

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
)
Expanding Flexible Use in Mid-Band Spectrum) GN Docket No. 17-183
Between 3.7 and 24 GHz)
)

NOTICE OF INQUIRY

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By the Commission: Chairman Pai and Commissioners Clyburn and O’Rielly issuing separate statements.

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I. INTRODUCTION

1. In this Notice of Inquiry, we seek input on potential opportunities for additional flexible access—particularly for wireless broadband services—in spectrum bands between 3.7 and 24 GHz (mid-band spectrum). In recent years, the Commission has made significant progress toward making spectrum

available for next generation wireless broadband networks. These efforts, however, have primarily focused on the bands below 3.7 GHz and above 24 GHz. The Commission believes that exploring options to expand access opportunities in mid-band frequencies could further our goal of establishing comprehensive, sound, and flexible spectrum policies, enabling innovations and investment to keep pace with technological advances, and maintaining U.S. leadership in deployment of next-generation services in the long term.

2. In particular, we seek detailed comment on three specific bands: 3.7-4.2 GHz; 5.925-6.425 GHz; and 6.425-7.125 GHz. These three bands have already garnered interest from industry stakeholders—both domestically and internationally—for expanded flexible broadband use. As such, we believe that these three bands represent an appropriate starting point for our inquiry into expanding access to mid-band spectrum. We ask commenters to identify other bands, allocated for exclusive non-federal use or shared federal and non-federal use, that might be suitable candidates for expanded flexible wireless broadband use so that we can understand any other interest in these mid-band frequencies and make more informed proposals to explore such bands in future proceedings, if appropriate.

3. We note that many of the shared bands between 3.7 and 24 GHz include significant and important federal operations and we are committed to ensuring that federal agencies can continue their important missions. Consistent with established practice, to the extent we further examine any band that includes a shared allocation for federal use, we will work closely with the National Telecommunications and Information Administration (NTIA)¹ to evaluate the potential operational impacts, costs, benefits, and resource considerations associated with any new or expanded non-federal use of those shared allocations.² As we consider proposals that will be submitted in response to this inquiry, some ideas will be further explored, while other, less promising ideas will not be pursued. Moreover, we do not plan to revisit recently decided federal/non-federal sharing issues in mid-band frequencies. This inquiry also is not intended to preclude us from acting on or otherwise addressing any pending matters involving federal/non-federal sharing issues in the mid-band frequencies in those pending proceedings. In this inquiry, our priority will be to look at the most viable repurposing proposals in exclusive non-federal use bands first, and then those in shared federal/non-federal mid-band frequencies in coordination with NTIA. Accordingly, this inquiry will focus on exploring potential opportunities in the mid-band frequencies allocated for exclusive non-federal use and for shared federal and non-federal use, that might be suitable candidates for expanded flexible wireless broadband use.

4. This inquiry may also help the Commission address international activities and statutory obligations in collaboration with the State Department, NTIA, and other federal agencies through established interagency processes. For example, this inquiry could provide valuable information in advance of upcoming World Radiocommunication Conferences (WRCs). Recently, there has been some international interest in identifying new frequency bands for wireless broadband below the 24 GHz frequency range.³ The State Department, in collaboration with the Commission and NTIA, may need to develop U.S. positions at WRC-19 on future agenda items for the next WRC on mid-band spectrum proposals. This proceeding could also be used to gather information that might help the Commission (and

¹ The Commission shares responsibility for managing the nation's use of spectrum with the Assistant Secretary for Communications and Information, who also serves as the Administrator of the NTIA, on authority delegated by the President of the United States. *See* 47 U.S.C. §§ 301, 305(a). The Commission has licensing authority over non-federal stations while NTIA assigns frequencies to federal stations.

² The Commission, NTIA, and affected federal agencies are currently collaborating on several high priority proceedings, including: (1) the AWS-3 transition; (2) completing of necessary work on the 3.55-3.7 GHz band; (3) studying the 1.35 GHz band; and (4) coordinating on certain Spectrum Frontiers bands above 24 GHz. These, and other, ongoing priorities will require resources from all agencies involved.

³ The European Conference of Postal and Telecommunications Administrations' (CEPT) Office of Electronic Communications Committee, recently initiated a study covering some of these bands, "Wireless Access Systems Including RLAN in the band 5925-6425 MHz", available at http://eccwp.cept.org/WI_Detail.aspx?wiid=627.

NTIA) with future efforts related to implementation of Sections 1006 and 1008(2) of the Spectrum Pipeline Act of 2015 by, for example, identifying demands for licensed and unlicensed uses in bands below 6 GHz and between 6 GHz and 57 GHz for three of our upcoming reports to Congress.⁴

II. BACKGROUND

A. Need to explore mid-band spectrum for wireless broadband

5. Wireless broadband—whether fixed or mobile, terrestrial or satellite—represents a critical component of economic growth, job creation, public safety, and global competitiveness.⁵ Recognizing a need for additional spectrum for wireless broadband use, the Commission in recent years has taken several steps to more efficiently and intensely use spectrum below 3.7 GHz, and has paved the way for new opportunities in frequencies above 24 GHz. For example, the recently concluded Incentive Auction repurposed 84 megahertz of 600 MHz band spectrum for wireless use.⁶ And in its proceeding to allow commercial use in certain Advanced Wireless Services (AWS) bands, the Commission, in collaboration with NTIA, reallocated an additional 65 megahertz of spectrum in the 1.7 and 2 GHz bands for commercial wireless use.⁷ With regard to high-frequency spectrum, the Commission's Spectrum Frontiers Proceeding made available almost 11 gigahertz of spectrum above 24 GHz for licensed and unlicensed fixed and mobile use, proposed to make available 18 gigahertz of additional spectrum, and sought comment on making spectrum above 95 GHz available for commercial use.⁸

6. To meet projected future demand, it is prudent that we continue to evaluate spectrum bands in all ranges and ensure that there is no gap in our policies in terms of enabling new opportunities for flexible broadband use. In other words, a sound spectrum policy necessitates that we now begin exploring new opportunities for flexible broadband use in the mid-band frequencies. The combination of favorable propagation characteristics of the mid-band frequencies (as compared to bands above 24 GHz) and the opportunity for additional channel bandwidth (as compared to bands below 3.7 GHz), could make many of these mid-band frequencies well-suited for next-generation wireless services. Notably, this balance of coverage and capacity could provide a critical input to operators to deploy new and improved wireless services to rural, remote, and underserved areas of the country.⁹

⁴ See Pub. L. 114–74, Title X, §§ 1006 and 1008(2), 129 Stat. 624–625 (Nov. 2, 2015).

⁵ See, e.g., *Service Rules for the Advanced Wireless Services H Block—Implementing Section 6401 of the Middle Class Tax Relief and Job Creation Act of 2012 Related to the 1915-1920 MHz and 1995-2000 MHz bands*, WT Docket No. 12-357, Report and Order, 28 FCC Rcd 9483, 9484–85, para. 2 (2013) (*H Block R&O*); *Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands*, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, Report and Order and Order of Proposed Modification, 27 FCC Rcd 16102, 16104, para. 3 (2012) (*AWS-4 Service Rules R&O*); *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands*, GN Docket No. 14-177, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8020, paras. 6-7 (2016) (*Spectrum Frontiers R&O and FNPRM*).

⁶ See Broadcast Incentive Auction and Post-Auction Transition, <https://www.fcc.gov/about-fcc/fcc-initiatives/incentive-auctions> (last visited July 11, 2017).

⁷ See *Amendment of the Commission's Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands*, GN Docket No. 13-185, Report and Order, 29 FCC Rcd 4610 (2014) (*AWS-3 Report and Order*).

⁸ See *Spectrum Frontiers R&O and FNPRM*.

⁹ “While the U.S. has pushed ahead with efforts to free new spectrum at both low and high frequencies, we lag behind other countries in so-called ‘mid-band’ spectrum—the range of frequencies between 3 GHz and 7 GHz.” Letter dated June 21, 2017, from Senator John Thune, Chairman, Committee on Commerce, Science, and Transportation, United States Senate, to the Honorable Ajit V. Pai, Chairman, Federal Communications Commission, https://www.commerce.senate.gov/public/index.cfm?a=Files.Serve&File_id=3CEFB171-0D50-4C23-9F31-48942E874CC6.

7. Some wireless broadband stakeholders have previously expressed interest in specific bands within this spectrum range, such as the 3.7-4.2 GHz band.¹⁰ With this Notice of Inquiry, we hope to obtain relevant data and information not only with respect to the three specific bands of interest, but also with respect to potential commercial requirements in non-federal and shared bands in the 3.7-24 GHz frequency range more broadly, so that we can make more informed and specific proposals in any future proceedings.

B. Current uses of spectrum between 3.7 and 24 GHz

8. The 3.7-24 GHz frequency range is allocated to many different services that support a wide variety of important uses. A portion of the spectrum is allocated to the Fixed Satellite Service (FSS), which has a variety of uses, including providing broadband Internet service to consumers (particularly in rural areas), enabling communications on board planes and ships, delivering television programming to cable headends, providing data connectivity for merchant credit card transactions, and supporting corporate data networks. The FSS also supports feeder links for the mobile-satellite service that itself plays a critical role during natural disasters and other emergencies. Allocations to the Broadcasting-Satellite Service (BSS) in this frequency range are used to provide television programming to over 33.8 million households.¹¹ Much of the spectrum used by the non-federal FSS and BSS is shared with the terrestrial Fixed Service (FS). In these shared frequency bands, earth stations and point-to-point microwave stations are coordinated on an individual basis. Federal agencies also operate satellites in this range for weather forecasting, earth imaging, and defense purposes.

9. Spectrum in this frequency range allocated for the FS is used for point-to-point microwave links that support a variety of critical services such as public safety (including backhaul for police and fire vehicle dispatch),¹² coordination of railroad train movements, control of natural gas and oil pipelines, regulation of electric grids, and backhaul for commercial wireless providers such as traffic between cellular base stations and wireline networks. Fixed point-to-point microwave operations provide connectivity for private data networks, public safety communications, and long-distance telephone service on a primary or redundant basis to other transmission medium such as fiber. FS spectrum is also used by the Broadcast Auxiliary Service (BAS) and the Cable Television Relay Service (CARS) for point-to-point transmission of television signals, such as between television studios and transmitters and cable television headends.

10. In addition, Federal agencies and Commission licensees use portions of this frequency range for radars. While satellite, point-to-point links, and radar are the predominant uses within the 3.7-24 GHz frequency range, many other services operate on these frequencies. For example, several bands have been allocated to the Mobile Service and used for purposes such as electronic newsgathering or public safety. Additionally, radio astronomy and spaceborne sensors conduct scientific research within

¹⁰ See, e.g., Fixed Wireless Communications Coalition Inc., Request for Modified Coordination Procedures in Bands Shared Between the Fixed Service and the Fixed Satellite Service, RM 11778, Petition for Rulemaking (Oct. 11, 2016) (FWCC Petition); *Fixed Wireless Communications Coalition, Inc. Request for Modified Coordination Procedures in Bands Shared Between the Fixed Service and the Fixed Satellite Service*, RM-11778, Public Notice, Consumer and Governmental Affairs Bureau Reference Information Center Petition for Rulemaking Filed, Report No. 3059 (CGB, Dec. 9, 2016) (FWCC Public Notice).

¹¹ AT&T Inc., FY16-Q3 Form 10-Q for the Period Ending Sept. 30, 2016 (filed Nov. 3, 2016), at 31; Dish Network Corp., FY16-Q3 Form 10-Q for the Period Ending Sept. 30, 2016 (filed Nov. 9, 2016), at 69.

¹² Public safety entities also have eligibility to hold licenses in the 4.9 GHz band (4.940-4.990 GHz), which is 50 megahertz of spectrum allocated for Fixed and Mobile except Aeronautical Mobile and used currently for a variety of public safety services including point-to-point, point-to-multipoint, video surveillance, and wireless local area networks. See 47 CFR § 90.1201 *et seq.*

this range, and unlicensed devices such as Wi-Fi are designed to operate in 580 megahertz of spectrum that is shared with radars.¹³

11. We also recognize that there are ongoing proceedings, applications, and activities that relate to spectrum within the 3.7-24 GHz frequency range.¹⁴ This Notice of Inquiry is not intended to preclude us from acting on or otherwise addressing these matters prior to the development of a record in this docket, nor is it intended to prejudge any of the matters we may decide in those proceedings.¹⁵ For example, we note our pending proceedings to implement a WRC-07 allocation for the Aeronautical Mobile Telemetry (AMT) service in the 5.925-6.700 GHz band and to allocate spectrum in these bands for radar tracking of non-federal space launches and satellite uplinks from federal earth stations. The Commission will continue to coordinate with NTIA to facilitate potential future AMT operations, commercial space launches, and federal access to non-federal satellites in these proceedings.¹⁶

¹³ The Unlicensed National Information Infrastructure (U-NII) bands, 5.15-5.35 GHz and 5.47-5.85 GHz, are available for use by unlicensed devices.

¹⁴ See, e.g., *Amendment of Part 101 of the Commission's Rules to Facilitate the Use of Microwave for Wireless Backhaul and Other Uses and to Provide Additional Flexibility to Broadcast Auxiliary Service and Operational Fixed Microwave Licensees*, WT Docket No. 10-153; *Petition of Fixed Wireless Communications Coalition, Inc., for Rulemaking in the Matter of Amendment of Parts 2 and 101 of the Commission's Rules to Provide for Federal and Non-Federal Sharing in the 7125-8500 MHz Band*, RM-11605, Public Notice, Consumer and Governmental Affairs Bureau Reference Information Center Petition for Rulemaking Filed, Report No. 2908 (CGB June 4, 2010); *Amendment of Part 90 of the Commission's Rules*, WP Docket No. 07-100, Fourth Report and Order and Fifth Further Notice of Proposed Rulemaking, 27 FCC Rcd 6577, 6584-6627 (2012) (*4.9 GHz Fifth Further Notice*); *Petition of Mimoso Networks, Inc. for Rulemaking to Create a New Frequency Allocation for Wireless Broadband Services*, RM-11715, Public Notice, Consumer and Governmental Affairs Bureau Reference Information Center Petition for Rulemaking Filed, Report No. 3002 (CGB, Mar. 11, 2014), see also *Amendment of Parts 2 and 90 of the Commission's Rules to Create a New Frequency Allocation for Wireless Broadband Services*, RM-11715, Order, 29 FCC Rcd 3177 (2014); *Petition of MVDDS 5G Coalition for Rulemaking to Permit Use of the 12.2-12.7 GHz Band for Two-Way Mobile Broadband Service*, RM-11768, Public Notice, Consumer and Governmental Affairs Bureau Reference Information Center Petition for Rulemaking Filed, Report No. 3042, (CGB, May 9, 2016); *Petition of Fixed Wireless Communications Coalition, Inc., for Rulemaking in the Matter of Request for Modified Coordination Procedures in Bands Shared Between the Fixed Service and the Fixed Satellite Service*, RM-11778, Public Notice, Consumer and Governmental Affairs Bureau Reference Information Center Petition for Rulemaking Filed, Report No. 3059, (CGB, Dec. 9, 2016) (FWCC Coordination Petition); *Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, IB Docket No. 16-408, Notice of Proposed Rulemaking, 31 FCC Rcd 13651 (2016); *Applications Accepted for Filing, Cut-Off Established for Additional NGSO-Like Satellite Applications or Petitions for Operations in the 12.75-13.25 GHz, 13.85-14.0 GHz, 18.6-18.8 GHz, 19.3-20.2 GHz, and 29.1-29.5 GHz Bands*, Public Notice, 32 FCC Rcd 4180 (IB 2017)); *WorldVu Satellites Limited, Petition for a Declaratory Ruling Granting Access to the U.S. Market for the OneWeb NGSO FSS System*, Order and Declaratory Ruling (FCC 17-77 rel. June 23, 2017); *Petition of Broadband Access Coalition for a Rulemaking to Amend and Modernize Parts 25 and 101 of the Commission's Rules to Authorize and Facilitate the Deployment of Licensed Point-to-Multipoint Fixed Wireless Broadband Service in the 3700-4200 MHz Band*, RM-11791, Public Notice, Consumer and Governmental Affairs Bureau Reference Information Center Petition for Rulemaking Filed, Report No. 3080 (CGB, July 7, 2017) (BAC Petition).

¹⁵ We encourage parties not to repeat arguments already made on specific issues in other proceedings, but rather to focus their discussions here on the larger issue of promoting increased broadband spectrum opportunities within the 3.7-24 GHz frequency range. To the extent commenters wish to submit arguments that are substantially similar to materials filed elsewhere, we ask that they provide us with a reference to the specific arguments in their pleadings in the relevant docket, rather than re-filing those comments in this proceeding.

¹⁶ See *Amendment of Parts 1, 2, 15, 25, 27, 74, 78, 80, 87, 90, 97, and 101 of the Commission's Rules Regarding Implementation of the Final Acts of the World Radiocommunication Conference (Geneva, 2007) (WRC-07), Other Allocation Issues, and Related Rule Updates*, ET Docket No. 12-338, ET Docket No. 15-99, and IB Docket 06-123, Report and Order, Order, and Notice of Proposed Rulemaking, 30 FCC Rcd 4183 (2015); *Amendment of Part 2 of the Commission's Rules for Federal Earth Stations Communicating with Non-Federal Fixed Satellite Service Space* (continued....)

III. DISCUSSION

12. We seek comment on the bands between 3.7 and 24 GHz with the most potential to support increased flexible uses, including wireless broadband services. Specifically, we seek comment on how existing service rules governing commercial services could be modified to further promote flexible use, stimulate investment, and encourage intensive deployment in three bands allocated exclusively for non-federal use and discussed below. For each band, we begin by describing current uses but, as part of this inquiry, we also seek comment on whether the Commission's information about the incumbents is complete and up to date. Do incumbent users need to update information about their operations? Are there further steps that the Commission needs to take to ensure that it has the needed information about incumbent operations? In addition, we seek comment on other potential opportunities for expanded flexible broadband use, particularly in non-federal and shared bands between 3.7 and 24 GHz.

A. 3.7-4.2 GHz

1. Current uses

13. The 500 megahertz of bandwidth in the 3.7-4.2 GHz band is currently allocated in the United States exclusively for non-federal use on a primary basis for FSS (space-to-Earth) and FS.¹⁷

14. For FSS, the 3.7-4.2 GHz band (space-to-Earth or downlink) is associated with the 5.925-6.425 GHz band (Earth-to-space or uplink), discussed below, and collectively these bands are the "conventional C-band."¹⁸ Domestically, approximately 48 satellites use this band to provide downlink signals of various bandwidths to approximately 4,700 registered Earth stations throughout the United States. Geostationary orbit (GSO) FSS satellites typically have 24 transponders, each with a bandwidth of 36 megahertz received by one or more Earth stations.¹⁹ Predominant GSO FSS uses include delivery of programming content to television and radio broadcasters, cable television and small master antenna systems, as well as the backhaul of international telephone and data traffic.²⁰ The 3.7-4.2 GHz band is also used for reception of telemetry signals transmitted by satellites, typically near 3.7 or 4.2 GHz. A significant number of the earth stations in this band are receive-only (RO), typically used for the reception

(Continued from previous page) _____
Stations, ET Docket No. 13-115, Notice of Proposed Rulemaking and Notice of Inquiry, 28 FCC Red 6698 (2013).

¹⁷ 47 CFR § 2.106, United States Table of Frequency Allocations, non-Federal Table for the band 3.7-4.2 GHz. In the 3.7-4.2 GHz band (space-to-Earth), earth stations on vessels (ESVs) may be authorized to communicate with space stations of the FSS and, while docked, may be coordinated for up to 180 days, renewable. ESVs in motion must operate on a secondary basis. *See id.*, Non-Federal Government (NG) Footnotes, 47 CFR § 2.106, footnote NG180. *See also* 47 CFR § 2.105(a) (the United States Table of Frequency Allocations (United States Table) is subdivided into the Federal Table of Frequency Allocations (Federal Table, column 4 of § 2.106) and the non-Federal Table of Frequency Allocations (non-Federal Table, column 5 of § 2.106).

¹⁸ *See* 47 CFR § 25.103 (Definitions).

¹⁹ Receive-only earth stations in the FSS that operate with U.S.-licensed space stations, or with non-U.S.-licensed space stations that have been duly approved for U.S. market access, may be registered with the Commission in order to protect them from interference from terrestrial microwave stations in bands shared coequally with the Fixed Service in accordance with the procedures of 47 CFR §§25.203 and 25.251, subject to the stricture in 47 CFR §25.209(c). *See* 47 CFR § 25.131(b). Unregistered receive-only earth stations are unprotected.

²⁰ According to an NTIA study of spectrum usage in the U.S., approximately 14,000 receive earth stations were sharing the 3.7-4.2 GHz band with over 39,000 terrestrial channel assignments during a peak period in 1988. The study also shows 9,500 transmit uplink earth stations coexisting with almost 27,000 terrestrial channel assignments during the same period. *See A Preliminary Look at Spectrum Requirements for the Fixed Services*. U.S. Department of Commerce Institute for Telecommunication Sciences Boulder Colorado, May 1993.

of programming content including cable headends and broadcast radio stations receiving network audio feeds.²¹

15. For the FS, 20 megahertz paired channels are assigned for point-to-point common carrier or private operational fixed microwave links.²² This band was the original long-haul common carrier microwave band, providing an analog transcontinental network for television and long-distance telephone circuits.²³ In 1988, there were over 39,000 licenses in the band but that total had fallen to approximately 13,000 licenses by 1997, which was around the same time that the Commission opened the band for private operational fixed use. Nonetheless, FS use of the band continued a steep decline over the past 20 years²⁴ as common carriers migrated to fiber or other FS bands²⁵ that offered more channelization options without the risk of interference disputes with licensed or unlicensed RO earth stations, and without the difficulty of coordinating new or modified links within the band with GSO FSS.²⁶ Current FS use of this band is relatively minimal (119 licenses).²⁷

2. Options for more intensive fixed use

16. Recognizing the existing uses of the band, we seek comment, generally, on the potential for more intensive use of the 3.7-4.2 GHz band for wireless broadband. We ask commenting parties to address how existing service rules governing GSO FSS and FS could be modified to further promote flexible use in this band, stimulate investment, and encourage more intensive deployment in the 3.7-4.2 GHz band for wireless broadband.

17. In 2016, the Fixed Wireless Communications Coalition (FWCC) filed a petition for rulemaking proposing, among other things, modifications to the coordination procedures that govern FSS and FS coexistence in the 3.7-4.2 GHz band.²⁸ According to FWCC, the current procedures are spectrally inefficient because new or modified FS links are not allowed to use fallow spectrum in the band even if there would be no harmful interference to any existing Earth-station operations. Satellite and programming/content distributors oppose FWCC's proposals²⁹ while most of the other commenters

²¹ See, e.g., IBFS File Nos. SES-REG-20020821-01447 (Comcast of Connecticut, Inc.), SES-REG-20110427-00510 (Charter Communications, LLC), and SES-REG-20130318-00270 (CBS Radio Stations Inc.).

²² See 47 CFR § 101.147(h). 4.190 GHz may also be assigned for unpaired use. 47 CFR § 101.147(h), note 1.

²³ See *Spectrum Usage for the Fixed Services*, NTIA Report 00-378, at 52.

²⁴ Approximately 14,000 receive earth stations were sharing the 3.7-4.2 GHz band with over 39,000 terrestrial channel assignments during a peak period in 1988 and 9,500 transmit uplink earth stations coexisted with almost 27,000 terrestrial channel assignments during the same period. See *A Preliminary Look at Spectrum Requirements for the Fixed Services*. U.S. Department of Commerce Institute for Telecommunication Sciences Boulder Colorado, May 1993.

²⁵ Earlier, as the 3.7-4.2 GHz band filled up, the overflow went into the 6 GHz band, which was designed to share waveguides and antennas with the 4-GHz network. See NTIA Report 00-378, at 52.

²⁶ "In the 3700-4200 MHz band, terrestrial fixed links have problems sharing with fixed satellite downlinks. The existing fixed terrestrial links are leaving this band at a rapid rate, and the lack of any new narrowband channelization suggests that this band is likely to be relatively lightly used by terrestrial fixed systems in the future." *Spectrum Usage for the Fixed Services*, NTIA Report 00-378 at 8.

²⁷ There are 109 licenses in the Common Carrier Fixed Point-to-Point Microwave Service (41 of which authorize temporary fixed stations to use the 3.7-4.2 GHz band in a large geographic area, e.g., multi-state areas), one license in the Local Television and Transmission Service, and nine licenses in the Microwave Industrial/Business Pool.

²⁸ See FWCC Coordination Petition, *supra* note 15.

²⁹ SES Americom, Inc., Petition to Dismiss or Deny, RM-11778 (Jan. 9, 2017); Satellite Industry Association, Petition to Dismiss or Deny, RM-11778 (Jan. 9, 2017); EchoStar Satellite Operating Corporation and Hughes Network Systems, LLC, Opposition, RM-11778 (Jan. 9, 2017); Intelsat License LLC, Opposition, RM-11778 (Jan. 9, 2017). See also Content Companies Letter, RM-11778, opposing FWCC's Petition (Jan. 24, 2017).

support FWCC's call for a reexamination of the coordination procedures.³⁰ Most of these other commenters also support "a broad inquiry about rule changes that could support more intensive terrestrial fixed use of the 3.7-4.2 GHz range"³¹ or additional shared uses of these bands while protecting incumbent operations from harmful interference.³² On June 21, 2017, several of these commenters and others jointly filed a petition for rulemaking to authorize and facilitate the deployment of licensed point-to-multipoint fixed wireless broadband service in the 3.7-4.2 GHz band.³³

18. We seek comment on whether to alter our existing service rules to permit more intensive fixed use in the 3.7-4.2 GHz band by allowing for the deployment of point-to-multipoint FS broadband services and by making the band more viable for shorter, last-mile point-to-point FS. Commenters are urged to propose specific changes to coordination requirements and technical and operational rules, and to suggest mechanisms for sharing between FSS and FS. Commenters should also address how any proposed rule changes would affect existing and future FSS operations, including possible approaches for mitigating harmful interference between different services.

3. Options for mobile broadband use

19. In addition to considering whether to modify the service rules to support more flexible point-to-point and point-to-multipoint use in the 3.7-4.2 GHz band, we also invite comment on whether this band is desirable or suitable for mobile use. Is the 3.7-4.2 GHz band well suited for future mobile broadband deployments?

20. We note that the Commission has previously permitted mobile service in other bands shared with fixed terrestrial and FSS users and we seek comment on how the experiences of licensees in such shared bands may inform Commission policy in the 3.7-4.2 GHz band. We recognize that FSS earth station deployment in the 3.7-4.2 GHz band is much more significant than in these other bands.³⁴ Do incumbent FS and FSS operations in this band present specific challenges to mobile use that are not present in other bands that are shared with these types of incumbent licensees? Are there recent technological advancements that could facilitate the deployment of mobile services and minimize the potential for harmful interference between different types of services in the band? Are there recent—or anticipated—equipment features that could enhance the potential for mobile service in this band? Commenters should address the costs and benefits of mobile use in the band and provide detailed technical and economic data to support their suggestions.

4. Changes to terrestrial service rules to promote flexible use

21. We seek comment on how the service rules governing the 3.7-4.2 GHz band could be modified to encourage the efficient use of spectrum resources. Specifically, what licensing and service

³⁰ See also Mimoso Networks, Inc., Comments, RM-11778 (Jan. 9, 2017); Wireless Internet Service Providers Association, Comments, RM-11778 (Jan. 9, 2017); Nokia, Comments, RM-11778 (Jan. 9, 2017); New America's Open Technology Institute and Public Knowledge, Comments, RM-11778 (Jan. 9, 2017); Google Fiber Comments, RM-11778 (Jan. 9, 2017); Federated Wireless, Inc., Comments, RM-11778 (Jan. 9, 2017); Dynamic Spectrum Alliance, Comments at 2, RM-11778 (Jan. 10, 2017).

³¹ Google Fiber Comments at 7, RM-11778 (Jan. 9, 2017); *see also id.*

³² New America's Open Technology Institute and Public Knowledge, Comments at 7-8, RM-11778 (Jan. 9, 2017). *See also* Dynamic Spectrum Alliance, Comments at 2, RM-11778 (Jan. 10, 2017).

³³ See BAC Petition.

³⁴ See, e.g., 47 CFR § 27.2(a); *AWS-3 Report and Order*, 29 FCC Rcd at 4650-51, para. 108, 4652, para.112 (licensing AWS-3 spectrum under Part 27 and providing AWS-3 licenses with the flexibility to provide any fixed or mobile service that is consistent with the allocations for the spectrum); *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, GN Docket No. 12-354, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959, 3972, para. 34 (adding primary fixed and mobile allocations to the 3.55-3.65 GHz band in the non-federal table).

rules would effectively facilitate coexistence between various licensees in the band and facilitate the deployment of new broadband networks? Are there particular licensing frameworks or technical rules that would more effectively promote investment in the band? Are there opportunities to create higher-capacity links by licensing larger channels in the band for FS or mobile? Are there pairing opportunities between this band and other spectrum bands for fixed or mobile services? We encourage commenters to discuss how potential modifications to the service rules could promote more robust and efficient use of spectrum resources, minimize the potential for harmful interference, and maximize flexibility for licensees to meet the needs of their end users. Would any specific terrestrial channel size(s) facilitate coordination with incumbent FSS?

22. Given the extensive incumbent use of this band, are there opportunities to incentivize relocation or repacking of incumbent licensees to make more spectrum available for flexible broadband use? We also seek comment on innovative approaches to promote coexistence between users and minimize the potential for harmful interference between and among licensees in the band. For example, would elements of the database-supported authorization framework used for the Citizens Broadband Radio Service in the 3.55-3.7 GHz band be appropriate here?³⁵ Are there alternate approaches that could better address the unique ecosystem of the 3.7-4.2 GHz band? Commenters should provide detailed descriptions of their proposals for protecting incumbent operations in the band.

23. We also seek comment on the unique challenges and opportunities that may be presented by the addition of mobile broadband services to the 3.7-4.2 GHz band and the effect that these services may have on the appropriate service rules. Would the addition of mobile services change the appropriate licensing and authorization framework? We seek comment on the costs and benefits of any authorization framework proposed for mobile services considering the existing deployments in the band.

B. 5.925-6.425 GHz Band

1. Current uses

24. The 500 megahertz of bandwidth in the 5.925-6.425 GHz band is currently allocated in the United States exclusively for non-Federal use on a primary basis for FSS (Earth-to-space) and FS. For FSS, the 5.925-6.425 GHz band (Earth-to-space) is associated with the 3.7-4.2 GHz band (space-to-Earth) and referred to collectively as the conventional C-band. There are about 1,535 earth station licenses in the 5.925-6.425 GHz band. While most of the earth stations operate at fixed locations, earth stations on vessels also operate in this band on a primary basis.³⁶ Additionally, one licensee, Higher Ground, has been granted a waiver to operate mobile devices that transmit to geostationary satellites to provide consumer-based text messaging/light email and Internet of Things (IoT), protecting terrestrial operations by using a database-driven, permission-based, self-coordination authorization system.³⁷ The 5.925-6.425 GHz band is also used for the transmission of command signals transmitted by Earth stations, typically near 5.925 or 6.425 GHz.

25. The 5.925-6.425 GHz band is also heavily used for FS. FS licensees may be authorized to operate point-to-point microwave links with up to 120 megahertz of paired spectrum for each authorized path. Individual paired channels may be assigned in specified bandwidths ranging from 400 kilohertz up to 60 megahertz.³⁸ The Commission's licensing records reflect that more than 27,000

³⁵ *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, GN Docket No. 12-354, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959 (2015).

³⁶ 47 CFR § 2.106 footnote NG181.

³⁷ *See Higher Ground LLC Application for Blanket Earth Station License*, IBFS File No. SES-LIC-20150616-00357, Order and Authorization, 32 FCC Rcd 728 (IB/WCB/OET 2017) (Applications for Review pending).

³⁸ *See* 47 CFR § 101.147(i). Certain frequencies are also available for unpaired use.

licenses are issued for point-to-point operations in this band.³⁹ FS operations support a variety of critical services such as public safety (including backhaul for police and fire vehicle dispatch), coordination of railroad train movements, control of natural gas and oil pipelines, regulation of electric grids, and backhaul for commercial wireless traffic.

2. Potential for flexible use

26. We seek comment on the potential for additional flexible wireless broadband use in the 5.925-6.425 GHz band, taking into consideration existing and future incumbent uses as well as compatibility with adjacent band services. Specifically, since the 5.925-6.425 GHz band is close to spectrum that we have designated for Unlicensed National Information Infrastructure (U-NII) use, it may be possible and technically beneficial for U-NII devices to operate in both this band and the existing U-NII spectrum. This would allow the devices to operate with wider channel bandwidths and higher data rates as well as with increased flexibility for all types of unlicensed operations.

27. U-NII devices are unlicensed devices that currently operate in the 5.15-5.35 GHz and 5.47-5.725 GHz bands. As unlicensed devices, U-NII equipment operates under our Part 15 rules.⁴⁰ Devices operating pursuant to Part 15 generally share spectrum with allocated radio services, and must operate on a non-interference basis.⁴¹ That is, these unlicensed devices shall not cause, nor claim protection from, harmful interference, vis-à-vis allocated radio services and authorized users. The devices must meet technical requirements or standards designed to minimize the risk of harmful interference and thus provide manufacturers the flexibility to introduce a wide variety of devices for virtually any type of application. This approach has enabled the introduction and explosive growth of various technologies, including Wi-Fi.

28. In 2013, the Commission sought comment on making additional spectrum available for U-NII devices in the 5.35-5.47 GHz and 5.85-5.925 GHz bands.⁴² However, NTIA has recently concluded that there is no viable solution for U-NII devices to share the 5.35-5.47 GHz band with incumbent Federal systems.⁴³ The Commission is currently evaluating the feasibility of U-NII devices sharing the 5.85-5.925 GHz band with Dedicated Short Range Communications (DSRC) systems operating under the Intelligent Transportation Service (ITS).⁴⁴

29. We invite commenters to discuss whether unlicensed use may be expanded within the 5.925-6.425 GHz band either under our rules governing U-NII devices or under other provisions that would be implemented under our Part 15 rules. Unlicensed devices would need to protect the licensed

³⁹ Each of these licenses authorizes one or multiple point-to-point links. A small number of these licenses (71) authorize temporary fixed stations to use the 5.925-6.425 GHz band in a large geographic area, e.g., multi-state areas.

⁴⁰ 47 CFR § 15.401.

⁴¹ 47 CFR § 15.5(b).

⁴² *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Notice of Proposed Rulemaking, 28 FCC Rcd 1769, 1770, para. 2 (2013).

⁴³ Lawrence E. Strickling, Assistant Secretary of Commerce for Communications and Infrastructure, Remarks on the 5G Wireless Future and the Role of the Federal Government at the Hudson Institute (Dec.) <https://www.ntia.doc.gov/speechtestimony/2016/remarks-assistant-secretary-strickling-5g-wireless-future-and-role-federal>.

⁴⁴ *Office of Engineering and Technology Announces Schedule for Testing Prototype U-NII-4 Devices*, Public Notice, 31 FCC Rcd 10518 (2016); *The Commission Seeks to Update and Refresh the Record in the "Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band" Proceeding*, Public Notice, 31 FCC Rcd 6130 (2016). DSRC uses short-range wireless communication links to facilitate information transfer between appropriately equipped vehicles and appropriately equipped roadside systems and between appropriately equipped vehicles.

services that operate in the band. Because the FSS operates in the Earth-to-space direction in this band, FSS earth stations would not receive interference from unlicensed devices. However, the aggregate energy from large numbers of unlicensed devices would need to be evaluated from the perspective of potential interference to satellite receivers. Unlicensed devices would also need to avoid causing interference to FS licensees. If the Commission allowed unlicensed use in the 5.925-6.425 GHz band, would it be feasible for the Commission to adopt techniques to mitigate the risk of interference from unlicensed devices to licensed services? For example, could we limit the unlicensed devices to operate at a lower power than has traditionally been permitted by our rules, restrict the types of antennas permitted, limit the EIRP toward the geostationary arc,⁴⁵ allow only indoor use,⁴⁶ or require the devices to have a geo-location capability and means to access a database to determine whether they may transmit?⁴⁷ Commenters that address the potential expansion of U-NII to this band should discuss how the devices would operate without causing interference to licensed services. We also invite comment on whether it may be viable to realign or retune existing incumbent operations in this band to make more efficient use of this spectrum and better facilitate sharing. Commenters advocating realignment or retuning of incumbent operations must address the costs and benefits of doing so, including possible reimbursement mechanisms.

30. In considering unlicensed use of the 5.925-6.425 GHz bands, we seek to better understand commenters' experiences in using existing spectrum that has been made available for unlicensed use. In particular, within the 580 megahertz of spectrum available in the U-NII bands, the most active use appears to have congregated in discrete portions of the bands not subject to dynamic frequency selection (DFS) requirements (such as the 5.25-5.35 GHz and 5.47-5.725 GHz bands).⁴⁸ This trend appears to increase the prospect of congestion within the most intensely used portions of the U-NII bands, where DFS is not required. While we do not anticipate modifying our DFS requirements, we are interested in the U-NII industry's experience in deploying equipment with DFS. Though we are not currently contemplating changes to the DFS rules, we seek to better understand whether DFS is providing meaningful access to spectrum. How are the bands subject to DFS requirements currently being used by U-NII devices? What are the costs of developing and deploying U-NII devices in these bands compared to those bands with no DFS requirement? Is the testing regime used to certify the DFS functionality of devices, required to protect incumbent users as established by the Commission rules, a disincentive to developing and deploying U-NII devices in these bands? Have particular implementations of the DFS requirements been more effective at detecting radar signals or more economical to implement than others?

31. The 5.925-6.425 GHz band may also be suitable for licensed wireless broadband. As with the 3.7-4.2 GHz band, the licensed broadband services would have to coexist with FS licensees

⁴⁵ We have adopted power restrictions on U-NII operations based on elevation angle in the 5.150-5.250 GHz band to limit potential interference to satellite receivers. *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, 29 FCC Rcd 4127, 4137-38, paras. 36-37 (2014).

⁴⁶ Prior to 2014, U-NII devices in 5.15-5.25 GHz were restricted to indoor operation. *Id.* at 4137, para. 34. If we restrict U-NII devices in this band only to indoor operations, how should we define the indoor locations where they will be permitted to operate? How could the devices be prevented from operating outdoors?

⁴⁷ The Commission's Part 15 rules allow unlicensed devices to operate in the TV bands at locations where frequencies are not in use by licensed services. 47 CFR Part 15 subpart H. These devices are required to check a database at least once a day to determine on which channels they may operate. 47 CFR § 15.711(b)(3)(i).

⁴⁸ 47 CFR § 15.407(h)(2); *Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band*, Report and Order, 18 FCC Rcd 24484, 24497-98, paras. 39-32 (2003). DFS is required to avoid causing interference to radar systems which share the bands. Prior to the start of any transmission, a U-NII device equipped with DFS capability must continually monitor the radio environment for radar's presence. If the U-NII device determines that a radar signal is present, it must either select another channel to avoid interference with radar, or go into a "sleep mode" if no other channel is available.

operating in the band. Licensed broadband services would also have to coexist with transmitting FSS earth stations. We seek comment broadly on how this band could be used for licensed fixed and mobile broadband services. For example, would it be advantageous to pair this band with the 3.7-4.2 GHz band? Commenters addressing licensed wireless broadband in the 5.925-6.425 GHz band should also address how the band may coexist with existing services. We encourage commenters to address the same questions raised previously with regard to the 3.7-4.2 GHz band in any proposal for expanded flexible use of the 5.925-6.425 GHz band.

C. 6.425-7.125 GHz

1. Current uses

32. The 700 megahertz of bandwidth in the 6.425-7.125 GHz band is currently allocated in the United States exclusively for non-Federal use on a primary basis for FS at 6.525-7.125 GHz, Mobile Service at 6.425-6.525 GHz and 6.875-7.125 GHz, and FSS at 6.425-6.700 GHz and 7.025-7.075 GHz for uplink and at 6.700-7.025 GHz for both uplink and downlink.⁴⁹

33. FSS operations in the 6.425-7.125 GHz band (earth-to-space) are less intensive than in the 5.925-6.425 GHz band. In the 6.615-6.687 GHz band, currently the only Commission authorization is for feeder links for one radionavigation satellite.⁵⁰ FSS operations in the 6.700-7.075 GHz band (space-to-Earth) are limited by rule to feeder links for NGSO MSS in the space-to-Earth direction,⁵¹ while in the band 7.025-7.075 GHz such operations are further limited to two grandfathered satellite systems.⁵² Currently there are about 65 FSS earth station licenses in the 6.425-7.075 GHz band. One foreign-licensed FSS space station is authorized for U.S. market access in the Earth-to-space direction in the 6.725-7.025 GHz band.⁵³

34. Mobile operations are permitted in the 6.425-6.525 GHz band in channel bandwidths ranging from 1 megahertz to 25 megahertz licensed pursuant to parts 74 (BAS), 78 (CARS), and 101 (mobile including Local Television Transmission Service) of our rules.⁵⁴ Mobile operations are also permitted in the 6.875-7.125 GHz band.⁵⁵ The Commission's licensing records reflect that 139 BAS, 26 CARS, and 243 Part 101 licenses are issued for mobile operations in the 6.425-6.525 GHz band, and 346 BAS, 19 CARS, and 38 Part 101 licenses are issued for mobile operations in the 6.875-7.125 GHz band.

35. For fixed operations, FS licensees in the 6.525-6.875 GHz and 6.875-7.125 GHz bands may be authorized to operate point-to-point microwave links on paired channels assigned in specified bandwidths ranging from, respectively, 400 kilohertz to 30 megahertz and 5 megahertz to 25 megahertz.⁵⁶ Fixed BAS operations are also authorized in these bands. The Commission's licensing records reflect that approximately 18,000 and 4900 licenses have been issued for point-to-point operations, respectively, in the 6.525-6.875 GHz and 6.875-7.125 GHz bands. The FS and BAS operations in these bands support a variety of critical services such as public safety (including police and fire vehicle dispatch), coordination of railroad train movements, control of natural gas and oil pipelines,

⁴⁹ FSS is allocated to use 325 megahertz of spectrum for uplink only and 325 megahertz of spectrum for uplink or downlink.

⁵⁰ See IBFS File No. SAT-LOA-19990427-00046, Call Sign S2371.

⁵¹ 47 CFR § 2.106, 5.458(B).

⁵² 47 CFR § 2.106, NG172.

⁵³ See IBFS File No. SAT-PPL-20160722-00064, Call Sign S2969.

⁵⁴ See 47 CFR §§ 74.602(i), 78.18(a)(5), 101.147(j), 101.803(a).

⁵⁵ See 47 CFR §§ 74.602(a), 78.18(a)(7), 101.803(b).

⁵⁶ See 47 CFR §§ 74.602(a), 101.147(k).

regulation of electric grids, backhaul for wireless traffic, television studio-transmitter links (STLs), television relay, and television translator relay stations.

2. Potential for more intensive fixed or flexible use

36. We seek comment, generally, on the potential for more intensive FS or mobile use of the 6.425-7.125 GHz band. We note that the 6.425-7.075 GHz band is less heavily used by FSS than, for example, the 3.7-4.2 GHz and 5.925-6.425 GHz bands, and that there is no FSS allocation in the United States in the 7.075-7.125 GHz band. We also note that 350 megahertz of the 6.425-7.125 GHz band is allocated for mobile. We seek comment on whether, these factors could make it easier—relative to other frequency bands—for new FS or mobile operators to coordinate and share the 6.425-7.075 GHz band with incumbent operators. We ask that commenting parties provide specific proposals to modify existing allocation, technical and service rules. We note that the 6.425-6.725 GHz band is an extended C-band uplink band paired with the extended C-band downlink band at 3.6-3.7 GHz, which the Commission recently made available for expanded terrestrial fixed and mobile use.⁵⁷ Does this development facilitate the opportunity for more intensive use of the 6.425-6.725 GHz band for FS or mobile service? Would the 6.425-7.125 GHz band or specific subsets of this band be a viable expansion opportunity for U-NII or for other unlicensed operations? What sharing techniques can be used for FS and mobile to coexist with current FSS, FS, and mobile operations? We also invite comment on issues raised in our discussion of more intensive use of the 3.7-4.2 GHz band to the extent they have relevant application to more intensive use of the 6.425-7.075 GHz band.

D. Expanding wireless broadband access in other bands

37. *Flexible Use in Other Bands Within the 3.7 to 24 GHz Range.* In addition to the specific spectrum bands discussed above, we seek comment on other potential opportunities for expanded flexible broadband use, on a licensed or unlicensed basis, particularly in non-federal and shared bands between 3.7 and 24 GHz. Consistent with established coordination practices, any viable proposals for flexible use in spectrum bands allocated for both federal and non-federal use will need to be carefully evaluated by both the Commission and NTIA, taking into consideration the resources necessary to study such bands. We ask commenters to identify other bands that might be suitable candidates for deployment of wireless broadband access. As part of any proposal, we encourage commenters to explain the demand for and specific needs that a particular band would serve. Specifically, we seek comment on the key characteristics that make particular bands suitable for wireless broadband. Commenters should address the circumstances they would expect to face in deploying systems in bands they identify, such as the costs of such deployments, the availability and/or development of necessary technology, the desired timeframe for licensing and initiating service, and any suggested methods for balancing the needs for licensed and unlicensed access approaches. Commenters should also identify current non-federal users of candidate bands, the intensity of such uses as best understood, anticipated future growth of these uses, and feasible options for coexisting with or relocating them. As stated previously, we will give priority to requests targeting exclusive non-federal bands and request input from prospective new entrants and existing incumbents.

38. *Rule Modifications.* We seek comment on whether modification of any service rules applicable to spectrum bands between 3.7 and 24 GHz that were not discussed above presents an opportunity for more intensive and efficient use of this spectrum. Are there additional service rules that could be altered to promote more intensive and efficient use of spectrum between 3.7 and 24 GHz? Commenters should identify specific rules, suggest modifications, and explain how a rule's modification would further the public interest. In doing so, commenters should consider the effects of any such proposals on incumbent operations and consumers. Commenters should address how their proposals

⁵⁷ The extended C-band is the 3.6-3.7 GHz (space-to-Earth), 5.85-5.925 GHz (Earth-to-space), and 6.425-6.725 GHz (Earth-to-space) FSS frequency bands. 47 CFR § 25.103 (Definitions). The 3.6-3.7 GHz band is available for terrestrial use under Part 96 of the Commission's rules (Citizens Broadband Radio Service).

could affect existing operators in the band and propose appropriate approaches to mitigate any harmful effects.

39. *Elimination of Rules.* Are there any service rules that could be eliminated to reduce regulatory burdens and promote more intensive and efficient non-federal use of other spectrum bands between 3.7 and 24 GHz? If so, commenters should identify any such rule and explain how the elimination of a particular rule would encourage additional flexible use and deployment of new services or otherwise advance the public interest, and explain why the rule is unnecessary and why its elimination would not detrimentally affect other users. Commenters should consider both the costs and benefits of the elimination of a particular rule and demonstrate how the increased deployment would outweigh the reason for adoption of the rule. Are there opportunities to increase deployment of new services, particularly in rural, remote, and/or economically challenged areas, by eliminating specific rules in defined geographic zones where application is unnecessary to achieve the general rule's purpose?

40. *Updating Allocations to Reflect Technological Progress.* We also seek comment on how developing technologies may enable spectrum to be used more efficiently and intensively for flexible-use operations in non-federal and shared bands between 3.7 and 24 GHz not already discussed above. For example, spectrum in the 2 GHz range that is now used extensively for broadband PCS and AWS was, prior to 1992, allocated to the FS and used for fixed, point-to-point services.⁵⁸ To accommodate the new uses, the Commission added Mobile allocations to the bands. Based on this example, are there recent or upcoming technological developments that may present similar opportunities for spectrum between 3.7 and 24 GHz to be used more flexibly while accommodating the communication requirements of incumbents? If so, commenters should describe these technologies in detail along with any associated allocation changes needed to enable the new opportunities that they present.

41. *Incentives to Increase Efficient Spectrum Use.* We seek comment on types of large-scale incentives for non-federal users that could be used to increase the flexibility of existing non-federal allocations and remove outdated or inefficient assignments. In particular, we seek comment on whether auctions or incentive auctions could be used to increase the availability of flexible use spectrum in such bands within the 3.7 to 24 GHz range.⁵⁹ Building on the Commission's recent experiences with the Broadcast Incentive Auction, under what circumstances could a similar approach be used to encourage incumbent non-federal licensees to relinquish their licenses in exchange for incentive payments? How should the Commission structure such an auction to promote robust use of the spectrum? Are such market-based relocation approaches inappropriate for certain services, such as public safety services? If not, how should public safety needs for alternative spectrum and funding of relocation costs best be accommodated? Should the Commission instead focus on holding traditional spectrum auctions in cases where sharing is undesirable? If so, how could incumbent users' reasonable expectations be accommodated? For example, could the Commission auction flexible-use licenses with an obligation to protect or relocate incumbent systems, as was done in the broadband PCS reallocation where new licensees negotiated with incumbent microwave systems?⁶⁰ Alternatively, we seek comment on whether the Commission should grant additional flexibility to incumbent licensees to promote more efficient use of a given band. How do the costs and benefits of granting additional flexibility to an incumbent licensee

⁵⁸ See, e.g., *Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies*, ET Docket No. 92-9, First Report and Order and Third Notice of Proposed Rule Making, 7 FCC Rcd 6886, 6891-92, para. 31 (1992).

⁵⁹ See 47 U.S.C. § 309(j)(8)(G) (Commission may encourage a licensee to relinquish voluntarily some or all of its licensed spectrum usage rights to permit the assignment of new initial licenses subject to flexible use service rules by sharing with the licensee a portion of the proceeds from an auction, with the licensee's potential share based on the value of the relinquished rights as determined in the reverse auction provided that at least two competing licensees participate in the reverse auction).

⁶⁰ *Amendment of the Commission's Rule Regarding a Plan for Sharing the Costs of Microwave Relocation*, WT Docket No. 95-157, First Report and Order and Further Notice of Proposed Rulemaking, 11 FCC Rcd 8825 (1996).

compare to the costs and benefits of relocation or the use of overlay licenses? Under what circumstances would one approach be more efficient?

42. *Relocation of Incumbent Users to Enable Spectrum Access.* For the long term, are there opportunities to consider relocating some non-federal incumbent users of the 3.7 to 24 GHz bands to alternate spectrum, similar to the Commission's approach in the Emerging Technologies Proceeding?⁶¹ To what extent could the Commission use a tool similar to the Spectrum Relocation Fund to compensate non-federal incumbent users for the costs associated with relocation? Should a third-party clearinghouse be used for these purposes and, if so, what duties should be assigned to this body?

43. *Long-Term Strategies to Promote Flexible Use Opportunities.* We invite commenters to discuss long-term (*i.e.*, beyond 10 years) approaches for promoting expanded spectrum access, increasing flexibility, and promoting future investment in the bands between 3.7 and 24 GHz. Are there opportunities to increase flexible spectrum use by realigning non-federal allocations? Are there steps we can or should take to mitigate interference between or among currently shared or adjacent allocations? For any identified opportunities, commenters are asked to discuss what methods should be used to determine how like services should be grouped, and how much spectrum should be allocated to particular types of uses.

IV. PROCEDURAL MATTERS

A. *Ex parte* presentations

44. This proceeding shall be treated as a "permit-but-disclose" proceeding in accordance with the Commission's *ex parte* rules.⁶² Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter's written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with Rule 1.1206(b). In proceedings governed by Rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (*e.g.*, .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules.

B. Comment filing procedures

45. Pursuant to sections 1.415 and 1.419 of the Commission's rules, 47 CFR §§ 1.415, 1.419, interested parties may file comments and reply 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). See *Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- Electronic Filers: Comments may be filed electronically using the Internet by accessing the ECFS: <http://apps.fcc.gov/ecfs/>.

⁶¹ *Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies*, ET Docket No. 92-9, Second Report and Order, 8 FCC Rcd 6495 (1993).

⁶² 47 CFR. §§ 1.1200 *et seq.*

- Paper Filers: Parties who choose to file by paper must file an original and one copy of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.

Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.

- All hand-delivered or messenger-delivered paper filings for the Commission's Secretary must be delivered to FCC Headquarters at 445 12th St., SW, Room TW-A325, Washington, DC 20554. The filing hours are 8:00 a.m. to 7:00 p.m. 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 overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9300 East Hampton Drive, Capitol Heights, MD 20743.
- U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12th Street, SW, Washington DC 20554.

46. People with Disabilities: To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to fcc504@fcc.gov or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (tty).

V. ORDERING CLAUSE

47. Accordingly, IT IS ORDERED, pursuant to Sections 1, 303(g), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 303(g), and 403, and Section 1.430 of the Commission's rules, 47 CFR § 1.430, that this NOTICE OF INQUIRY IS ADOPTED.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

**STATEMENT OF
CHAIRMAN AJIT PAI**

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

Usually, we don't think of the "middle" as the best place to be. The middle seat. Middle-child syndrome. The middleman. And, as anyone who has seen *Reservoir Dogs* knows, one doesn't want to be "Stuck in the Middle with You."

However, that calculus changes when we're talking about spectrum. That's why the FCC is looking to free up mid-band spectrum for wireless innovation. As the world goes wireless, as consumers rely ever more heavily on their mobile devices, we need to keep up—and that means in part looking at spectrum bands "in the middle," where the FCC historically hasn't focused.

In addition to asking more general questions about the potential uses of mid-range spectrum, this proceeding specifically asks about the C band (3.7–4.2 GHz and 5.925–6.425 GHz) and the upper 6 GHz band (6.425–7.125 GHz). We want to know how existing rules can be modified to promote additional access to these "middle" bands. We want to hear whether and how these bands can enable wireless broadband services and economic growth.

This *Notice of Inquiry* is just the beginning of our efforts to free up more mid-band spectrum for flexible wireless use. We aim to close the mobile digital divide so that American consumers, especially in rural areas, won't be eternally "stuck in the middle" of dead or spotty wireless service zones. And along the way, we hope to boost investment, job creation, and our nation's global competitiveness.

There was nothing middling about the team effort from the FCC staff on this item. Thank you to all those who pitched in. From the Wireless Telecommunications Bureau: Stephen Buenzow, Peter Daronco, Jessica Greffenius, Nese Guendelsberger, Joyce Jones, Roger Noel, Matthew Pearl, Paul Powell, Blaise Scinto, Dana Shaffer, Don Stockdale, Joel Taubenblatt, and Brian Wondrack. From the Office of Engineering and Technology: Michael Ha, Julius Knapp, Nicholas Oros, Jamison Prime, and Ron Repasi. From the International Bureau: Jennifer Gilsean, Michael Mullinix, Robert Nelson, Jim Schlichting, and Thomas Sullivan. From the Public Safety and Homeland Security Bureau: David Furth and Renee Roland. From the Enforcement Bureau: Jeremy Marcus. From the Media Bureau: Thomas Horan. And from the Office of General Counsel: Deborah Broderson and David Horowitz.

**STATEMENT OF
COMMISSIONER MIGNON L. CLYBURN**

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

There is no question that the demand for wireless broadband services is increasing at a very fast clip. The latest data from the Cisco Visual Networking Index (VNI) shows that traffic from wireless and mobile devices will account for more than 63 percent of total Internet Protocol (IP) traffic by 2021, and mobile data traffic is predicted to increase sevenfold between 2016 and 2021.

In recent years, the Commission has initiated various proceedings aimed at ensuring that we have adequate spectrum to meet consumers' growing reliance on wireless services. We have looked high, we have looked low – but today we look in the middle.

In this item, we commence an exploration of mid-range spectrum bands between 3.7 and 24 GHz for flexible use with a specific focus on wireless broadband services. We highlight three bands that have already been the subject of domestic and international study for detailed comment, namely 3.7-4.2 GHz, 5.925-6.425 GHz and 6.425-7.125 GHz, and we solicit input on other mid-band spectrum that can be utilized to unleash new opportunities for flexible licensed and unlicensed wireless broadband use cases.

We recognize that these mid-range spectrum bands support a wide variety of important uses, and accordingly ask commenters to provide detailed descriptions of how they plan to protect incumbents in the band. We also seek comment on steps that can or should be taken to mitigate interference between or among currently shared or adjacent allocations.

The unique properties of mid-band spectrum make it particularly attractive for deployment of next-generation wireless services. And as we continue to explore and invent innovative and expedient wireless use cases to enhance and enrich our lives, from telehealth and distance learning to smart cities and IoT, we can clearly see that mid-band spectrum is not just important, but instrumental to unleashing the promise of 5G and beyond.

As this agency seeks to meet consumers' insatiable appetite for wireless broadband services, I am grateful to the staff of the Wireless Telecommunications Bureau and the Office of Engineering and Technology for your continuing efforts to make sure no band of spectrum is unexplored.

**STATEMENT OF
COMMISSIONER MICHAEL O'RIELLY**

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

The next generation of wireless networks is right on the horizon, and the Commission has acted to facilitate its development and deployment. From 600 MHz and millimeter wave to infrastructure, the Commission has taken, or is in the process of considering, the necessary steps to open new spectrum bands and reduce the regulatory hurdles that are delaying or preventing small cell siting. However, the Commission had not officially considered potential mid-band spectrum opportunities. Today, we rectify this need.

While our action in no way minimizes the importance of freeing up millimeter wave frequencies, it quickly became apparent at this year's Mobile World Congress that many countries were focusing on mid-band spectrum for next-generation networks. For instance, Europe has identified 3.4 to 3.8 GHz as its primary band for early 5G development. Japan, Korea and China are also proponents of using frequencies in this range, with Japan possibly looking to extend 5G up to 4.2 GHz.

Generally, interested parties should take this opportunity to discuss any and all bands of interest between 3.7 and 24 GHz – which we are calling mid band – that can be used for wireless broadband. But, this notice specifically focuses on the domestic use of the 3.7 to 4.2 GHz band, which the U.S. wireless industry has identified for 5G given its underutilization by incumbent licensees.

It is hard not to see that the mid bands targeted for 5G include frequencies that are also part of our 3.5 GHz band. As you know, we are in the process of revisiting the 3.5 GHz priority access licenses (PALs) to ensure they provide the appropriate vehicle for innovation and investment. Ultimately, the potential of combining PALs with the nearby 3.7 to 4.2 GHz band for mobile services may permit limitless opportunities for manufacturers and wireless providers, to the benefit of American consumers. And, the action we take today will facilitate the international harmonization of these bands and help the U.S. maintain its global leadership in wireless technologies.

Moreover, the notice also seeks comment on additional uses for the 6 GHz band, which is adjacent to the unlicensed 5 GHz band. It could provide, for example, a great opportunity to relieve the already congested 2.4 and 5 GHz unlicensed bands. The potential is even greater if the 5.9 GHz band is made available for unlicensed use.

For these reasons, I am pleased to support today's item. I look forward to engaging on this topic, reading of the myriad possibilities for mid-band spectrum, and the various ideas of how incumbents can be accommodated, either through relocation or appropriate protection mechanisms. I do ask that we expedite this proceeding. The consideration of the 3.7 to 4.2 and 6 GHz bands was likely ripe for a notice of proposed rulemaking rather than the notice of inquiry route, so I hope at a minimum we will push these bands forward as quickly as possible.