



**Requirements
for
Protection of Incumbents in the 6 GHz Band**

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Interim Release

Interim Release Status

This is the first of several planned interim releases in the development of this report. Interim releases are approved at the Committee level, but do not go through final Forum ballot. Accordingly, the contents of this document are not final and are subject to change as the project progresses.

Interim Release

Contributors

Editor: Mark Gibson, CommScope, Inc

Authors:

Cisco Systems, Peter Eccelsine

Charter Communications, Reza Hedayat

CommScope, Inc., Mark Gibson

Ericsson, Kumar Balachandran

iPosi, Chris Kurby

Nokia Corp., Fabiano Chaves

Sony Corporation, Sho Furuichi

Sony Corporation, Naotaka Sato

Requirements for Protection of Incumbents in the 6 GHz Band

1 Scope

The scope of this document is to identify for 6 GHz stakeholders (e.g., incumbents, proposed unlicensed interests, FCC, etc.) the requirements for the protection of incumbents to support unlicensed operation of Universal National Information Infrastructure (U-NII) devices in the 6 GHz band (5925-7125 MHz) in the U.S. These requirements are identified based on the FCC NPRM. [1]

This document presumes there will be an Automatic Frequency Coordination (AFC) system as described in the NPRM, “To determine whether an individual unlicensed device can transmit at a particular location on a given frequency...”. [2]

This document is provided from the perspective of incumbent protection. For the purposes of this document, “incumbents” refers to any system authorized to operate in parts or the entirety of the four U-NII sub-bands comprising the 6 GHz band.¹[1] and “U-NII devices” refers to, unless otherwise specified, Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) which will operate on an unlicensed basis in the sub-bands which would require AFC system. The document specifically concerns itself with protection of the fixed microwave services that occupy large parts of 5925-7125 MHz.

2 References

- [1] FCC, “In the Matter of Unlicensed Use of the 6 GHz Band Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz; ET Docket No. 18-295 and GN Docket No. 17-183,” FCC 18-147, October 2018. (“NPRM”)
- [2] *Id*, Sec III A. 2., para 25
- [3] *Id*, para 41
- [4] WINNF-TR-1002, Version V0.0.0-r6.0, “Propagation Models and Interference Protection Criteria for Sharing between the Fixed Service and Unlicensed Devices in the 6 GHz Band”
- [5] NPRM, Sec II B.

3 Definitions and Abbreviations

This document uses the following definitions and abbreviations:

¹ See section II B. “Incumbent Services in the 6 GHz Band”

3.1 Abbreviations

Abbreviation	Description
3DEP	3D Elevation Program (USGS)
6MSC	6 GHz Band Multi-stakeholder Committee
AFC	Automated Frequency Coordination
APO	Availability Performance Objective
ATPC	Automated Transmit Power Control
BEL	Building Entry Loss
CBRS	Citizens Broadband Radio Service
CFR	Code of Federal Regulations
EAS	Equipment Authorization System
ECC	European Communications Committee
ECO	European Communications Office
EIRP	Equivalent Isotropic Radiated Power
eHata	Extended Hata
EPO	Error Performance Objective
FCC	Federal Communications Commission
FS	Fixed Service
IPC	Interference Protection Criteria
ISM	Industrial, Scientific, and Medical
ITM	Irregular Terrain Model
ITS	Institute of Telecommunications Studies
ITU-R	International Telecommunications Union, Radio Communications Bureau
LA	Link Adaptation
NLoS	Non-line of Sight
LoS	Lone of Sight
LPI	Low Power Indoor
NLCD	National Land Cover Database
NPO	Network Performance Objective

Abbreviation	Description
NPRM	Notice of Public Rule-Making
NSMA	National Spectrum Management Association
NTIA	National Telecommunications and Information Administration
P2P	Point-to-Point
R&O	Report and Order
RLAN	Radio Local Area Network
SAS	Spectrum Access System
SDR	Software Defined Radio
ULS	Universal Licensing System
U-NII	Unlicensed National Information Infrastructure
USGS	United States Geological Survey
VLP	Very Low Power
WinnForum	Wireless Innovation Forum

3.2 Definitions

4 Requirements

Below is an outline of areas that requirements must address regarding protection of incumbents in the 6 GHz bands (5925-7125 MHz). These will be more developed in future releases.

4.1 Data

Requirements must describe the data on incumbent operations needed to protect incumbents and identify data sources. Requirements must also describe how to address data accuracy issues and how data are corrected.

4.1.1 Data Required

The data needed to perform effective determination of harmful interference from U-NII devices into incumbents.

Information on incumbent deployments should include details about assigned frequencies, the location of the installation, the height of any receiving structures relative to a suitable reference (e.g. ground level or mean sea level), antenna characteristics that include, at a minimum, gain and half-power beamwidths of the receiving antenna in the horizontal and vertical directions, and the front-to-side-lobe ratio and front-to-back ratio. It would be preferable to get the antenna directivity in azimuthal and elevation profiles and the peak gain of the antenna. The absence of such a database will require the FCC to actively solicit the corresponding information from incumbent users as a condition of receiving protection from U-NII devices.²

4.1.2 Data Sources

The sources of the data detailed above including FCC databases (ULS, EAS, others) or other data sources. [3]

4.1.3 Update Interval

How frequently the data should be updated from the data sources considering the dynamic nature of licensing or frequency coordination.

4.1.4 Accuracy & Corrections

Mechanism to ensure data are accurate and there is a way to apply corrections.

4.1.5 Public Availability

Should any of this data be made public if it is not already so?

4.2 Spectrum Availability Determination

Requirements must detail how spectrum availability will be determined for operation of U-NII devices. The requirements should also include the factors that should be considered and how are they used to determine spectrum availability.

² The FCC could issue Public Notices inviting incumbents to update their information in the various FCC databases.

4.2.1 U-NII Device-specific Information

Radio transmission characteristics of U-NII devices need to be considered under some circumstances when determining the allowable transmit power and frequency ranges on which the U-NII devices may operate. Specific implementation details of these characteristics may be guided by regulations, but the precise definitions should be left to industry. For example, how these characteristics are considered, when and how they are shared between entities (e.g., AFC, U-NII device, etc.) and which operational entities might take actions based on these characteristics can be addressed under the appropriate multi-stakeholder groups.

Examples of radio transmission characteristic that might affect radio operational parameters include:

- Total transmit power (conducted plus antenna gain or EIRP), power density
- Occupied bandwidth
- Activity factor (i.e., fraction of time actual transmission occurs)
- Location
- Whether or not it's talking to an AFC and what kind
- Antenna characteristics

4.2.2 Accounting for Multiple U-NII Devices

Methods to account for combination of received interference at the incumbent's antenna from multiple U-NII devices operating from multiple locations.

UNII device aggregation, if used by AFC, should be subject to a statistical distribution of multiple UNII devices with mapping to associated characteristics of the incumbent antenna.

4.2.3 Propagation Modeling (or measurements, possibly per U-NII device)

Describe propagation models appropriate for varied situations. Should address the following (note this has also been addressed in [4]):

Clutter Loss

Building Entry Loss (BEL) (optionally, the AP can report measured BEL)

BEL is suggested for structures with various construction materials such as conventional low-loss building materials (e.g. plain glass windows) and new construction e.g. using foil-backed insulation and low-emissivity windows.

For BEL evaluation, a minimum distance, e.g. 1-3 meters, may be considered for the distance of a UNII device from a window.

Visual inspection to determine potential blockages

Interference Protection Criteria

Probability of crossing the I/N threshold at the FS receiver

For clutter loss, in addition or as a replacement of analytical models, clutter evaluation using mapping software, e.g. Google Earth, may be considered.

4.2.4 Incumbent Receiver Characteristics

How the above information is used to determine potential for interference and describe additional data required to perform calculations. Industry solutions need to consider:

- Antenna & cabling/waveguide characteristics
- Near-field considerations
- Polarization decoupling
- Blocking
- Rx filter selectivity

4.2.5 Quiet Zones

Identify and describe any Quiet Zones and the method for protecting (e.g., exclusion zone). These will likely be provided by the FCC.

Quiet zones may be subject to a time limit, and occurrence limit per incumbent station per unit time interval.

4.2.6 U-NII Device Location and Accuracy

This will be used to calculate an ellipsoid of location uncertainty around each U-NII device roughly equal to the device's location accuracy in three axes. The uncertainty ellipsoid will be used to determine proximity of the device to a given incumbent.

4.2.7 Periodic Spectrum Availability Re-check

The circumstances and how often devices need reverify available spectrum due to the following:

- U-NII device relocation (max distance device can be moved and not have to recheck)
- Frequency of recheck: How often should the device recheck considering dynamic nature of incumbent activity (e.g., new ULS filings, frequency coordinations, etc.)
- Power off/on: Device powers off then back on.

4.3 Testing and Certification

AFCs and U-NII devices operating under AFC management will likely need to be tested and certified. This section describes the potential requirements for the testing and certification process for AFCs associated U-NII devices to ensure they meet minimum requirements and have appropriate certifications.

4.3.1 Development of Test Plans

How test plans will be developed to ensure sufficient testing of device's compliance with FCC rules.

4.3.2 Testing Agency

Identify criteria for testing agencies to instantiate test plans into a certification testing program.

4.3.3 Minimum Requirements for Certification

Describes the minimum testing requirements for devices to be certified by the FCC.

4.3.4 Reporting & feedback requirements

How to address bug fixes, changes, enhancements, etc. that would require additional testing and certification.

4.4 Performance requirements

Incumbents need assurance that AFCs are duly certified and operating pursuant to that certification.³ This section describes the potential requirements for AFC system operator.

4.4.1 Term

The duration of the AFCs' certification

4.4.2 Termination

Circumstances that would cause an AFC to lose certification

4.4.3 Change of AFC Ownership or Transfer of Responsibility

This may be provided by the FCC, but requirements should dictate how to handle changing who manages an AFC (AFC system operator).

4.5 Interference Reporting, Identification and Mitigation

Incumbents need assurance there is a means to report interference and ensure it is promptly and correctly mitigated.⁴ This section describes the potential requirements for interference reporting, identification and mitigation. The section also includes the relevant analysis.

4.5.1 Description of Interference

Describe and characterize what is interference and what AFC can manage. Need to consider whether devices are managed or not managed by the AFC.

LPI (Low Power Indoor) and VLP (Very Low Power) devices are not coexisting with Standard Power Access Points in the band.

LPI and VLP devices are coexisting with Standard Power Access Points in the band.

4.5.2 U-NII Device Registration

Registering on an AFC and providing location information will help identify potential interferers. As an alternative, AFC might poll device behavior but need to balance complexities of this approach and pending privacy verification/checks.

³ See for example UTC NPRM Reply Comments at Sec. 6.

⁴ See FWCC NPRM Reply Comments at Sec 10.

4.5.3 Interference Mitigation

The steps to mitigate interference once it is verified.

4.5.4 Enforcement Actions

Actions by the FCC to enforce incumbent interference protection. (Note, the FCC may likely engage AFC system operator in the enforcement process. Would be worthwhile to discuss and suggest a process.)

4.5.5 Considerations on Unmanaged U-NII Devices

What are the steps (if any) to identify and mitigate interference from U-NII devices not managed by an AFC.

4.5.6 Aggregative Effects

How to accommodate aggregate interference when the interferer is not a single source. Also need to consider interference with incumbents that may be transportable such as Broadcast Auxiliary.

4.6 Security

This section assesses the potential for security breaches that could put incumbents at risk and identifies mitigations.

4.6.1 Threat Assessment

Comprehensive assessment of all potential security threats.

4.6.2 Verification and Validation

How threats are verified and validated.

4.6.3 Blacklisting

What are conditions and circumstances for blacklisting and de-blacklisting devices if needed.

4.6.4 Device Integrity

How to ensure device is resistant to hacking, tampering, software trust, etc.

4.6.5 Privacy

How to ensure end-user privacy.

AFC should be designed and enabled to protect the information of the U-NII devices that have been authorized or considered for authorization by the AFC.

4.7 Ongoing ecosystem management

Need process to ensure ecosystem evolves as needed and there is a means to capture lessons learned and feedback to requirements as needed.

4.7.1 Management of Operational Feedback

How to gather operational feedback to ensure capture of lessons learned and improvements to processes and procedures.

4.7.2 Requirements Review

Process to review, update and reissue requirements as needed given the above.

4.7.3 Management of Future Releases

How to manage the above in the context of future releases, what are the requirements and responsibilities and who manages.

5 Recommendations and Conclusions

6 Future work