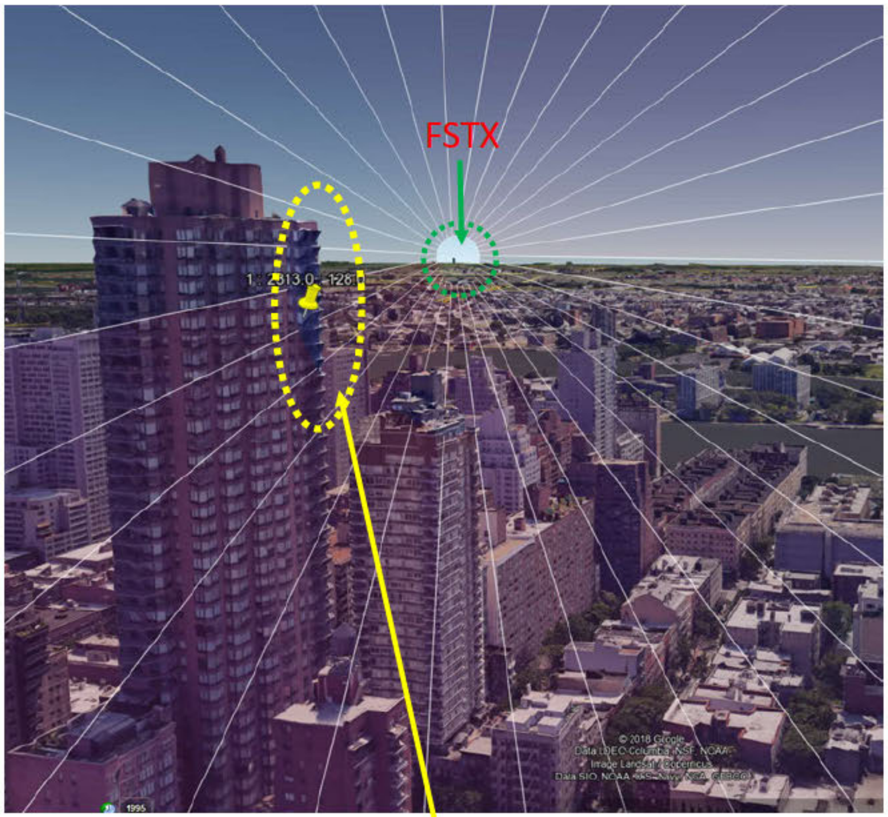


Link Example #1 – Long Link with Partial Protrusion (WHS328)

- ABC Television (TI)
- Queens (TX) to Midtown (RX)
- 21.9 km path
- 25 MHz bandwidth
- Andrew PAR6-65 (1.8°)
- Receive path shaves 7 apartments on upper right corner of building at 2.3 km



Link Example #1 – Long Link with Partial Protrusion (WHS328)



1st RLAN protrusion @ 2.3 km

WANTED FS SIGNAL		
FREQUENCY	6963	MHz
FS BANDWIDTH	25	MHz
FS PATH DISTANCE	21.9	km
FS TX POWER	46.2	dBm
FS TX GAIN	38.8	dBi
FS RX GAIN	38.8	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-136.2	dB
FS SIGNAL	**-14.4**	**dBm**
FS NOISE FLOOR	-95.0	dBm

↓↓

AVAILABLE FS C/N	80.6	**dB**
FS REQUIRED SNR	21.2	**dB**
FS LINK MARGIN	**59.4**	**dB**
RLAN-INDUCED FMR	2.78	**dB**
FS+RLAN LINK MARGIN	**56.6**	**dB**

←

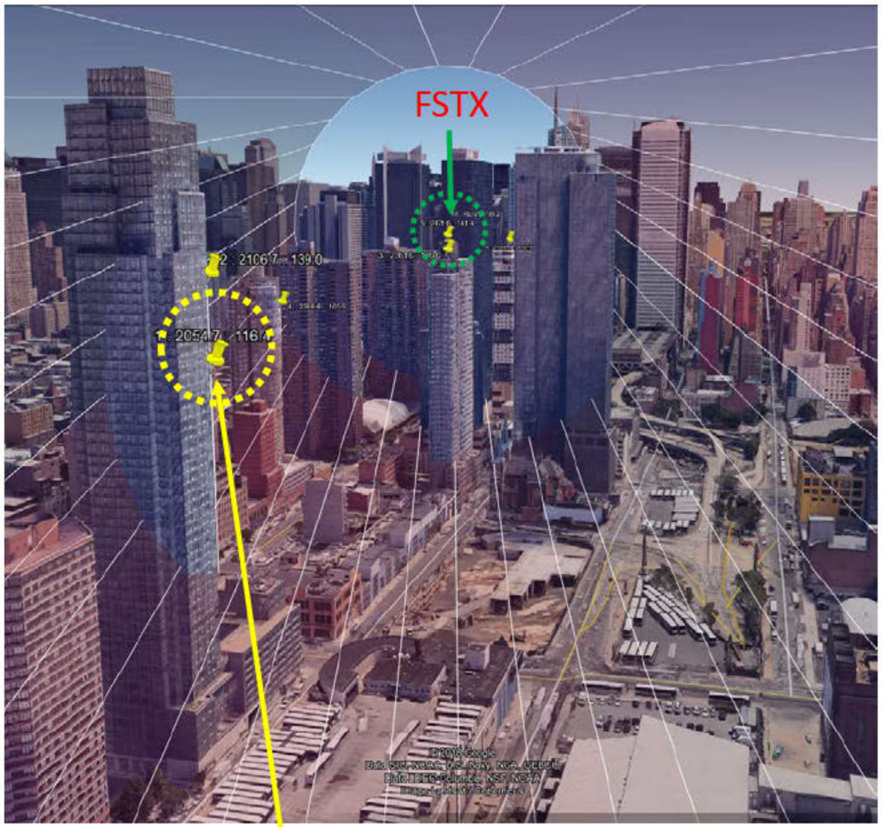
RLAN INTERFERENCE		
FREQUENCY	6963	MHz
RLAN BANDWIDTH	80	MHz
RLAN DISTANCE	**2.31**	**km**
RLAN TX POWER	24	dBm
RLAN TX GAIN	6	dBi
FS RX ANT GAIN	38.8	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-116.6	dB
RLAN SIGNAL	**-49.8**	**dBm**
POLARIZATION LOSS	-3	DB
BLDG ENTRY LOSS	-30	DB
RLAN PATTERN MISMATCH	-5	DB
FS OFF-AXIS REJECTION	-2.6	DB
BANDWIDTH MISMATCH	-5.05	DB
ADJUSTED RLAN RSL	**-95.5**	**DBM**
RLAN I/N @ FS RECEIVER	**-0.47**	**DB**

- Worst case example in entire study.
- Link has 80.6 dB of C/N due to high EIRP
- Including RLAN-induced fade margin reduction (FMR) and required SNR, the link has over 56 dB of residual margin.

Link Example #2 – Worst Case Ultra-Short Path (KEH21)

- Port Authority of NJ & NY (MW)
- Midtown (TX) to New Jersey (RX)
- Ultra short – just 2.6 km
- 10 MHz bandwidth
- One-way video link
- Low gain 30.2 dBi with wide 5° beam
- First “incidental” building protrusion at 2.0 km

Link Example #2– Worst Case Ultra-Short Path (KEH21)



1st RLAN protrusion @ 2 km

WANTED FS SIGNAL		
FREQUENCY	6725	MHz
FS BANDWIDTH	10	MHz
FS PATH DISTANCE	2.6	km
FS TX POWER	28.5	dBm
FS TX GAIN	30.2	dBi
FS RX GAIN	30.2	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-117.4	dB
FS SIGNAL	**-30.5**	**dBm**
FS NOISE FLOOR	-99.0	dBm

↓↓

AVAILABLE FS C/N	68.5	**dB**
FS REQUIRED SNR	17.2	**dB**
FS LINK MARGIN	**51.4**	**dB**
RLAN-INDUCED FMR	0.84	**dB**
FS+RLAN LINK MARGIN	**50.5**	**dB**

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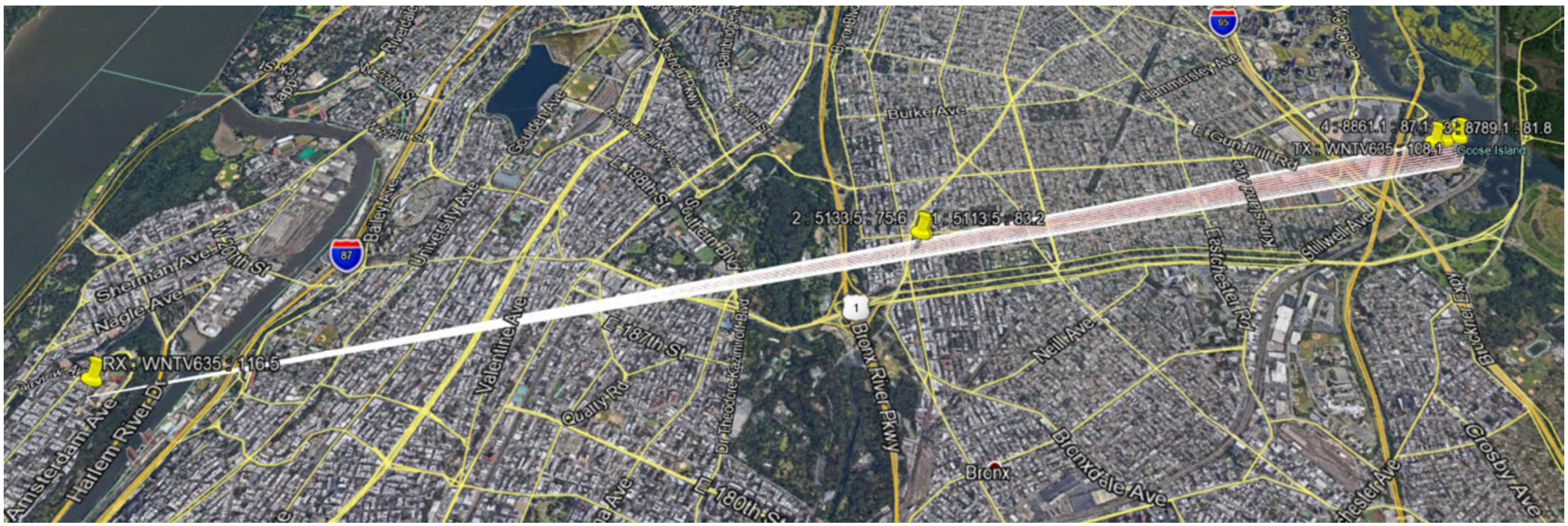
RLAN INTERFERENCE		
FREQUENCY	6725	MHz
RLAN BANDWIDTH	80	MHz
RLAN DISTANCE	**2.05**	**km**
RLAN TX POWER	24	dBm
RLAN TX GAIN	6	dBi
FS RX ANT GAIN	30.2	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-115.3	dB
RLAN SIGNAL	**-57.1**	**dBm**
POLARIZATION LOSS	-3	DB
BLDG ENTRY LOSS	-30	DB
RLAN PATTERN MISMATCH	-5	DB
FS OFF-AXIS REJECTION	-1.6	DB
BANDWIDTH MISMATCH	-9.03	DB
ADJUSTED RLAN RSL	**-105.7**	**DBM**
RLAN I/N @ FS RECEIVER	**-6.72**	**DB**

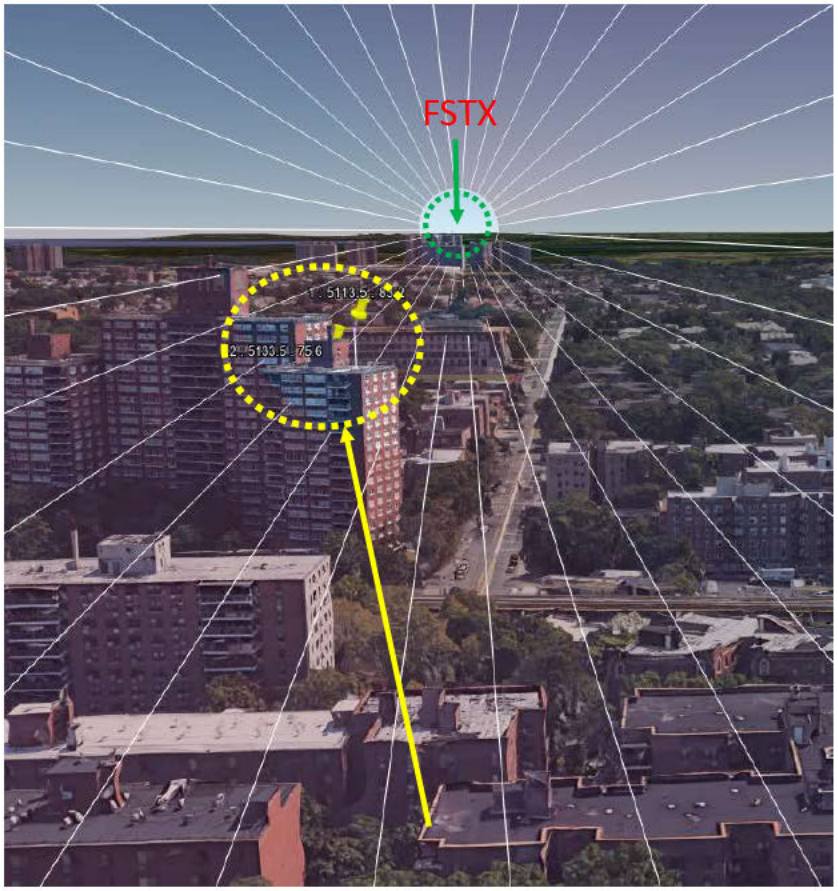
- Even at point-blank range, I/N for the RLAN protrusion passes -6 dB I/N due to low-gain antennas required to avoid FSRX overload, and off-axis rejection.
- Including RLAN-induced fade margin reduction (FMR) and required SNR, the link still has over 50 dB of margin.

Link Example #3 – Short Path with Partial Midpoint Protrusion (WNTV635)



- NY State Police (MW)
- Goose Island (TX) to Upper Manhattan (RX)
- 8.9 km path
- 10 MHz bandwidth
- 64 QAM modulation
- Andrew HP8-65F (1.3°)
- Main beam clips upper right corner of apartment building at 5.1 km

Link Example #3 – Short Path with Partial Midpoint Protrusion (WNTV635)



1st RLAN partial protrusion @ 5.1 km

WANTED FS SIGNAL		
FREQUENCY	6825	MHz
FS BANDWIDTH	10	MHz
FS PATH DISTANCE	8.9	km
FS TX POWER	8.6	dBm
FS TX GAIN	42.3	dBi
FS RX GAIN	42.3	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-128.2	dB
FS SIGNAL	**-37.6**	**dBm**
FS NOISE FLOOR	-99.0	dBm

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AVAILABLE FS C/N	61.4	**dB**
FS REQUIRED SNR	15.3	**dB**
FS LINK MARGIN	**46.1**	**dB**
RLAN-INDUCED FMR	2.02	**dB**
FS+RLAN LINK MARGIN	**44.1**	**dB**

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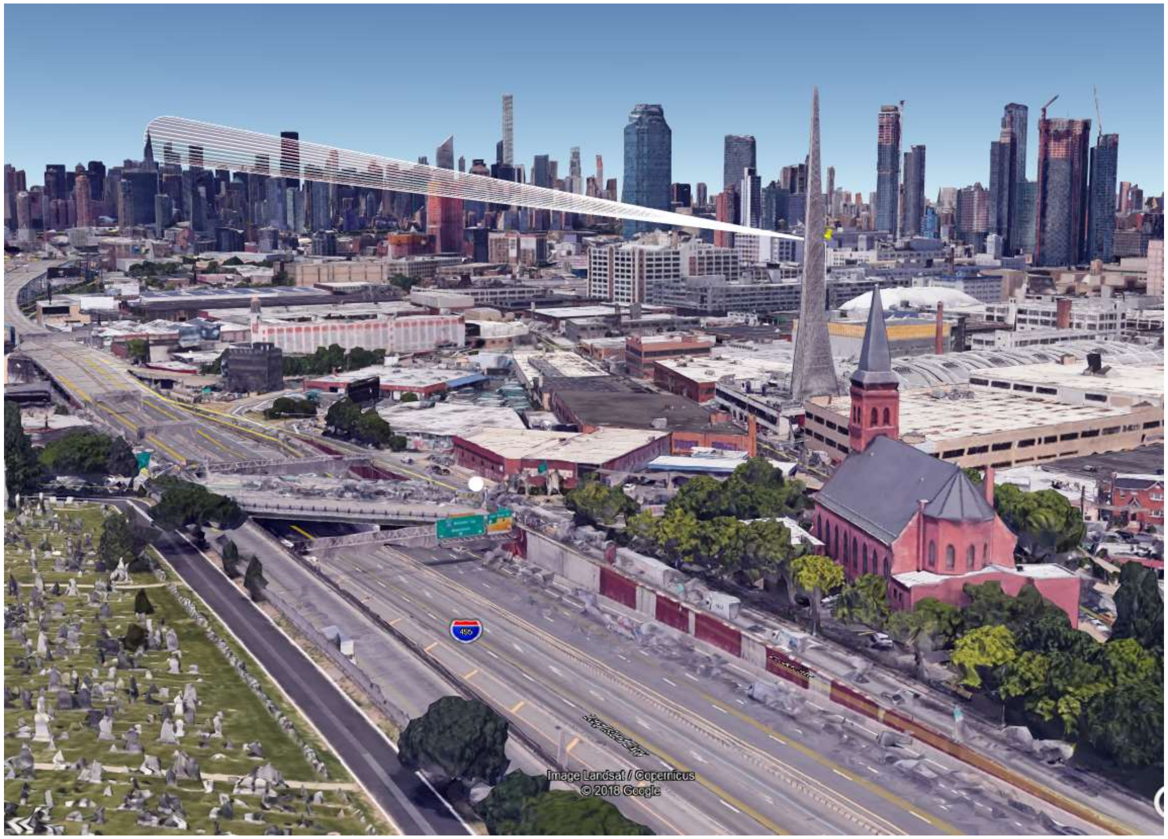
RLAN INTERFERENCE		
FREQUENCY	6825	MHz
RLAN BANDWIDTH	80	MHz
RLAN DISTANCE	**5.11**	**km**
RLAN TX POWER	24	dBm
RLAN TX GAIN	6	dBi
FS RX ANT GAIN	42.3	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-123.4	dB
RLAN SIGNAL	**-53.1**	**dBm**
POLARIZATION LOSS	-3	DB
BLDG ENTRY LOSS	-30	DB
RLAN PATTERN MISMATCH	-5	DB
FS OFF-AXIS REJECTION	-1.2	DB
BANDWIDTH MISMATCH	-9.03	DB
ADJUSTED RLAN RSL	**-101.3**	**DBM**
RLAN I/N @ FS RECEIVER	**-2.29**	**DB**

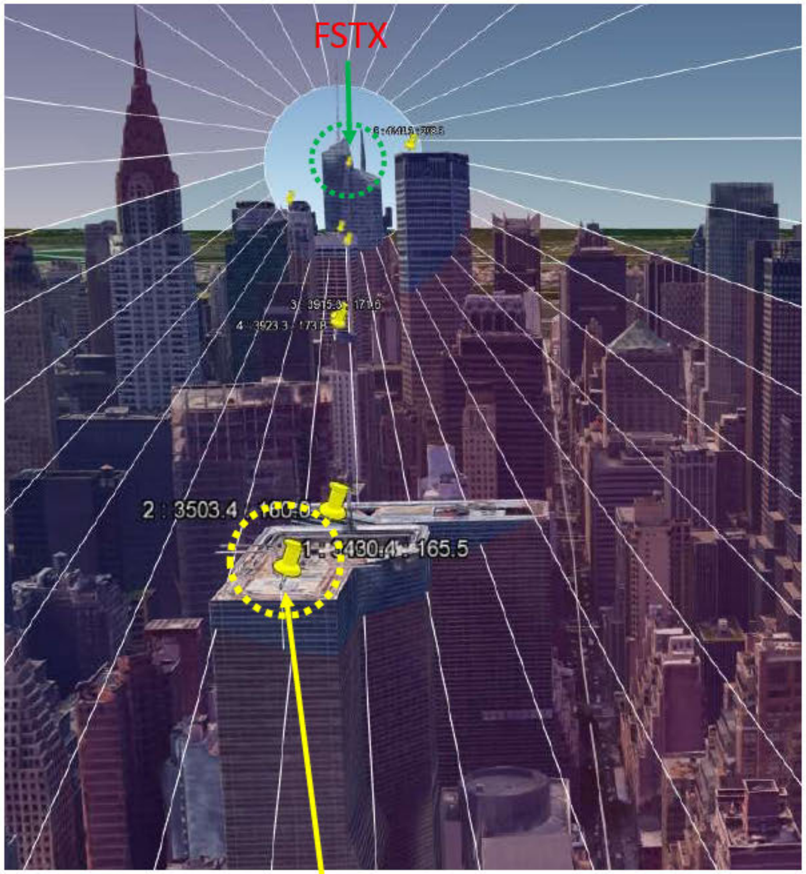
- An RLAN at first protrusion would yield -2.29 dB I/N.
- Link still has 44 dB residual margin after including SNReq and RLAN FMR. Fading will be reduced due to shortness of path.

Link Example #4 – Ultra-Short Path (WQHC827)

- City of New York (MW)
- Long Island (RX) to H&M Building Midtown (TX)
- 5 km path / 2 frequencies
- 30 MHz bandwidth
- 128 TCM modulation
- Andrew HP6-59 (1.8°)
- First "incidental" protrusion just past UN building @ 3.4 km
- Reverse link has no protrusions above clutter line



Link Example #4 – Ultra-Short Path (WQHC827)



1st RLAN protrusion @ 3.43 km

WANTED FS SIGNAL		
FREQUENCY	6034.15	MHz
FS BANDWIDTH	30	MHz
FS PATH DISTANCE	4.9	km
FS TX POWER	23.7	dBm
FS TX GAIN	38.9	dBi
FS RX GAIN	38.9	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-122.0	dB
FS SIGNAL	**-22.5**	**dBm**
FS NOISE FLOOR	-94.2	dBm

↓↓

AVAILABLE FS C/N	71.7	**dB**
FS REQUIRED SNR	17.2	**dB**
FS LINK MARGIN	**54.6**	**dB**
RLAN-INDUCED FMR	2.11	**dB**
FS+RLAN LINK MARGIN	**52.5**	**dB**

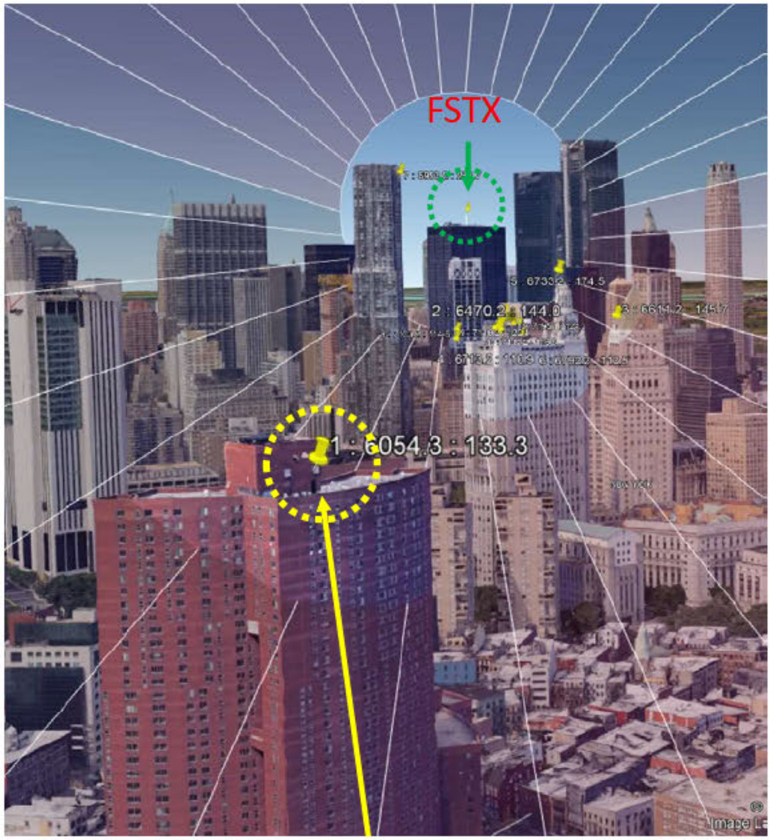
RLAN INTERFERENCE		
FREQUENCY	6034.15	MHz
RLAN BANDWIDTH	80	MHz
RLAN DISTANCE	**3.43**	**km**
RLAN TX POWER	24	dBm
RLAN TX GAIN	6	dBi
FS RX ANT GAIN	38.9	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-118.8	dB
RLAN SIGNAL	**-51.9**	**dBm**
POLARIZATION LOSS	-3	DB
BLDG ENTRY LOSS	-30	DB
RLAN PATTERN MISMATCH	-5	DB
FS OFF-AXIS REJECTION	-2.1	DB
BANDWIDTH MISMATCH	-4.26	DB
ADJUSTED RLAN RSL	**-96.3**	**DBM**
← **RLAN I/N @ FS RECEIVER**	**-2.05**	**DB**

- Main beam shaves top of building at 3.4 km. An RLAN in this location would yield -2.05 dB I/N.
- Link still has over 52 dB residual margin after including required SNR and RLAN FMR. Link is too short for significant fading.

Link Example #5 – Short Path (WQHC635)

- City of New York (MW)
- FDNY Brooklyn (RX) to One Liberty Plaza (TX)
- 7.45 km path
- 30 MHz bandwidth
- 128 TCM modulation
- Andrew PAR6X-59 (1.9°)
- First "incidental" protrusion at Confucius Plaza (cited by Commscope) at 6 km
- Reverse link has no protrusions above clutter line

Link Example #5 – Short Path (WQHC635)



1st RLAN protrusion @ 6.05 km

WANTED FS SIGNAL		
FREQUENCY	6004.5	MHz
FS BANDWIDTH	30	MHz
FS PATH DISTANCE	7.4	km
FS TX POWER	25.4	dBm
FS TX GAIN	37.9	dBi
FS RX GAIN	37.9	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-125.5	dB
FS SIGNAL	**-26.3**	**dBm**
FS NOISE FLOOR	-94.2	dBm

↓↓

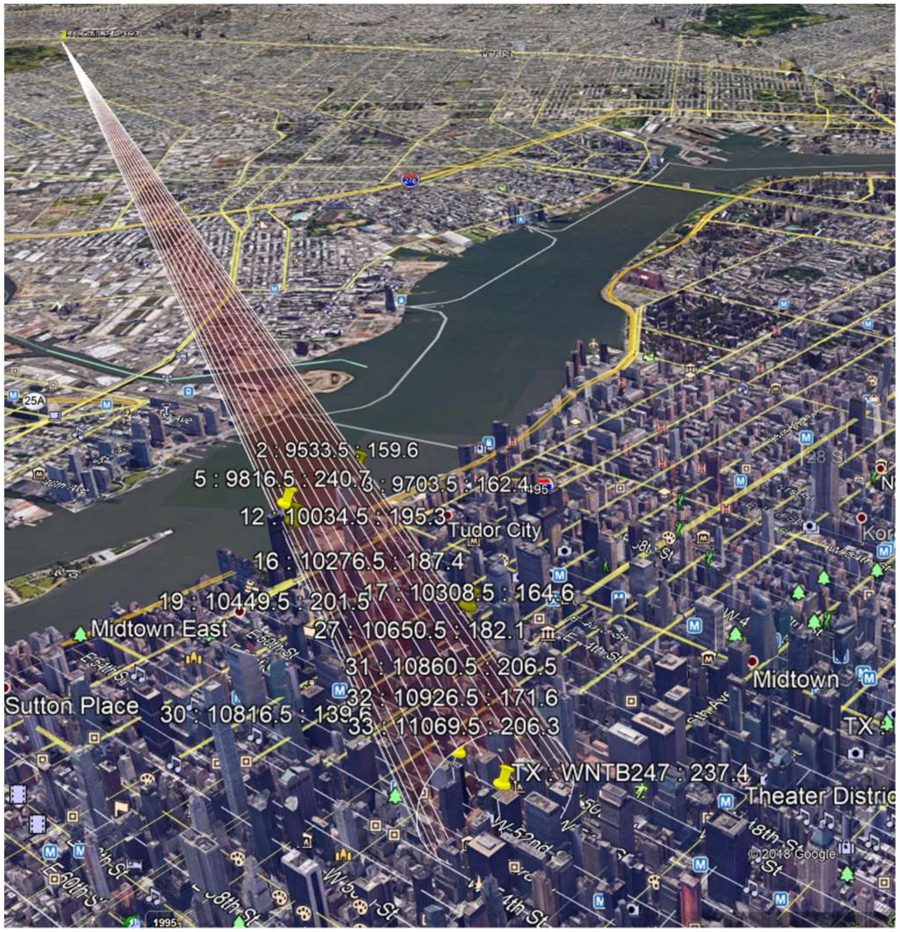
AVAILABLE FS C/N	67.9	**dB**
FS REQUIRED SNR	17.2	**dB**
FS LINK MARGIN	**50.7**	**dB**
RLAN-INDUCED FMR	0.68	**dB**
FS+RLAN LINK MARGIN	**50.1**	**dB**

RLAN INTERFERENCE		
FREQUENCY	6004.5	MHz
RLAN BANDWIDTH	80	MHz
RLAN DISTANCE	**6.05**	**km**
RLAN TX POWER	24	dBm
RLAN TX GAIN	6	dBi
FS RX ANT GAIN	37.9	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-123.7	dB
RLAN SIGNAL	**-57.8**	**dBm**
POLARIZATION LOSS	-3	DB
BLDG ENTRY LOSS	-30	DB
RLAN PATTERN MISMATCH	-5	DB
FS OFF-AXIS REJECTION	-1.9	DB
BANDWIDTH MISMATCH	-4.26	DB
ADJUSTED RLAN RSL	**-102.0**	**DBM**
RLAN I/N @ FS RECEIVER	**-7.73**	**DB**

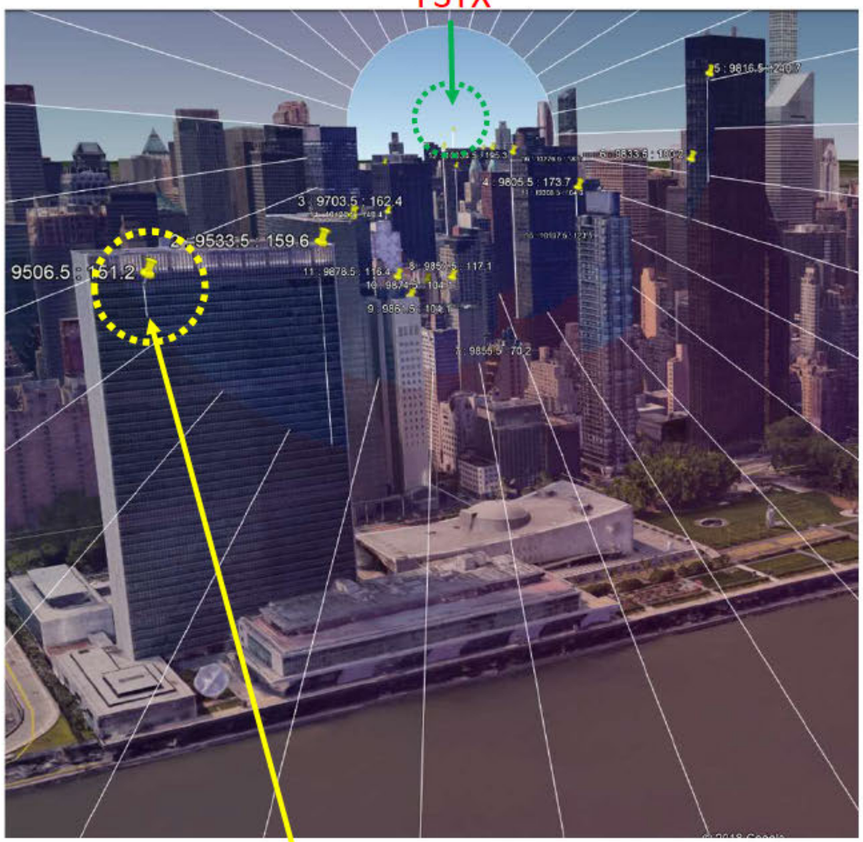
- First protrusion cited by Commscope meets IPC requirement at -7.73 dB I/N considering off-axis rejection and typical losses.
- Link has over 50 dB residual margin after including required SNR and RLAN FMR. Link is too short for significant fading.

Link Example #6 – Short Path (WNTB247)

- NYC Transit Authority (MW)
- Midtown (RX) to Brooklyn(TX)
- 11.25 km path
- 5 MHz bandwidth
- 128 TCM modulation
- Commscope P6-65D (1.7°)
- First "incidental" building protrusion is upper right corner of United Nations building at 9.5 km
- Reverse link has no protrusions above the clutter line



Link Example #6 – Short Path (WNTB247)



1st RLAN protrusion @ 9.5 km

WANTED FS SIGNAL		
FREQUENCY	6795	MHz
FS BANDWIDTH	5	MHz
FS PATH DISTANCE	11.2	km
FS TX POWER	18.1	dBm
FS TX GAIN	39.9	dBi
FS RX GAIN	39.9	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-130.2	dB
FS SIGNAL	**-34.3**	**dBm**
FS NOISE FLOOR	-102.0	dBm

↓↓

AVAILABLE FS C/N	67.7	**dB**
FS REQUIRED SNR	17.2	**dB**
FS LINK MARGIN	**50.6**	**dB**
RLAN-INDUCED FMR	0.29	**dB**
FS+RLAN LINK MARGIN	**50.3**	**dB**

←

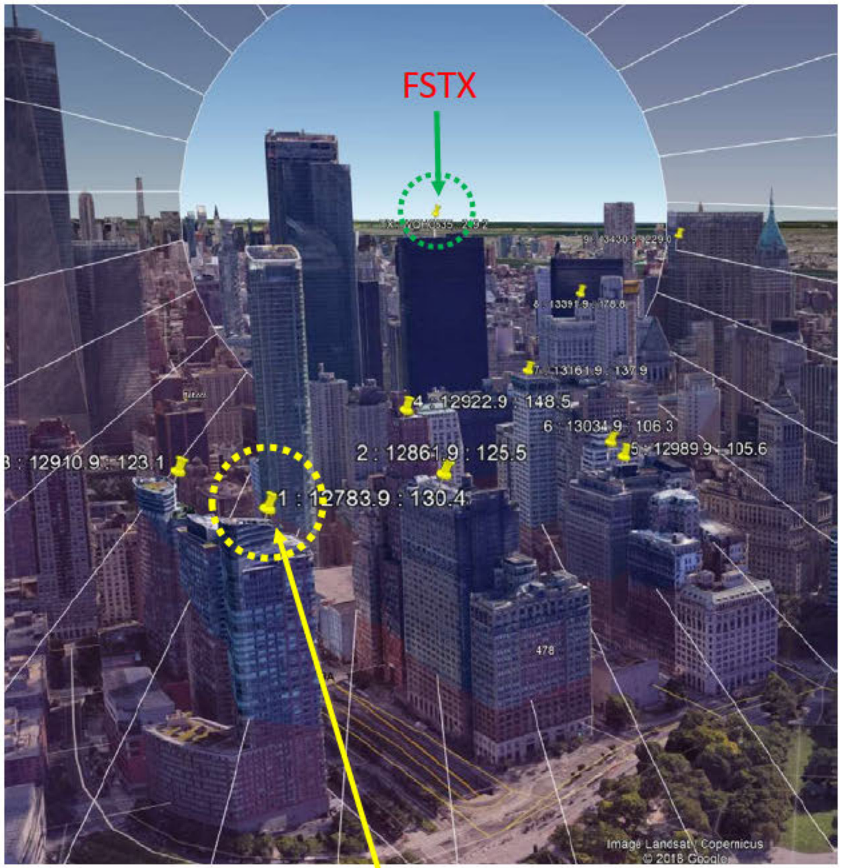
RLAN INTERFERENCE		
FREQUENCY	6795	MHz
RLAN BANDWIDTH	80	MHz
RLAN DISTANCE	**9.50**	**km**
RLAN TX POWER	24	dBm
RLAN TX GAIN	6	dBi
FS RX ANT GAIN	39.9	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-128.7	dB
RLAN SIGNAL	**-60.8**	**dBm**
POLARIZATION LOSS	-3	DB
BLDG ENTRY LOSS	-30	DB
RLAN PATTERN MISMATCH	-5	DB
FS OFF-AXIS REJECTION	-2.8	DB
BANDWIDTH MISMATCH	-12.04	DB
ADJUSTED RLAN RSL	**-113.6**	**DBM**
RLAN I/N @ FS RECEIVER	**-11.63**	**DB**

- An RLAN at first protrusion would yield -11.63 dB I/N.
- Link still has over 50 dB residual margin after including required SNR and RLAN FMR.

Link Example #7 – Short Path with Engineered protrusions (WQHC635)

- City of New York (MW)
- Staten Island (RX) to One Liberty Plaza (TX)
- 13.5 km path
- 30 MHz bandwidth
- 128 TCM modulation
- Andrew HP6-59 (1.8°)
- First "incidental" building occlusion at 12.8 km
- Reverse link has no protrusions above the clutter line

Link Example #7 – Short Path with Engineered protrusions (WQHC635)



1st RLAN protrusion @ 12.78 km

WANTED FS SIGNAL		
FREQUENCY	6034.14	MHz
FS BANDWIDTH	30	MHz
FS PATH DISTANCE	13.5	km
FS TX POWER	25.4	dBm
FS TX GAIN	38.9	dBi
FS RX GAIN	38.9	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-130.7	dB
FS SIGNAL	**-29.5**	**dBm**
FS NOISE FLOOR	-94.2	dBm

↓↓

AVAILABLE FS C/N	64.7	**dB**
FS REQUIRED SNR	17.2	**dB**
FS LINK MARGIN	**47.5**	**dB**
RLAN-INDUCED FMR	0.22	**dB**
FS+RLAN LINK MARGIN	**47.3**	**dB**

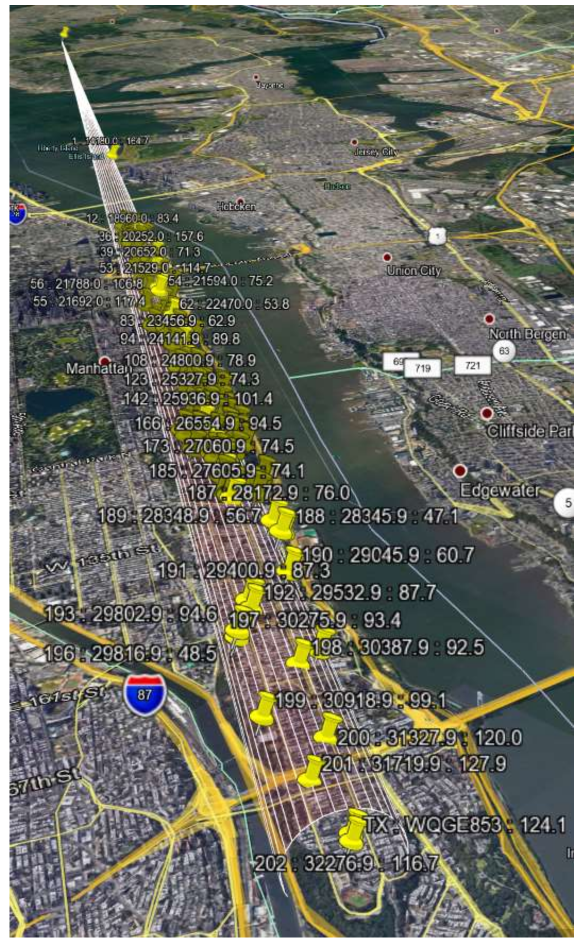
RLAN INTERFERENCE		
FREQUENCY	6034.14	MHz
RLAN BANDWIDTH	80	MHz
RLAN DISTANCE	**12.8**	**km**
RLAN TX POWER	24	dBm
RLAN TX GAIN	6	dBi
FS RX ANT GAIN	38.9	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-130.2	dB
RLAN SIGNAL	**-63.3**	**dBm**
POLARIZATION LOSS	-3	DB
BLDG ENTRY LOSS	-30	DB
RLAN PATTERN MISMATCH	-5	DB
FS OFF-AXIS REJECTION	-1.4	DB
BANDWIDTH MISMATCH	-4.26	DB
ADJUSTED RLAN RSL	**-107.0**	**DBM**
RLAN I/N @ FS RECEIVER	**-12.78**	**DB**

- An RLAN at first protrusion would yield -12.78 dB I/N.
- Link still has over 47 dB margin after including required SNR and RLAN FMR.

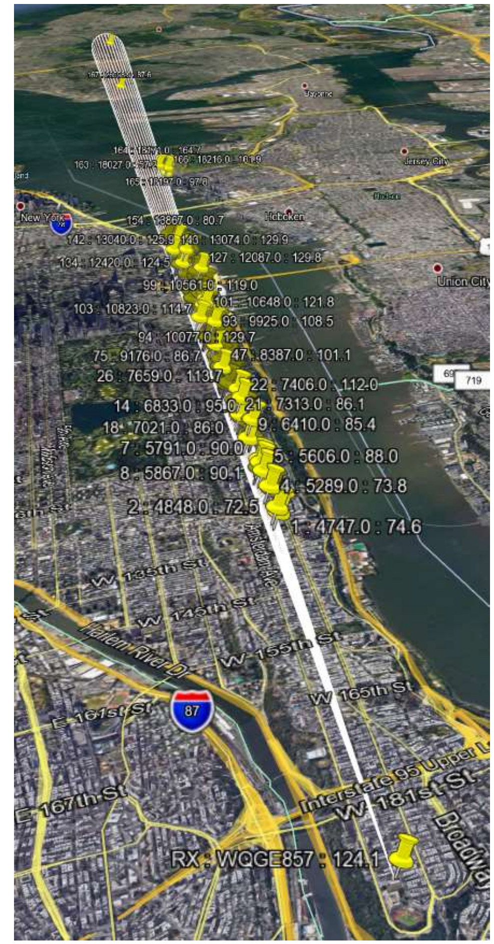
Link Example #8 – Long Reciprocal Paths WQGE853 / WQGE857

- NY State Police (MW)
- Staten Island to Hudson Heights
- 32.3 km path
- 10 MHz bandwidth
- 64 QAM modulation
- 1.3° beam
- First southbouth protrusion is 65m apartment on Upper West Side (5.6 km)
- First northbound protrusion is Goldman Sachs tower at Colgate Center in New Jersey (14.1 km)

WQGE853

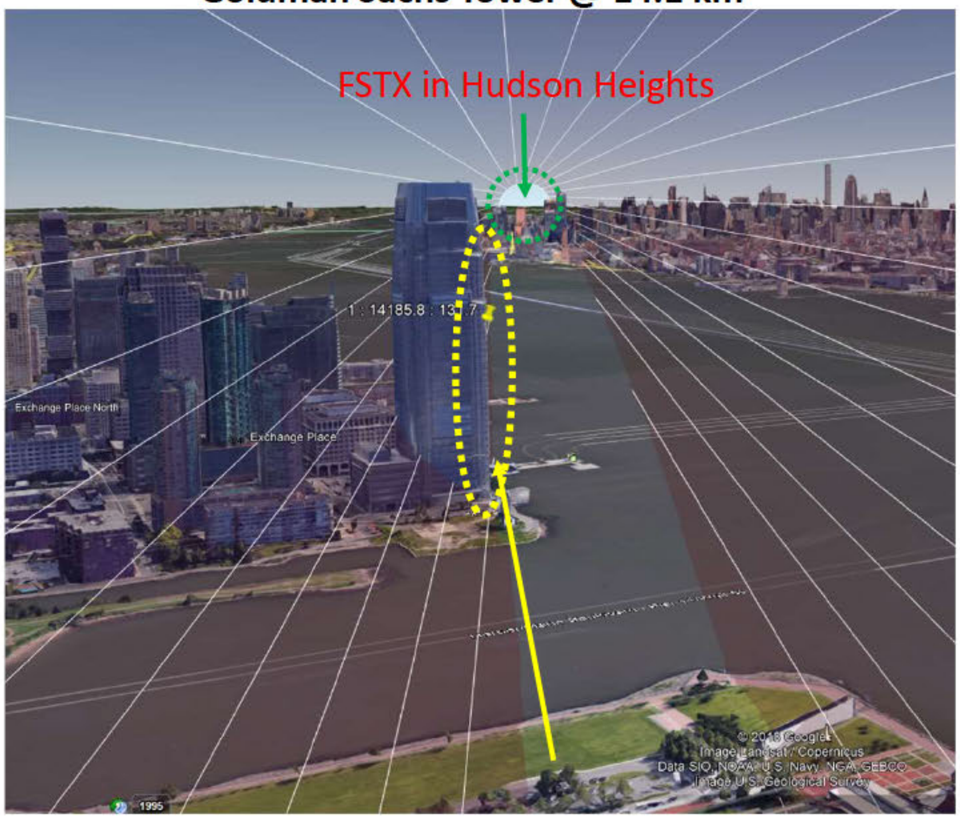


WQGE857



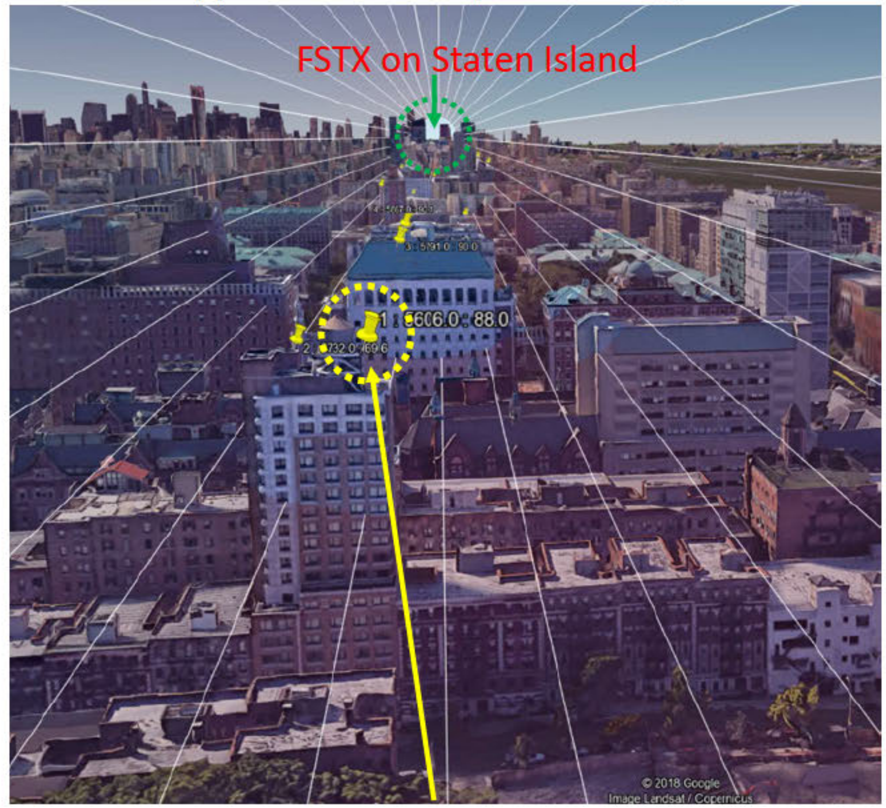
Views of 1st protrusion in Each Direction – Link Example #8

First Northbound (partial) protrusion
Goldman Sachs Tower @ 14.1 km



1st RLAN protrusion @ 14.1 km

First Southbound (partial) protrusion
Upper West Side Apartments @ 5.6 km



1st RLAN protrusion @ 5.6 km

Link Example #8 – Long Reciprocal Paths

WQGE853 First Northbound protrusion
Goldman Sachs Tower @ 14.1 KM

WANTED FS SIGNAL		
FREQUENCY	6595	MHz
FS BANDWIDTH	10	MHz
FS PATH DISTANCE	32.4	km
FS TX POWER	25.2	dBm
FS TX GAIN	42.3	dBi
FS RX GAIN	42.3	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-139.1	dB
FS SIGNAL	**-31.3**	**dBm**
FS NOISE FLOOR	-99.0	dBm
	↓↓	
AVAILABLE FS C/N	67.7	**dB**
FS REQUIRED SNR	15.3	**dB**
FS LINK MARGIN	52.4	**dB**
RLAN-INDUCED FMR	0.40	**dB**
FS+RLAN LINK MARGIN	52.0	**dB**

RLAN INTERFERENCE		
FREQUENCY	6595	MHz
RLAN BANDWIDTH	80	MHz
RLAN DISTANCE	**14.18**	**km**
RLAN TX POWER	24	dBm
RLAN TX GAIN	6	dBi
FS RX ANT GAIN	42 3	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-131 9	dB
RLAN SIGNAL	**-61.6**	**dBm**
POLARIZATION LOSS	-3	DB
BLDG ENTRY LOSS	-30	DB
RLAN PATTERN MISMATCH	-5	DB
FS OFF-AXIS REJECTION	-0 5	DB
BANDWIDTH MISMATCH	-9.03	DB
ADJUSTED RLAN RSL	**-109.1**	**DBM**
← **RLAN I/N @ FS RECEIVER**	-10.15	**DB**

WQGE857 First Southbound protrusion
Upper West Side Apartments @ 5.6 KM

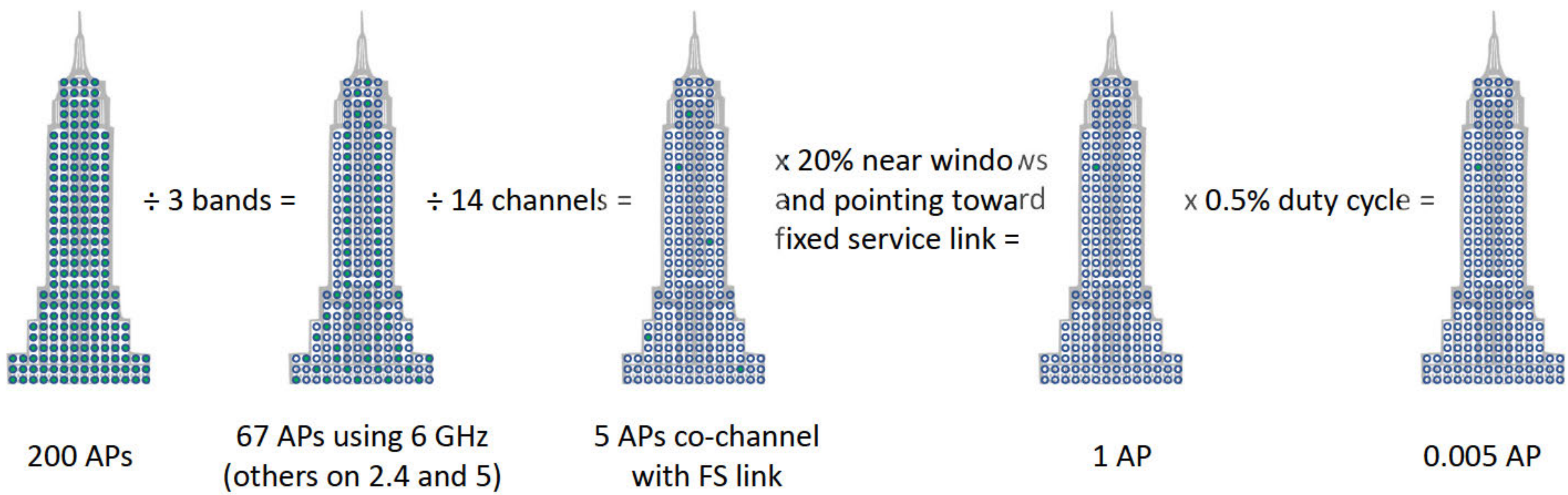
WANTED FS SIGNAL		
FREQUENCY	6755	MHz
FS BANDWIDTH	10	MHz
FS PATH DISTANCE	32.4	km
FS TX POWER	25.2	dBm
FS TX GAIN	42.3	dBi
FS RX GAIN	42.3	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-139.3	dB
FS SIGNAL	**-31.5**	**dBm**
FS NOISE FLOOR	-99.0	dBm
	↓↓	
AVAILABLE FS C/N	67.5	**dB**
FS REQUIRED SNR	15.3	**dB**
FS LINK MARGIN	52.2	**dB**
RLAN-INDUCED FMR	1.32	**dB**
FS+RLAN LINK MARGIN	50.9	**dB**

RLAN INTERFERENCE		
FREQUENCY	6755	MHz
RLAN BANDWIDTH	80	MHz
RLAN DISTANCE	**5.61**	**km**
RLAN TX POWER	24	dBm
RLAN TX GAIN	6	dBi
FS RX ANT GAIN	42.3	dBi
FS FEEDER LOSS	-2	dB
FSPL ATTENUATION	-124.1	dB
RLAN SIGNAL	**-53.8**	**dBm**
POLARIZATION LOSS	-3	DB
BLDG ENTRY LOSS	-30	DB
RLAN PATTERN MISMATCH	-5	DB
FS OFF-AXIS REJECTION	-2.7	DB
BANDWIDTH MISMATCH	-9 03	DB
ADJUSTED RLAN RSL	**-103.5**	**DBM**
← **RLAN I/N @ FS RECEIVER**	**-4.50**	**DB**

- The northbound link easily passes -6 dB I/N due to elapsed distance
- The soundbound link has a slight exceedance due to the first building protrusion being inside of 7 km.
- Including RLAN-induced fade margin reduction (FMR) and required SNR, the link still has <u>over 50 dB of margin</u> in each direction.

Why Aggregate Interference Is Not a Significant Factor Even When Multiple Protrusions Exist in an FS Main Beam

- 200 devices distributed over 3 bands (2.4/5/6 GHz), 14 gigabit-capable 80-MHz channels in 6 GHz, 20% of devices near windows with significant EIRP towards FS link, each device transmitting 0.5% of the time
- Effectively 200 * 1/3 * 1/14 * 20% * 0.5% = 0.005 RLAN devices transmitting on one 6-GHz FS channel at one time, on average
- Additional factors such as listen-before talk (LBT), off-axis rejection, and peak-average power ratio (PAPR) backoff for high-order modulations will further reduce interference



Summary

- Low Power Indoor (LPI) and Very Low Power (VLP) are device classes that are vital to the future viability of the 6 GHz band.
- Incumbents have repeatedly argued that all RLANs must be AFC controlled (and consequently LPI/VLP are not feasible) because of the risk of RLANs in high-rise buildings protruding into FS main beams.
- To investigate this claim, the RLAN Group conducted a detailed geospatial analysis using high-resolution aerial USGS Lidar data for 1,000 square miles of the NYC metro area that contains 292 FS receivers serving unique one-way paths.
- Our analysis shows that the high-rise building risk is extremely low because:
  - Only 17.4% of all one-way FS paths in the Lidar footprint (51 out of 292 total paths) experience a high-rise building of 50 meters or greater height protruding into a 3dB main beam.
  - The median distance from an FS receiver to a building protrusion is over 11 kilometers. In no case did a protrusion beyond 6 kilometers result in an I/N exceedance.
  - For just 2.7% of paths (8 out of 292) , an RLAN at the first protrusion may have a slight exceedance over -6 dB I/N after considering typical Low Power Indoor (LPI) losses. Free space path loss was used for this analysis.
  - The 51 paths with building protrusions have a median C/N of 67 dB. Small exceedances above -6 dB I/N will not cause harmful interference to these links.
- The Commission should allow LPI across the entire 6 GHz band and VLP as we have proposed in U-NII-5, U-NII-7 and the lower 100 MHz of U-NII-8.