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Dynamic Spectrum Alliance

Initial Comments in FCC's Spectrum Frontiers FNPRM

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Introduction

On July 14, 2016, the FCC released a Report and Order and Further Notice of Proposed Rulemaking (R&O and FNPRM) regarding the use of certain spectrum bands above 24 GHz. In the R&O portion of the decision (¶¶ 17-368), the FCC made available nearly 11 GHz of high-frequency spectrum by creating a new Part 30 Upper Microwave Flexible Use (UMFU) service in the 28 GHz (27.5-28.35 GHz), 37 GHz (37-38.6 GHz), and 39 GHz (38.6-40 GHz) bands, and a new unlicensed band at 64-71 GHz. The rules adopted in the R&O include exclusive use licensing, shared access, and unlicensed access.

In the FNPRM portion (¶¶ 369-516), the FCC proposed flexible service rules for an additional 17.7 GHz of spectrum in various frequency bands. The FNPRM generally recommends applying licensing, service, and technical rules that are similar to those established in the R&O. (R&O Appendix G) For each of these bands, the FCC seeks comment on its proposal as well as alternative licensing mechanisms, including unlicensed operation. The FCC seeks comment on sharing mechanisms, including Spectrum Access Systems (SASs). The FNPRM also seeks comment on (1) 37 GHz band federal/commercial sharing, (2) Internet of Things (IoT) and machine-to-machine performance requirements, (3) mobile spectrum holding policies, (4) mmWave antenna height limits, (5) bandwidth scaling factors for transmitter power limits, (6) power flux density (PFD) levels for Fixed-Satellite Service (FSS) in the 37 and 39 GHz bands, (7) coordination limits for point-to point operations, and (8) sharing analysis and modeling.

I. DSA'S Interest in this Proceeding

The Dynamic Spectrum Alliance (DSA) is a global organization advocating for laws and regulations that will lead to more efficient and effective spectrum utilization. Our membership spans multinationals, small-and medium-sized enterprises, and academic, research, and other organizations from around the world, all working to create innovative solutions that will increase the amount of available spectrum to the benefit of consumers and businesses alike. Our primary goals are to close the digital divide by reducing the cost of deploying last-mile wireless networks, freeing up an ample supply of spectrum for innovative uses, enabling the Internet of Things ("IoT") and other forward-looking applications.

DSA appreciates the opportunity to provide written comments in this proceeding. We filed comments earlier this year in the initial phase of this docket. There, we applauded the Commission's focus on allocating additional spectrum in the millimeter wave bands, as a way of furthering the deployment of 5G wireless services, increased in-room bandwidth, as well as low-

cost last mile broadband access. In particular, we requested that the Commission designate the 64-71 GHz bands for unlicensed operations.[1]

II. The Case for Dynamic Allocation of Spectrum

Building and maintaining robust wireless connectivity – including Wi-Fi – depends on access to unlicensed radio frequency spectrum. DSA believes it is vital that the FCC continue to advance policies that will make available additional unlicensed spectrum, both by designating bands for unlicensed use where available, and through intensive spectrum sharing between and among licensed and unlicensed users where possible. Moreover, similar to licensed spectrum, there is a need for low-, mid-, and high-band unlicensed spectrum due to the varying propagation characteristics of radio waves in different spectrum bands as well as the available channel sizes. In general, low-band license-exempt spectrum is better for providing wireless broadband coverage, while mid- and high-band unlicensed spectrum is better suited for delivering wireless broadband capacity. Generally, larger channel sizes are possible in mid- and high-band spectrum than low-band spectrum.

The DSA views existing static models used for assigning spectrum as inherently inefficient. The current static licensing models assign the exclusive use of spectrum to a specific user for a fixed time period in a fixed geographic area. If the assigned user does not utilize the allocated spectrum, then its potential may be lost forever. Previously the only alternative to this was license-exempt usage, where anyone can use the spectrum on a best-efforts basis. Where feasible, this system remains more than acceptable for many users and applications. In most countries, though, there are little, if any, low- and mid- band spectrum that has not been allocated and assigned to one or more commercial licensed services or for government use.

Where unlicensed status is not feasible, dynamic spectrum sharing would allow available spectrum to be used more efficiently than any existing static techniques. The recently adopted Part 96 rules, with its Citizens Band Radio Service (CBRS), has introduced dynamic spectrum management to the 3.5 GHz bands. These rules will enable access to spectrum in a given band to be coordinated in real time (or near-real time). The amount of spectrum can be adjusted depending on the service demand at any given moment, while taking into account geographic characteristics.

Depending on the specific requirements for protecting from harmful interference the primary users in a given frequency band, dynamic spectrum sharing as now encapsulated in the Part 96 rules can utilize a combination of technologies; these include geo-location databases (the SAS), access control technologies, sensing, and data analytics, all to allocate the available spectrum in the most efficient manner. Maximizing the efficiency of the spectrum usage increases the value of this finite resource, lowers barriers to access in established markets, and fosters the growth of new niche ones. Such dynamic thinking would allow for innovative sharing with different services across the sub-bands, ushering in considerable innovation throughout the ecosystem.

III. Part 96-Style Dynamic Allocation Is Well Suited for the 24 GHz and 37 GHz Bands

[1] Letter from DSA to FCC, GN Docket No. 14-177, filed January 26, 2016.

DSA supports finding additional spectrum above the 6 GHz bands for shared, dynamic use. Two bands in particular would be suitable: the 24 GHz band (24.25-24.45, and 24.75-25.25 GHz), and the 37 GHz band.

A. The Part 96 CBRS/SAS Model Would Be Suitable for the 24 GHz Band

Currently, the 24 GHz band is used for FSS uplinks (limited to Broadcast Satellite Service feeder links) and digital fixed services. (FNPRM ¶¶ 379-380 and 24 GHz Market Area) The FCC proposes to authorize flexible fixed and mobile uses in the 24 GHz band and seeks comment on various service rules and sharing solutions as discussed below. (FNPRM ¶¶ 379-385)

The Commission proposes a mobile allocation in the 24.25-24.45 and 24.75-25.25 GHz segments and a fixed allocation in the 24.75-25.05 GHz segment, consistent with the Part 30 UMFUS rules. The new allocations will be added on a co-primary basis and mobile rights will be granted to existing fixed licensees or, alternatively, mobile or fixed use will be secondary to existing FSS operations. (FNPRM ¶ 383). The agency proposes to license the 24.25-24.45 GHz segment as a single, unpaired block of 200 MHz, and the 24.75-25.25 GHz segment as two unpaired blocks of 250 MHz each. Alternatively, license 100 MHz unpaired channels in the 24.25-24.45 GHz segment and/or two 200 MHz channels and one 100 MHz channel in 24.75-25.25 GHz segment. (FNPRM ¶ 385)

The FCC seeks comment on sharing mechanisms to promote coexistence between existing satellite services and mobile operations. (FNPRM ¶ 384). The FCC also asks if existing 24 GHz band FSS licenses should be converted to Part 30 UMFUS licenses and/or repacked to clear space for new licensees. (FNPRM ¶ 385).

DSA believes the Commission should consider applying its Part 96 rules framework to the 24 GHz bands. Those bands would work well in a CBRS/SAS model, similar to what the Commission adopted in the 3.5 GHz bands. Here, as there, the incumbents occupy a limited portion of the bands for services that would coexist with PALs and GAA users.

As the Commission is aware, the Part 96 rules were adopted to enable wireless broadband use on a shared basis in the 3550-3700 MHz band. The approach requires Priority Access and GAA services to avoid interference to incumbent military and non-federal users, while Priority Access users receive protection from interference from third-tier operations licensed by rule. A similar approach would be successful in the 24 GHz band because there are substantial similarities to the 3.5 GHz band. In particular, satellite links would be protected in the same way they are protected for 3.5 GHz. Registered fixed links would also be protected.

B. To Best Address the 37 GHz Band Sharing Issues, the Commission Should Apply the Part 96 CBRS/SAS Model As Well

To further develop 37 GHz band rules regarding Federal and non-Federal co-primary geographic sharing, the FCC seeks comment on the coordination mechanisms adopted in the R&O for the lower band segment, and methods for shared access of the upper band segment. (FNPRM ¶ 447)

For the lower band segment (37-37.6 GHz), the agency seeks comment on the regulatory, technical, or procedural tools necessary to facilitate coordinated access. (FNPRM ¶¶ 448, 450) Specifically, the FCC asks if it should establish a maximum protection contour for coordinated sites or allow the coordinated party to request specific protection levels. (FNPRM ¶ 451) The FCC also seeks comment on whether a portion of the lower band segment should be made available for priority access by Federal users (for example, up to 200 MHz of the segment). Specifically, the FCC asks if the coordination mechanism should statically reserve this space or dynamically make it available when requested. (FNPRM ¶ 456) The FCC also seeks comment on enforcement mechanisms to help identify and rectify interference events. (FNPRM ¶ 458)

While the Commission has proposed some coordination techniques for the 37-37.6 bands, the better approach is to designate it as subject to the Part 96 rules and establish a CBRS/SAS system of allocation.

The DSA generally supports the framework proposed in the FNPRM, with access authorized by rule and available to both Federal and non-Federal users on a coordinated, co-equal basis and subject to very short time-to-live authorizations (e.g., 7 days). The DSA fully concurs with the Commission that "[a]llowing part of the band to be made available on a non-exclusive, shared basis will promote access to spectrum by a wide variety of entities, support innovative uses of the band, and help ensure that spectrum is widely utilized." (R&O ¶ 112) To realize this goal, the Commission should define Shared Access Licenses (SALs) to be as similar as feasible to General Authorized Access within the CBRS/Part 96 framework.

The most open, intensive and efficient use of the entire 37 GHz band can be achieved by adopting a dynamic enforcement mechanism modeled on the Spectrum Access Systems (SAS) currently being certified to manage three tiers of shared access to the 3.5 GHz band. An automated mmW SAS, certified by the Commission and operated by one or more third parties, would best be able to coordinate the greatest degree of spectrum sharing by a variety of users with varying needs for interference protection. Because of the propagation characteristics of the band, the coverage area of a registered device will be very small. Manual coordination through a portal will not scale to handle the sheer quantity of authorizations, or the potential for multiple and overlapping SALs in an area, combinations that could change frequently given the anticipated use cases and short-term nature of the SAL authorizations, A SAS is also the most reliable mechanism to protect incumbent Federal sites, while also enforcing any prioritization for Federal operations that the Commission adopts now or in the future.

The DSA believes that to the extent Shared Access licensees will receive a degree of interference protection for "a particular bandwidth of spectrum at a particular location" (FNPRM ¶ 449), the capabilities of a dynamic SAS should be leveraged to maximize the availability of the band for all potential users. Accordingly, we urge the Commission to adopt a a standardized engineering metric to calculate the protection contour for a Shared Access licensee, as it did to facilitate General Authorized Access to unused PAL spectrum in its *Order on Reconsideration and Second Report and Order* (rel. May 2, 2016) for the CBRS at 3.5 GHz. It would be most objective and efficient for the SAS to calculate the protection contour based on the location, power, height and other information the device would report upon registration. To the extent SAL licensees are permitted to report their coverage area, it should be likewise be subject to an objective maximum enforced by the SAS (*id.* at para. 174).

The DSA concurs fully with the Commission's proposal "that registered non-Federal sites must be put into service within seven days of coordination and that registered and coordinated sites must reassert their registration every seven days." (FNPRM ¶ 456) While it is not clear that enforcing mutual exclusivity to a particular bandwidth at a particular location is truly necessary given the propagation characteristics of the 37 GHz band and the ability of a SAS to dynamically coordinate potentially conflicting requests for bandwidth, a seven day authorization would at least minimize the number of other potential users and uses excluded from spectrum that is not actually put to use. As the FNPRM proposes, SALs can be renewable, but the operator "must reassert their registration every seven days" (FNPRM ¶ 456) in a manner that verifies actual use. Seven days is a reasonable balance between the needs of operators and the public interest in ensuring capacity on this band does not lie fallow if there is demand by others who are ready to put it to immediate use.

For similar reasons, the DSA proposes that the Commission "refrain from setting a minimum channel size and instead require the coordination mechanism to attempt to maximize the number of users in a given area." (FNPRM ¶ 455) If the coordination is a full SAS implementation, as it should be, then SAL authorizations can be based on the actual bandwidth the user requires, which increases the availability of bandwidth for other users. Accordingly, device registrations and/or operator requests for a SAL should specify the bandwidth needed both initially and each time the user reasserts their registration at the end of the short time-to-live period.

While the Commission should ensure that SAS coordination accommodates as many users as possible, the DSA suggests that if a location is fully occupied, then a first-in approach would be most fair and predictable. The FNPRM proposes that a single user could occupy "up to the maximum of 600 megahertz where available." (FNPRM ¶ 454) In the absence of contention, DSA agrees this will optimize the use of the band, particularly because the most prevalent use case is likely to be indoors where only a single operator is likely to be active. However, if a contending authorization request would be denied because a single operator has SALs that in the aggregate exceed 400 megahertz, then the SAS should reduce the first-in-time authorization to a maximum of 400 megahertz if that is necessary to accommodate a conflicting request.

The DSA further suggests that the Commission consider the feasibility of authorizing indoor-only use of the 37 to 37.6 GHz band on a General Authorized Access basis. The Commission decided not to adopt the NPRM's proposal to authorize unlicensed indoor-only operations across the entire 37 GHz band because "signal leakage through windows" could adversely impact the operations of UMFUS licensees, many of which require exclusive rights to ensure quality of service. However, if indoor-only use is limited to the lower 37 – 37.6 GHz band segment, the trade-off is very different. Although the Commission has proposed to grant a measure of interference protection to SALs – relying on protection contours managed by a SAS or other frequency coordinator – this may not be necessary with respect to indoor devices separated by at least one wall from neighboring deployments. On the other hand, the guaranteed availability of General Authorized Access within every building for indoor-only use would ensure that every venue (including every Federal building) has access to and control over 600 megahertz of mmW bandwidth that can enable a diverse variety of needs and new innovations.

A number of additional protections can minimize the risk that "signal leakage" from indoor-only use of the 37 – 37.6 GHz band could disrupt neighboring deployments. First, as the FNPRM observes, the Commission can "require that these devices be AC-powered in order to ensure that they only operate indoors." (FNPRM ¶ 440) Second, the Commission can adjust the technical rules for GAA operations to preclude the power levels and/or directional antennas that make

signal leakage significant enough to create risks of disruption to neighboring SAL operations. Third, if GAA users are required – like SAL users – to register and recheck the SAS for continued permission to operate, if a SAL operator experiences harmful interference, it can be more readily identified and resolved, including by denying permission for any continued GAA operation within the protection contour associated with the impacted SAL.

The FNPRM also seeks comment on whether a portion (e.g., 200 megahertz) of the lower band segment should be available for "priority access" by Federal users. If the Commission determines, now or in the future, that there are compelling Federal uses that require this particular spectrum, the DSA suggests that this spectrum should never be reserved in advance, but instead be assigned by the SAS only when requested and only for as long as needed. One of the advantages of a full SAS implementation in the 37-39 GHz band is that bandwidth can be dynamically assigned and reassigned as needed. Further, as recommended above, this dynamic assignment can continue to meet the needs of the greatest number of users if authorizations are based on needed bandwidth rather than on static 100 megahertz channel sizes.

C. The Commission Should Authorize Opportunistic Access on a Use-or-Share Basis to Unused Capacity Across the 37-39 GHz Bands

The DSA strongly supports the Commission's proposal "to permit shared access of the unused portions of the five channels in the upper band segment" of the 37 GHz band (37.6-38.6 GHz). (FNPRM ¶ 460) As the FNPRM acknowledges, there is likely to be "significant unused spectrum in the upper band segment at any given time" due to the "flexible build out requirements" adopted in the *Report & Order* (*id.*) and because of the economics of deploying very dense small cell networks outside of heavily-trafficked urban areas and venues. Indeed, because that rationale applies equally to the adjacent 39 GHz band, the DSA supports extending opportunistic access on a use-or-share basis across the entire 37 – 39 GHz band. As the FCC states, the technical and service rules adopted in the *Report & Order* "provides 2400 megahertz of contiguous spectrum under the same licensing and technical rules" (*id.*), which includes a requirement that devices be capable of operating across the entire 37-40 GHz band.

The Commission should conclude, as it did last year in its *3.5 GHz Report & Order*, that permitting opportunistic access to unused channels "would maximize the flexibility and utility of the [ ] band for the widest range of potential users" and "ensure that the band will be in consistent and productive use." (*3.5 GHz Report & Order* at ¶ 72) Similarly, in the mmW bands, a "use-or-share" approach would accomplish a number of objectives, including more intensive use of fallow spectrum capacity, lowering barriers of entry to a diverse range of uses and users, and providing added incentives for licensees to construct and operate facilities.

The DSA concurs with the FCC that UMFUS licensees above 37.6 GHz should "retain the primary right to construct and provide service anywhere within its license area at any time" and that any opportunistic use is inherently temporary and "subject to displacement by the primary licensee" once that licensee is ready to commence operations. (FNPRM ¶ 462) The most reliable and cost-effective mechanism to manage and enforce opportunistic access would be the same Spectrum Access System recommended just above to coordinate dynamic sharing of the adjacent 37 – 37.6 GHz band segment. A SAS can effectively review requests for access to bandwidth above 37.6 GHz and deny, grant or renew requests based on up-to-date information about active operations provided by licensees, as the Commission proposes. (FNPRM ¶ 462) The DSA recommends that these authorizations for opportunistic access be subject to the same technical

rules and short time-to-live duration as a Shared Access License for the 37 – 37.6 GHz band segment (that is, no longer than seven days).

If the Commission leverages the capabilities of an automated Spectrum Access System to coordinate and enforce opportunistic access to unused spectrum, there would be no justification for a multi-year waiting period after the date the UMFUS geographic area license is granted. (*See* FNPRM ¶ 463) The only relevant consideration is whether a qualified SAS is certified, tested and ready to accurately ensure that a use-or-share authorization will be revoked and the spectrum is fully available for the licensee on the date it plans to commence commercial operations. The use-or-share concept is not intended to "punish" licensees for failure to build out. It is properly seen as an efficient mechanism to ensure interference protection to parties that purchase exclusive licenses, while simultaneously reducing spectrum warehousing and facilitating the most intensive possible use of the public resource.

In addition, the capabilities of the SAS should be leveraged to make as much unused spectrum as possible availabile to potential users. Accordingly, as we recommended above with respect to the assignment of SALs, the DSA urges the Commission to adopt a standardized engineering metric to calculate the protection contour for deployments by UMFUS licensees. The process for a SAS grant of opportunistic access should be the same as the Commission has adopted to facilitate General Authorized Access to unused PAL spectrum in its *Order on Reconsideration and Second Report and Order* (rel. May 2, 2016) for the CBRS at 3.5 GHz. The most objective and efficient option is for the SAS to calculate the protection contour based on the location, power, height and other information the device would report upon registration. To the extent that UMFUS licensees are permitted to report their coverage area, it should likewise be subject to an objective maximum enforced by the SAS (*id.* at para. 174).

IV. The Commission At This Time Should Refrain from Applying the Part 96 Framework to the 70/80 GHz Bands, But Authorize Unlicensed Indoor-Only Use

Per the FCC's ULS database, there are 456 active non-exclusive, nationwide millimeter wave (mmW) licenses in the 71-76 and 81-86 GHz bands. The FCC proposes additionally to authorize flexible fixed and mobile uses in the 70/80 GHz band and seeks comment on various service rules and sharing solutions including the following. (FNPRM ¶¶ 375, 424-441).[2] Fixed and mobile operations would be governed by the Part 96 Citizens Broadband Radio Service rules or, alternatively, the Part 30 UMFU rules. (FNPRM ¶ 440) Under Part 96, the FCC proposes three tiers of users based on the 3.5 GHz model—Incumbent Access users, Priority Access Licensees (PALs), and General Authorized Access (GAA) users. (FNPRM ¶ 440)

While DSA is a strong supporter of the Part 96 rules as a means of bringing the many benefits of dynamic spectrum allocation to U.S. users, there are certain limited situations where the framework does not provide optimal benefits. The Commission should implement frameworks that take account of the propagation characteristics and potential uses for each band. In general, from a technical perspective, sharing is relatively easy to accomplish in high-frequency bands, so a lighter regulatory touch is appropriate. Propagation and atmospheric absorption characteristics make the bands well-suited for line-of-sight operations that can be mapped and

[2] While the FCC proposes to the new requirements nationwide, it invites comment on establishing a separate regulatory framework for the 16 counties with a site density of more than one 70/80 GHz transmit or receive site per square mile. (FNPRM ¶ 440)

protected with relative ease. Highly-directional antennas typically are required to achieve significant range, which reduces interference to others. In some cases, the bands are already used for highly-directional point-to-point operations.

The unlicensed 60 GHz band is right below the 70/80 GHz bands, with 14 GHz of spectrum available for a more dynamic allocation approach. DSA long has supported the unlicensed treatment of the 60 GHz bands, as an additional swath of spectrum best suited for dynamic allocation. We also support the proposal to extend that unlicensed treatment up to 72.5 GHz, which would allow for an additional unlicensed channel dedicated to WiGig and related services.

In the case of the 70/80 GHz bands, the non-exclusive, nationwide light-licensing framework that exists now is well suited to the point-to-point links in this band, which by regulation and physics are highly directional. New entrants to the market can still deploy, with light license and low friction. By contrast, an area-wide PAL for highly directional links may constrain an area from new entrants, where the protection isn't necessary beyond the light licensing. At this time there is no reason to move away from the existing approach. [3]

As discussed above, the 24 GHz band at the other end of the millimeter wave spectrum is a much better candidate for a three-tiered, SAS-managed approach similar to 3.5 GHz.

Although the Commission should refrain at this time from introducing a three-tier regulatory framework under either Part 30 or Part 96, the DSA believes that unlicensed access for indoor-only use would yield substantial public interest benefits with no risk to either incumbent fixed point-to-point licensees or to Federal FSS operations at military bases. In its comments at the outset of this proceeding, the DSA and other parties proposed the authorization of unlicensed use up to 72.5 GHz, which would allow for an additional IEEE 802.11ad channel. (DSA Comments at 3) The Commission decided that permitting unlicensed operations as a general underlay in the band is not warranted at this time "due to the presence of the numerous existing fixed links in the 71-76/81-86 GHz bands." (Report & Order, ¶ 131) Although the FCC declined to authorize a general unlicensed underlay, the DSA agrees that "authorizing unlicensed, indoor-only operations" under Part 15 would be feasible and not interfere with licensed outdoor operations.

As the Commission observed in the *Report & Order*, WiGig devices operate over unlicensed spectrum in the 60 GHz band and are designed to deliver multi-gigabit speeds, low latency, and security-protected connectivity between nearby devices. (Report & Order, ¶ 130) These products are already being marketed and "are standardized pursuant to an internationally harmonized channelization scheme, which should promote their growth and usage." (*Id.*) Since most high-capacity broadband use is indoors, the availability of greater capacity on an open and unlicensed basis inside every building would serve the public interest.

The DSA concurs with the Commission's observation in the FNPRM that "the comparative amount of signal leakage through windows could be much lower in the 71-76 GHz and 81-86 GHz bands, and consequently less likely to interfere with outdoor operations." (FNPRM ¶ 440) The means to limit an unlicensed underlay to indoor use in these mmW frequencies is already established in Part 15 for the 92-95 GHz band, "require[ing] that these devices be AC-powered

[3] Should the Commission be looking for a more dynamic point to multipoint system in the 70/80 GHz bands, perhaps the rules could evolve to allow for a more clean registration of transmissions from a tower to a coverage area on the ground, with dynamic beam-forming links. This can be covered even today with registration of multiple links to register the full coverage area.

in order to ensure that they only operate indoors." *(Id*., and see 47 CFR § 15.257) Similarly, in the 70/80 GHz bands, unlicensed devices certified for indoor-only use would have no impact on outdoor operations and could be available for consumers off-the-shelf without the complication or burden of database registration. Indeed, an AC power requirement to ensure indoor-only use would be more protective of outdoor operations than the conditions on level probing radars (LPRs) that the Commission authorized under Part 15 in 2014 to share access to the 75-85 GHz band. (Report & Order, ¶ 131)

Conclusion

Consistent with these comments, the Commission should (1) adopt a Part 96 dynamic allocation framework for the 24 GHz band, (2) apply the Part 96 approach to the 37 GHz band, and (3) refrain for now from altering the existing lightly licensed regime for the 70 and 80 GHz bands.

Respectfully submitted,

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