PUBLIC NOTICE

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INFORMATION SOUGHT ON SHARING IN THE LOWER 37 GHZ BAND IN CONNECTION WITH THE NATIONAL SPECTRUM STRATEGY IMPLEMENTATION PLAN

WT Docket No. 24-243

Comment Date: September 9, 2024

With this *Public Notice*, the Wireless Telecommunications Bureau seeks to further develop the record for the 37.0-37.6 GHz band (Lower 37 GHz band) with the goal of informing the forthcoming report mandated by the National Spectrum Strategy (NSS) Implementation Plan. The NSS identified the Lower 37 GHz band for in-depth study to determine how a co-equal, shared-use framework which allows federal and non-federal operations should be implemented.[1] The final report with findings is to be completed by November 2024.[2]

Background. In 2016, the Federal Communications Commission (Commission), in coordination with the National Telecommunications and Information Administration (NTIA), made the Lower 37 GHz band available for coordinated, co-primary sharing between federal and non-federal fixed and mobile users and determined that federal and non-federal users would access the Lower 37 GHz band by registering individual sites through a coordination mechanism that would be developed through government/industry collaboration.[3] In the accompanying *Further Notice of Proposed Rulemaking,* the Commission defined the parameters for a successful coordination mechanism and sought comment on the most appropriate coordination mechanism for the band.[4] In 2018, the Commission noted that the Lower 37 GHz band would innovatively accommodate a variety of use cases and sought comment on utilizing a third-party coordinator or alternatively, implementing a coordination model similar to that used in Part 101 point-to-point bands.[5]

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[1] National Telecommunications and Information Administration, National Spectrum Strategy at 3, 6-7 (2023), https://www.ntia.gov/sites/default/files/publications/national_spectrum_strategy_final.pdf (NSS). National Telecommunications and Information Administration, National Spectrum Strategy Implementation Plan at 6 (2024), https://www.ntia.gov/sites/default/files/publications/national-spectrum-strategy-implementation-plan.pdf (NSS Implementation Plan).

[2] NSS Implementation Plan at A-12.

[3] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services,* GN Docket No. 14-177, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8057-8060, paras. 105, 111, and 113 (2016) (*2016 R&O* or *2016 FNPRM*, as appropriate).

[4] *2016 FNPRM*, 31 FCC Rcd at 8171, paras. 449-450.

[5] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services,* GN Docket No. 14-177, Third Report and Order, Memorandum Opinion and Order, and Third Further Notice of Proposed Rulemaking, 33 FCC Rcd 5576, 5602, paras. 63-64 (2018) (*2018 FNPRM*).

National Spectrum Strategy. The NSS identified the Lower 37 GHz Band as a band for further study "to implement a co-equal, shared-use framework allowing federal and non-federal users to deploy operations in the band."[6] The NSS Implementation Plan established a schedule under which a study of the band would be completed by October 2024 and a final report issued by November 2024.[7] In order to aid in the study of the band and the preparation of the report, we seek public input on various issues relating to the Lower 37 GHz Band.[8] The record developed in response to this *Public Notice* will be publicly available in WT Docket No. 24-243 and shared with the NTIA, the Department of Defense (DoD), and other interested agencies.

Potential Uses of the Lower 37 GHz Band. We find that additional information on potential uses of the Lower 37 GHz band would be helpful in the preparation of the Lower 37 GHz Report. The current record on potential uses of the band is limited. While commenters foresee uses including fixed wireless broadband, point-to-point links, Internet of Things networks, device-to-device operations, augmented reality applications, smart cities, smart grids, and as part of private networks,[9] they have not provided much detail about implementation of these services in the band. We therefore ask interested operators to provide specific and updated information on the contemplated uses of the band, to include interdependencies of pairing spectrum bands with the Lower 37 GHz band. We also seek input regarding the feasibility of Aeronautical Mobile Service (AMS) operations within the band.[10] This information will be helpful as we develop sharing mechanisms for the band. We anticipate that operations offered in the band initially will be point-to-point and point-to-multipoint operations, although other types of operations—including mobile operations—may develop later. We encourage commenters to explain how the various ideas presented below would facilitate or hinder contemplated operations.

Coordination Framework. Under our contemplated framework, proposed operations must be successfully coordinated with the relevant federal and non-federal operators before they can be registered. A coordination portal, where Federal and non-Federal operators could generate phase one coordination contour(s), which identifies if further phase two coordination would be required, has been proposed. We seek input on the portal's capabilities in all phases and how the coordination portal could be funded. As referenced in the NSS,[11] in 2020 the Commission began intra-governmental collaboration with NTIA and DoD to further define and develop a possible coordination mechanism that permits the innovative type of spectrum sharing envisioned for the band. These conversations focused on balancing the desire to make this spectrum available expeditiously for deployment with the need to protect both federal and non-federal operations in the band from harmful interference. In addition, we intend that the framework be sufficiently flexible to accommodate multiple uses while also being simple enough to deploy more quickly than other more elaborate sharing mechanisms.

As an outgrowth of prior discussions with representatives from the Commission, NTIA, and DoD, a two-phase process emerged as a possible coordination mechanism to ensure meaningful access to spectrum by later entrants, including federal entrants, while ensuring adequate protection from harmful

[6] NSS at 7.

[7] NSS Implementation Plan at A-12.

[8] We note that another proceeding generated relevant comments regarding potential uses of the Lower 37 GHz band. *See Shared Use of the 42-42.5 GHz Band*, WT Docket No. 23-158, Notice of Proposed Rulemaking, 38 FCC Rcd 6362 (2023).

[9] *See*, *e.g.*. Comments of Starry, Inc., GN Docket No. 14-177 (filed Sep. 10, 2018); Comments of Qualcomm, Inc., WT Docket No. 23-158 and GN Docket No. 14-177 (filed Aug. 30, 2023) at 4; Comments of NCTA – The Internet & Television Association, WT Docket No. 23-158 and GN Docket No. 14-177 (filed Aug. 30, 2023) at 3-4.

[10] A new allocation would be required to allow Aeronautical Mobile Service to operate in the Lower 37 GHz band.

[11] NSS at 7.

interference to incumbents.[12] In the first phase, an interference contour would be drawn around each existing and potential site based on its technical parameters, including transmitter details such as location (latitude and longitude), equivalent isotropic radiated power, antenna height, and antenna azimuth angle. The contour calculation would also take into account propagation loss due to terrain. If the prospective site's contour does not overlap with that of any existing registration, coordination is successful, and registration of the new site may proceed. If there is overlap, there would be a second phase of coordination, in which operators would communicate directly to discuss whether and under what circumstances a placement inside the relevant contours might be feasible. This phase would allow for more advanced interference mitigation techniques, such as antenna directivity, polarization, or shielding to provide solutions in specific situations without requiring a one-size-fits-all approach. The operators would be required to provide technical information on their respective operations[13] and cooperate in good faith to determine whether coexistence would be possible. A dispute resolution process would be established to resolve any disputes that arose during the coordination process. We seek input on what information should be included within a dispute resolution process. If the second phase of coordination is successfully achieved, the applicant would be permitted to register that particular site.

For non-federal site registrations, the technical details of the proposed site would be part of the registration and publicly available in the Universal Licensing System (ULS). For federal site registrations, NTIA would maintain the relevant technical details. For non-federal coordination with federal incumbents, these federal site registration details would be queried during the first phase of coordination. That query would return either a green light (no contour overlap), or a yellow light (overlapping contours and potential interference risk); for a yellow light result, contact information for the relevant federal agency would be provided to allow a non-federal applicant to proceed to phase two, as described above. We seek input on this coordination framework.

Adjacent Band Protection. In the *2016 R&O*, the Commission adopted an out-of-band emission limit that it concluded would "keep emissions from an UMFUS device into the 36-37 GHz band well below the -10 dBW level specified by footnote US550A," noting that the -10 dBW power limit "was adopted to protect passive sensors in the 36-37 GHz band in accordance with ITU Resolution 752 (WRC-07)."[14] Under FCC Part 30.203, operations are limited to -13 dBm/MHz, which expands to -13 dBW/GHz. Subsequently, Resolution 243 (WRC-19), Table 1, established a -23 dBW/GHz unwanted emission mean power for IMT stations within the frequency band 36-37 GHz.[15] In light of these developments, we seek input on whether additional measures are needed to protect spaceborne remote passive sensors in the 36-37 GHz band.

Licensing. For non-federal operations, the licensing process would consist of two steps. A non-federal entity seeking to operate in the Lower 37 GHz band would first obtain a nationwide non-exclusive license from the Commission, and then, following successful coordination, would register specific site locations in ULS. All registered site locations would be protected from harmful interference from any subsequent registrations, on a first-come first-served basis.[16] Registered non-federal sites would then generally be required to finish construction and begin operation within 120 days of the date the

[12] *See* Appendix A: Draft Lower 37 GHz Phase 1 Coordination Zone Contour Methodology and Appendix B: Draft Lower 37 GHz Phase 2 Coordination Methodology, attached. We also seek input on the methodologies contained in these appendices, including the parameters proposed.

[13] DoD contemplates that in some instances there may be complications with data exchange due to data security concerns.

[14] *2016 R&O*, 31 FCC Rcd at 8073, para. 156.

[15] Terrestrial component of International Mobile Telecommunications in the frequency bands 37-43.5 GHz and 47.2-48.2 GHz, Resolution 243, WRC-19.

[16] First-in-time priority would apply to both federal and non-federal operations.

registration is accepted, or the registration would be cancelled, and the licensee would forfeit their interference protection priority. As discussed above, we anticipate that most sites initially would be either point-to-point links or point-to-multipoint deployments, but this licensing process would potentially be able to accommodate other uses as well. We seek input on this licensing process.

Priority Access. Consistent with the questions asked in the *2018 FNPRM*,[17] we envision that the lower 200 megahertz band segment, 37.0-37.2 GHz, would be subject to priority use by DoD and military agency departments. The goal of this priority access would be to ensure that spectrum is available for military deployments, which may be on a longer timescale than commercial deployments. Military interests include pursuing air-to-ground use as part of a future sharing framework for the Lower 37 GHz band. This interest, in part, reflects the physics of the band inasmuch as in the upper atmosphere, the propagation is dominated by line-of-sight paths with reduced obstruction and atmospheric absorption. Given technology advancements since the adoption of the *2016 R&O*, we seek input on this matter. We also invite suggestions on the conditions under which non-federal users could operate in this portion of the band while maintaining the requisite flexibility for military deployments. For example, allowing non-federal users to register and deploy sites immediately, subject to a condition that they must modify or potentially cease operations in the future if those operations conflict with later military deployments could allow this spectrum to more quickly be put into use. Further, we could impose conditions that specify that non-federal operators would not be protected from harmful interference from subsequent military deployments. We seek input on implementing priority access.

We seek input on these and any other suggestions for the use of this band, as we continue to explore options for making this spectrum available for shared use.

Ensuring Widespread Access to Lower 37 GHz Spectrum. Given the limited number of channels available in the Lower 37 GHz band, the variety of potential uses of the band, and the fact that both federal and non-federal entities will have access to the band, we anticipate that initial demand for the band may exceed the available supply of channels in some areas. We recognize there is a risk, particularly in larger markets, that future entrants (both federal and non-federal) may be precluded from accessing the band if the band is fully licensed in the initial licensing phase. On the other hand, we want operators to put this available spectrum to use quickly—both for non-federal and federal uses—in order to serve the public interest.

We seek input on what measures could be taken to control access to the Lower 37 GHz band during the initial site registration phase. For example, during this phase, applicants could be limited to a single 100 megahertz channel per site, which would ensure that multiple operators could access the band. Another possible approach would be to establish accelerated buildout deadlines (*e.g.*, 60 or 90 days) for registrations issued during the initial phase. That would provide some assurance that only *bona fide* operators who are ready to construct and commence operations file site registrations. Finally, to avoid cases where multiple applicants seek to register the same channel, the Commission could reserve the right to grant an applicant a different 100 megahertz channel than the channel it originally sought.

Finally, we seek input on whether there are alternative measures that should be considered to enable multiple providers to operate in the Lower 37 GHz band.

Filing Requirements. Interested parties may file comments on or before the dates indicated on the first page of this document. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS) using WT Docket No. 24-243.

- Electronic Filers: Comments may be filed electronically using the Internet by accessing the ECFS: https://www.fcc.gov/ecfs/.

[17] *2018 FNPRM*, 33 FCC Rcd at 5604, para. 68.

• Paper Filers: Parties who choose to file by paper must file an original and one copy of each filing.

- Filings can be sent by hand or messenger delivery, by commercial courier, or by the U.S. Postal Service. **All filings must be addressed to the Secretary, Federal Communications Commission.**
- Hand-delivered or messenger-delivered paper filings for the Commission's Secretary are accepted between 8:00 a.m. and 4:00 p.m. by the FCC's mailing contractor at 9050 Junction Drive, Annapolis Junction, MD 20701. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes and boxes must be disposed of before entering the building.
- Commercial courier deliveries (any deliveries not by the U.S. Postal Service) must be sent to 9050 Junction Drive, Annapolis Junction, MD 20701.
- Filings sent by U.S. Postal Service First-Class Mail, Priority Mail, and Priority Mail Express must be sent to 45 L Street NE, Washington, DC 20554.

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Additional Information. For further information, contact Catherine Schroeder, Broadband Division, Wireless Telecommunications Bureau, at (202) 418-1956 or Catherine.Schroeder@fcc.gov.

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APPENDIX A

DRAFT LOWER 37 GHZ PHASE 1 COORDINATION ZONE CONTOUR METHODOLOGY

Overview

Application process initiated and validated at NTIA for federal users and FCC for non-federal users

Under Phase 1 Coordination:

- Establish coordination zone contour based on station type
- The same technical assumptions will apply to federal and non-federal users
- Identify overlap between coordination zone contours of existing and proposed systems
- If no overlap in coordination zone contours proposed station approved for licensing (non-federal stations) or frequency authorization (federal stations), otherwise proceed to Phase 2 (e.g., compatibility analysis performed by operators)
- Note: Provide an interference resolution process for non-overlapping contours

1. POINT-TO-MULTIPOINT STATION COORDINATION ZONE CONTOURS

Transmitter Parameters (Provided by Federal and Non-Federal Applicant)

- Equivalent Isotropic Radiated Power (EIRP) (dBm/100 MHz)
- Latitude and Longitude (decimal degrees)
- Antenna Height (meters)

Reference Receiver

- Antenna Height: 10 meters

Coordination Trigger

- Power Spectral Density Threshold (PSDT): -110 dBm/100 MHz

Required Propagation Loss Calculation

- LRequired = EIRP – PSDT
- Irregular Terrain Model (ITM) and ITU-R Recommendation P.676 atmospheric attenuation used to determine distance corresponding to LRequired
- ITM parameters provided in Table 1
- ITU-R P.676 parameters provided in Table 2
- No clutter loss

Coordination Zone Contours

- Use each distance for each radial to establish coordination zone contour (see Figure 1 for example)

2. BASE-TO-MOBILE STATION COORDINATION ZONE CONTOURS

Transmitter Parameters (Provided by Federal and Non-Federal Applicant)

- Equivalent Isotropic Radiated Power (EIRP) (dBm/100 MHz)
- Latitude and Longitude (decimal degrees)
- Antenna Height (meters)

Reference Receiver

- Antenna Height: 1.5 meters

Coordination Trigger

- Power Spectral Density Threshold (PSDT): -110 dBm/100 MHz

Required Propagation Loss Calculation

- LRequired = EIRP – PSDT
- Irregular Terrain Model (ITM) and ITU-R Recommendation P.676 atmospheric attenuation used to determine distance corresponding to LRequired
- ITM parameters provided in Table 1
- ITU-R P.676 parameters provided in Table 2
- No clutter loss

Coordination Zone Contours

- Use each distance for each radial to establish coordination zone contour (see Figure 1 for example)

3. COORDINATION ZONE CONTOURS FOR POINT-TO-POINT STATIONS

Parameters (Provided by Federal and Non-Federal Applicant)

- Equivalent Isotropic Radiated Power (EIRP) (dBm/100 MHz)
- Latitude and Longitude (decimal degrees)
- Transmitter and Receiver Antenna Height (meters)
- Antenna Azimuth Angle (degrees)

Reference Receiver

- Antenna Height: Provided by Applicant

Coordination Trigger

- Power Spectral Density Threshold (PSDT): -110 dBm/100 MHz

Required Propagation Loss Calculation

Key Hole Coordination Zone Contour Distance (Within ±5° of Mainbeam)

- Keyhole Angle: Fixed ± 5 degrees with respect to azimuth angle
- LRequired = EIRP – PSDT
- Irregular Terrain Model (ITM) and ITU-R Recommendation P.676 atmospheric attenuation used to determine distance corresponding to LRequired
- ITM parameters provided in Table 1
- ITU-R P.676 parameters provided in Table 2
- No clutter loss

Circular Coordination Zone Contour Distance (±5° to ±15° of Mainbeam)

- LRequired = EIRP - Antenna Discrimination Factor (ADF) – PSDT, where the ADF is 0 dB at 5 degrees off the axis of the main beam of the antenna and increases linearly at 3dB for each additional degree off axis up to 30 dB at 15 degrees off the axis of the main beam of the antenna.
- Irregular Terrain Model (ITM) and ITU-R Recommendation P.676 atmospheric attenuation used to determine distance corresponding to LRequired
- ITM parameters provided in Table 1
- ITU-R P.676 parameters provided in Table 2
- No clutter loss

Circular Coordination Zone Contour Distance (±15° to ±45° of Mainbeam)

- LRequired = EIRP - 30 dB – PSDT
- Irregular Terrain Model (ITM) and ITU-R Recommendation P.676 atmospheric attenuation used to determine distance corresponding to LRequired
- ITM parameters provided in Table 1
- ITU-R P.676 parameters provided in Table 2
- No clutter loss

Circular Coordination Zone Contour Distance (±45° to ±55° of Mainbeam)

- LRequired = EIRP – ADF - PSDT, where the ADF is 30 dB at 45 degrees off the axis of the main beam of the antenna and increases linearly at 1dB for each additional degree off axis up to 40dB at 55 degrees off the axis of the main beam of the antenna.
- Irregular Terrain Model (ITM) and ITU-R Recommendation P.676 atmospheric attenuation used to determine distance corresponding to LRequired
- ITM parameters provided in Table 1
- ITU-R P.676 parameters provided in Table 2
- No clutter loss

Circular Coordination Zone Contour Distance (±55° to ±80° of Mainbeam)

- LRequired = EIRP – 40 dB - PSDT
- Irregular Terrain Model (ITM) and ITU-R Recommendation P.676 atmospheric attenuation used to determine distance corresponding to LRequired
- ITM parameters provided in Table 1
- ITU-R P.676 parameters provided in Table 2
- No clutter loss

Circular Coordination Zone Contour Distance (±80° to ±100° of Mainbeam)

- LRequired = EIRP – ADF – PSDT, , where the ADF is 40 dB at 80 degrees off the axis of the main beam of the antenna and increases linearly at 0.5 dB for each additional degree off axis up to 50 dB at 100 degrees off the axis of the main beam of the antenna.
- Irregular Terrain Model (ITM) and ITU-R Recommendation P.676 atmospheric attenuation used to determine distance corresponding to LRequired
- ITM parameters provided in Table 1
- ITU-R P.676 parameters provided in Table 2
- No clutter loss

Circular Coordination Zone Contour Distance (outside of ±100° of Mainbeam)

- LRequired = EIRP – 50 dB - PSDT
- Irregular Terrain Model (ITM) and ITU-R Recommendation P.676 atmospheric attenuation used to determine distance corresponding to LRequired
- ITM parameters provided in Table 1
- ITU-R P.676 parameters provided in Table 2
- No clutter loss

Coordination Zone Contours

- Use each distance for each radial to establish coordination zone contour starting from system location

TABLE 1. ITM PARAMETERS USED IN COORDINATION ZONE CONTOUR GENERATION[18]

Parameter	Value
Frequency	37 GHz
Mode	Terrain Dependent
Transmitter Antenna Height	Provided by Applicant
(Above Ground Level)	
Reference Receiver Antenna Height (Above Ground Level)	Point-to-Multipoint: 10 meters Base-to-Mobile: 1.5 meters Point-to-Point: Provided by Applicant
Transmitter Location	Latitude (Decimal Degrees) and Longitude (Decimal Degrees)
Mode of Variability	Single Message
Surface Refractivity	301 N-Units
Dielectric Constant of Ground	15
Radio Climate	Continental Temperate
Reliability	50%
Confidence	50%
Terrain Data	United States Geological Survey 1-Second
Atmospheric Attenuation	Recommendation ITU-R P.676[19]
Number of Radials	360 (1 Degree Increments)
Spacing Along Radial	30 meters
Distance Criteria	1st point along radial where the required path loss is achieved

TABLE 2. ITU-R P.676 PARAMETER INPUTS

Parameter	Value
Frequency	37 GHz
Air Temperature	23 C
Surface Atmospheric Pressure	1013.25 hPa
Ground-level Water Vapor Density	7.5 g/m3

[18] National Telecommunications and Information Administration, NTIA Report 82-100, *A Guide to the Use of the ITS Irregular Terrain Model in the Area Prediction Mode* (April 1982).

[19] Recommendation ITU-R P.676-12, *Attenuation by atmospheric gases and related effects* (Aug. 2019). The model in ITM is limited to an upper frequency limit of 20 GHz. ITM does not explicitly compute gaseous attenuation (the remaining propagation loss models in ITM are not affected by going to higher frequencies). By augmenting (i.e., adding) the basic transmission losses predicted by ITM with the product of the P.676 specific attenuations (dB/km) and the path distance (in consistent units), the basic transmission loss will include gaseous attenuation that is required.

STATION DEFINITIONS[20]

Point-to-Multipoint Hub Station. A fixed point-to-multipoint radio station that provides one-way or two-way communication with fixed Point-to-Multipoint Service User Stations.

Point-to-Multipoint Service. A fixed point-to-multipoint radio service consisting of point-to- multipoint hub stations that communicate with fixed point-to-multipoint user stations.

Point-to-Multipoint User Station. A fixed radio station located at users' premises, lying within the coverage area of a Point-to-Multipoint Hub station, using a directional antenna to receive one-way communications from or providing two-way communications with a fixed Point-to- Multipoint Hub Station.

Point-to-point station. A station that transmits a highly directional signal from a fixed transmitter location to a fixed receive location.

Transportable station. Transmitting equipment that communicates with a base station and is not intended to be used while in motion, but rather at stationary locations.

Base station. A fixed station that communicates with mobile or transportable stations.

Mobile station. A station in the mobile service intended to be used while in motion or during halts at unspecified points.[21]

[20] These station definitions are taken from, or based on, the definitions set forth in 47 CFR 30.2.

[21] This station definition is taken from the FCC rules. *See* 47 CFR 2.1.

APPENDIX B

DRAFT LOWER 37 GHZ PHASE 2 COORDINATION METHODOLOGY

Overview

The phase two coordination methodology provides guidance to the operators (federal and non-federal) performing compatibility analysis when there is an overlap in the coordination contours generated in Phase 1.

When phase one contours overlap and trigger phase two coordination, the applicant will contact the incumbent, who should provide a response within 15 working days.

Under Phase 2 Coordination:

- Parties should exchange technical characteristics to perform compatibility analysis.
- Operators should negotiate in good faith and work cooperatively.
- The same Phase 1 technical assumptions will apply to federal and non-federal users. Additional Phase 2 coordination may apply agreed upon models.
- Applicable propagation terrain and building databases should be used when available.
- Operators should take full advantage of interference mitigation techniques such as antenna directivity, polarization, frequency selection, shielding, site selection, and transmitter power control to facilitate the implementation, operation, compatibility between systems.
- A dispute resolution process will be established by FCC and NTIA to resolve disagreements between operators that arise during the coordination process.

Technical Parameters for Phase 2 Coordination

Table 1 provides the technical parameters to be exchanged between operators for the Lower 37 GHz Phase 2 Coordination. If operators agree, a subset or additional technical parameters can be exchanged for the compatibility analysis.

Table 1. Phase 2 Coordination Technical Parameters

Technical Parameter	Units	Comments
Transmitter Geographic Coordinates	Degrees/Minutes/Seconds	
Transmitter Antenna Ground Elevation	Meters	Above Mean Sea Level (as indicated by the USGS terrain database)
Transmitter Antenna Height	Meters	Above Ground Level
Transmitter Power	dBm	
Mainbeam Antenna Gain	dBi	
Equivalent Isotropic Radiated Power	dBm	
Center Frequency	MHz	
Emission Bandwidth[22]	MHz	
Emission Designator	Emission Classification Symbols	
Emission Spectrum	Relative Attenuation (dB) as a Function of Frequency Offset from Center Frequency (MHz)	-3 dB, -20 dB, -60 dB points
Transmitter Antenna Azimuth of Maximum Gain	degrees	With Respect to True North
Transmitter Antenna Downtilt/Uptilt (Elevation) Angle	degrees	With Respect to Horizontal
Transmit Antenna Polarization		
Transmitter Azimuth Off-Axis Antenna Pattern	dBi as a function of off-axis angle in degrees	Required for all use cases; point-to-point systems should use NSMA[23] Format
Transmitter Elevation Off-Axis Antenna Pattern	dBi as a function of off-axis angle in degrees	Required for all use cases; point-to-point systems should use NSMA Format
Transmitter Cable/Insertion Loss	dB	
Receiver Geographic Coordinates (Point to Point Systems Only)	Degrees/Minutes/Seconds	
Receiver Antenna Ground Elevation (Point to Point Systems Only)	Meters	Above Mean Sea Level (as indicated by the USGS terrain database)
Receiver Antenna Height (Point to Point Systems Only)	Meters	Above Ground Level
Receiver Mainbeam Antenna Gain	dBi	
Receiver Threshold/Sensitivity	dBm	Minimum Discernible Single/Criteria
Receiver Noise Figure	dB	

[22] Emission Bandwidth is synonymous with the definition of occupied bandwidth in the ITU radio regulations and FCC rules - ***Occupied bandwidth.*** The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

[23] National Spectrum Management Association.

Technical Parameter	Units	Comments
Receiver IF Selectivity	Relative Attenuation (dB) as a Function of Frequency Offset from Center Frequency (MHz)	-3 dB, -20 dB, -60 dB points
Receiver Antenna Azimuth of Maximum Gain	degrees	With Respect to True North
Receiver Antenna Downtilt/Uptilt (Elevation) Angle	degrees	With Respect to Horizontal
Receive Antenna Polarization		
Receiver Azimuth Off-Axis Antenna Pattern	dBi as a function of off-axis angle in degrees	Required for all use cases; point-to-point systems should use NSMA Format
Receiver Elevation Off-Axis Antenna Pattern	dBi as a function of off-axis angle in degrees	Required for all use cases; point-to-point systems should use NSMA Format
Receiver Cable/Insertion Loss	dB	

Interference Criteria for Phase 2 Coordination

The interference criteria for the Phase 2 coordination are set forth in Table 2. If coordinating parties are able to agree on mutually acceptable alternative interference criteria, such alternative criteria may be used in the compatibility analysis.

Table 2. Phase 2 Coordination Interference Criteria Use Case Matrix

Applicant Use Case	Incumbent Use Case	Interference Criteria
B-M	B-M	Receiver Noise – 6 dB
B-M	P-MP	Receiver Noise – 6 dB
B-M	P-P	Receiver Noise – 6 dB
P-MP	P-MP	Receiver Noise – 6 dB
P-MP	B-M	Receiver Noise – 6 dB
P-MP	P-P	Receiver Noise – 6 dB
P-P	P-P	Receiver Noise – 6 dB
P-P	B-M	Receiver Noise – 6 dB
P-P	P-MP	Receiver Noise – 6 dB
Receiver Noise = -114 + 10 Log IFBW + NF (Noise temperature is assumed to be 290 degrees Kelvin (room temperature) for all systems using this band) IFBW is the receiver 3 dB intermediate frequency bandwidth, in MHz, if available. If not available, emission bandwidth may be used. NF is the receiver noise figure, in dB I/N of - 6dB, used to determine the interference criteria unless another interference criteria is identified and agreed to by federal and non-federal operators		

Compatibility Analysis

The following general equation will be used to calculate the received interference power at the input of a receiver:[24]

$$P_R = P_T + G_T + G_R - L_P - L_T - L_R - L_C - L_A - L_{Pol} - FDR \quad (1)$$

where:

P_T is the transmitter power (dBm);
EIRP is the equivalent isotropically radiated power of the transmitter (dBm); G_T is the transmitter antenna gain in the direction of the receiver (dBi);
G_R is the receiver antenna gain in the direction of the receiver (dBi); L_P is the basic transmission loss, in the absence of clutter (dB);
L_T is the transmitter cable/insertion losses (dB); L_R is the receiver cable/insertion losses (dB); L_C is the clutter loss (dB);
L_A is the atmospheric loss (dB);
L_{Pol} is the polarization loss (dB); and
FDR is the Frequency Dependent Rejection (dB)

The compatibility analysis only considers single-entry interference. If operators mutually agree to do so, they may consider aggregate interference.

The computed receiver interference power will be compared to interference criteria to determine whether there is compatibility. The operators may exchange the interference threshold exceedance once the analysis is complete.

The amount in dB that the calculated interference from Equation 1 exceeds the interference criteria specified in Table 2 will be exchanged between the federal and non-federal users.

Antenna Models

Measured antenna patterns are preferred and should be used whenever available; in their absence, the operators may use modeled antenna patterns provided by the manufacturer, or a model that estimates the antenna pattern.[25]

Propagation Model

To calculate the propagation loss, operators may mutually agree to apply proprietary propagation models, actual measurement data, or other environmental data, consistent with good engineering practices. Both operators must agree on and accept the results of the analysis performed using the

[24] The link budget analysis approach used is described in Joint Spectrum Center, JSC-CR-10-004, *Communications Receiver Performance Degradation Handbook* (Aug. 11, 2010), Section 2, *available at* https://www.ntia.doc.gov/files/ntia/publications/jsc-cr-10-004final.pdf.

[25] For an active Advanced Antenna System (AAS) in the lower 37 GHz band ITU-R M.2101 contains a possible antenna model for a single element and composite pattern. For non-AAS, ITU-R F.1336 may be considered.

agreed-upon methodology. The Phase 2 coordination analysis should not consider worst-case conditions unless otherwise justified.

Coordinating parties may consider the use of open-source propagation models such as ITM and ITU-R P.676.[26] Annex 1 of this document contains the suggested propagation model inputs and application descriptions.

Clutter Loss Model

The operators may mutually agree to use proprietary clutter loss and building height databases. Operators may also consider using ITU-R P.2108, an open-source statistical clutter loss model**.**

Variation Acceptance in Analysis Results

Using the methodology in this document, it is possible for both operators to produce different analysis results if they choose to implement each model individually. Therefore, the operators are encouraged to exchange analysis results to resolve differences. The FCC and NTIA will establish a dispute resolution process through which operators can discuss their analyses and adjudicate disputes through NTIA and the FCC.

[26] ITU-R P.452 is another open-source propagation model that can be implemented if both parties agree to it.

ANNEX 1

This section provides a brief description of public models that can be used to calculate propagation loss, LP in equation 1. The models herein assume all operations are outdoor and all transmitters and receivers have fixed antenna heights.

ITM + ITU R P. 676

Application

This model might be used to calculate the propagation loss for paths in suburban and rural environments. ITM requires an array of terrain elevations as an input. A terrain database and terrain elevation extraction methods will be required to obtain the terrain elevations. ITM only considers bare-earth obstruction without any building, vegetation or other material clutter losses.

Source Code

NTIA/itm: The Irregular Terrain Model (ITM) (github.com)

Table 1. ITM Input Parameters

Parameter	Value
Frequency	Operating Frequency (GHz)
Mode	Terrain Dependent
Transmitter Antenna Height (Above Ground Level)	Provided by Applicant
Reference Receiver Antenna Height (Above Ground Level)	Point-to-Multipoint: 10 meters Base-to-Mobile: 1.5 meters Point-to-Point: Provided by Applicant
Transmitter Location	Latitude(Decimal Degrees) and Longitude(Decimal Degrees)
Mode of Variability	Single Message
Surface Refractivity	301 N-Units
Dielectric Constant of Ground	15
Radio Climate	Continental Temperate
Reliability	50%
Confidence	50%

Table 3. ITU-R P.676 Input Parameters

Parameter	Value
Frequency	37 GHz
Air Temperature	23 C
Surface Atmospheric Pressure	1013.25 hPa
Ground-level Water Vapor Density	7.5 g/m3