Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

	)	
In the Matter of	)	
	)	
MVDDS 5G Coalition	)	File No. RM-11768
	)	
Petition for Rulemaking to Permit MVDDS Use of the 12.2-12.7 GHz Band for Two-Way Mobile Broadband Service	)	
	)	

REPLY COMMENTS OF THE MVDDS 5G COALITION

June 23, 2016

TABLE OF CONTENTS

INTRODUCTION AND SUMMARY 1

I. MVDDS FLEXIBILITY SERVES THE PUBLIC INTEREST 5

II. THE PETITION PROTECTS DBS OPERATIONS 7

III. NGSO SYSTEMS SHOULD NOT BE PERMITTED IN THE BAND 11

A. Maintaining the Current Rules and the NGSO Allocations Would Threaten the Viability of Both MVDDS and NGSO Services 11

B. The Petition Would Protect and Advance Both MVDDS and NGSO Services. .. 13

C. MVDDS Mobile Broadband at 12.2-12.7 GHz Is a Superior Service to NGSO for Promoting Broadband. 14

IV. NEW MVDDS SERVICE RULES DO NOT REQUIRE MVDDS LICENSES TO BE REVOKED AND RE-AUCTIONED 15

A. There Is No Auction Requirement. 16

B. The Standard Advocated by T-Mobile Would Have Negative Policy Implications. 20

C. T-Mobile Improperly Attempts to Revisit the FCC's Decision to Extend the MVDDS Construction Deadlines. 20

CONCLUSION 21

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
MVDDS 5G Coalition	)	File No. RM-11768
	)	
Petition for Rulemaking to Permit MVDDS Use of the 12.2-12.7 GHz Band for Two-Way Mobile Broadband Service	)	

REPLY COMMENTS OF THE MVDDS 5G COALITION

Pursuant to Section 1.405 of the Commission's rules,[1] the MVDDS 5G Coalition ("Coalition") submits these reply comments in support of the above-captioned Petition for Rulemaking ("Petition") to permit the use of Multichannel Video Distribution and Data Service ("MVDDS") licenses in the 12.2-12.7 GHz band for a two-way mobile broadband service, including Fifth Generation ("5G") mobile broadband.

INTRODUCTION AND SUMMARY

The Petition is a prime example of industry answering a Commission call to action. It is a precise and swift response by members of the satellite and terrestrial industries (DISH and MVDDS licensees respectively) to the telecommunications goal of our era: sharing spectrum to allow a proven and successful Direct Broadcast Satellite ("DBS") satellite service to coexist with 5G mobile service, thereby helping to meet the skyrocketing demand for two-way broadband services. As Chairman Wheeler explained in March, the "Commission's spectrum agenda is at a

[1] 47 C.F.R. § 1.405.

hinge moment" and its future "is clear: 5G."[2] To reach this 5G future, we will "need to be innovative and flexible in how we utilize spectrum. We cannot limit ourselves to old models or worst-case analyses."[3] In particular, we need "the satellite industry to work with the mobile industry … [on] realistic sharing ideas for the coexistence of satellite and mobile."[4]

This Petition represents the "[i]ndustry-driven win-win solution" Chairman Wheeler has urged the industry to provide.[5] Among other things, the Coalition urges the Commission to update the MVDDS rules to permit MVDDS licensees to: provide two-way mobile broadband service while continuing to protect DBS operations from harmful interference; and delete or designate as secondary the existing unused non-geostationary satellite orbit ("NGSO") fixed satellite service ("FSS") allocation at 12.2-12.7 GHz (while preserving access to 3,500 MHz of other spectrum for NGSO).

The time is ripe for the Commission to evaluate the potential for 5G mobile services in the MVDDS spectrum; indeed, the 5G "timeline requires that we act to pave the way today."[6] Support for utilizing the MVDDS spectrum for 5G service has come from public interest groups (including Public Knowledge and the Open Technology Institute at New America), trade associations (including the Competitive Carriers Association ("CCA") and the Computer &

---

[2] Tom Wheeler, Chairman, FCC, Remarks at 19th Annual Satellite Leadership Dinner, Washington, D.C., at 2-3 (Mar. 7, 2016), https://apps.fcc.gov/edocs_public/attachmatch/DOC-338135A1.pdf ("Chairman Wheeler Satellite Leadership Speech").

[3] *Id.* at 3.

[4] *Id.* at 4; Tom Wheeler, Chairman, FCC, Remarks at National Press Club – The Future of Wireless: A Vision for U.S. Leadership in a 5G World, at 5 (June 20, 2016) , http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0620/DOC-339920A1.pdf ("Chairman Wheeler 5G Leadership Speech").

[5] *See* Chairman Wheeler Satellite Leadership Speech at 4.

[6] Chairman Wheeler 5G Leadership Speech at 4.

Communications Industry Association ("CCIA")), as well as from T-Mobile, which noted that "the Commission should undertake the required evaluation to determine whether, as Petitioners suggest, past impediments can be overcome."[7]

The opponents of the Petition fail to offer any meaningful reason *not* to commence a rulemaking as requested in the Petition. They suggest that the Commission decided the relevant issues in its 2002 *MVDDS Order*[8] and should not revisit those issues now. But the telecommunications world has changed dramatically in the last 14 years. The need for spectrum to provide 5G mobile service did not exist in 2002. Now it is an urgent national priority.[9] Moreover, 5G services have unique attributes that facilitate sharing in high frequency bands, such as the MVDDS band, since they can be used in a localized way to provide capacity relief in urban canyons and indoors.

Most importantly, unlike the opponents, the Coalition is not asking the Commission to prejudge these issues. The Petition merely seeks the initiation of a rulemaking proceeding to allow these issues to receive a full airing. The Coalition has presented a detailed technical analysis to demonstrate that it is feasible to provide 5G mobile service in the MVDDS spectrum without interfering with DBS service. It is also attaching as Appendix A to these Reply Comments a further technical examination of how the 12.2-12.7 GHz band could support 5G wireless broadband. In the additional study, Tom Peters, the former chief engineer of the

---

[7] T-Mobile Comments at 6.

[8] Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band with Frequency Range, *Memorandum Opinion and Order and Second Report and Order*, 17 FCC Rcd. 9614 (2002) ("*MVDDS Order*").

[9] Chairman Wheeler 5G Leadership Speech at 2 ("The interconnected world of the future will be the results of decisions we must make today. That is why 5G is a national priority.").

Wireless Telecommunications Bureau, has sought to test the robustness of his earlier conclusions regarding the promising prospects for co-frequency sharing between 5G MVDDS and DBS satellite receivers in the 12.2-12.7 GHz band. Mr. Peters applies even more conservative assumptions to a less forgiving physical environment and concludes that "MVDDS licensees can deploy two-way 5G services in the 12.2-12.7 GHz band while satisfying the current level of protection that DBS enjoys today from MVDDS licensees."[10] If there are objections to these technical analyses (or other aspects of the rule changes proposed in the Petition), the notice-and-comment rulemaking process provides the appropriate vehicle for addressing them.

The remaining concerns raised by the Petition's opponents do not provide any basis for failing to move forward with the requested rulemaking. Opposition based on presumed interference with DBS service should be given little weight. Coalition member DISH is one of the country's two DBS providers. DISH would not join a proposal that endangers its own service to about 14 million households. It is for that reason that the Coalition proposes preserving the effective power flux density ("EPFD") as the mechanism to protect DBS, while doing away only with the redundant and unduly prophylactic equivalent isotropically radiated power ("EIRP") limit.

The opposition by NGSO interests to removing the co-primary NGSO designation should likewise not stop the Commission. Those interests seek to maintain a status quo that has stymied development of the MVDDS spectrum for well over a decade, and they have not shown that use of the 12.2-12.7 GHz band is even necessary for NGSO service in light of the substantial range of other spectrum earmarked for that purpose. OneWeb, for example, makes conclusory

[10] Tom Peters, MVDDS 12.2-12.7 GHz Co-Primary Service Coexistence II at 2 (Jun. 23, 2016) (Attached hereto as Appendix A) ("Coexistence Study II").

assertions that it needs the extra 500 MHz of spectrum. But it does not supply any spectrum needs analysis to back these assertions. As for the many International Telecommunication Union ("ITU") filings for NGSO systems that will supposedly use the band one day, such paper filings are notoriously *not* sufficient proof of future, much less imminent, use.

Finally, as noted above, T-Mobile supports the Commission's further examination of MVDDS spectrum for 5G services. While DISH disagrees with T-Mobile's preferred assignment mechanism on both legal and policy grounds, T-Mobile's support for a rulemaking proceeding to consider use of the MVDDS spectrum for 5G bolsters the case for timely Commission action.

I. MVDDS FLEXIBILITY SERVES THE PUBLIC INTEREST

The current MVDDS rules are a prime example of "the failure to revisit historical allocations [that] can leave spectrum handcuffed to particular use cases and outmoded services."[11] As Public Knowledge observes, "the MVDDS licensees have actively sought to provide service as the Commission envisioned."[12] But, as CCIA explains, "[a]lthough licensees have pursued a number of ways for utilizing that spectrum, it has not become fully operational" due to a "combination of regulatory restrictions and the lack of development for the equipment necessary to facilitate use of the band."[13]

In short, the current rules have not worked. Despite numerous efforts by a variety of Coalition members, only one licensee is providing service today, and that licensee, MDS

[11] CCA Comments at 10; see also FCC, Connecting America: The National Broadband Plan, at 78-79 (2010), https://transition.fcc.gov/national-broadband-plan/national-broadband-plan.pdf ("National Broadband Plan").

[12] Public Knowledge and Open Technology Institute at New America Comments at 2.

[13] CCIA Comments at 2.

America, is doing so under a waiver of the current rules,[14] paired with unlicensed spectrum for the return link. The purpose of the Petition is to break the current logjam by eliminating the two biggest impediments in the current rules: (1) limiting MVDDS terrestrial service to fixed service and (2) requiring providers to use non-MVDDS spectrum for bi-directional service.

Granting this new flexibility for MVDDS will immediately free up 500 MHz for 5G mobile broadband use. As Chairman Wheeler noted just this week, this means "huge swaths of spectrum for super-fast data rates with low latency … now becoming unlocked because of technological advances in computing and antennas."[15] While Intelsat is correct that the band has not yet been proposed in the U.S. or at the ITU for 5G or International Mobile Telecommunications ("IMT") use,[16] it is not clear why that is a reason not to move forward. If anything, this attenuates Intelsat's main concern – the fear of international spillover that would affect its use of the band outside the U.S. In any event, the 2015 World Radiocommunication Conference ("WRC-15") has made clear one thing: the U.S. needs to lead and drive global harmonization. It cannot afford to await ITU actions before taking steps to accommodate 5G/IMT services under its own rules.[17] And this rulemaking is necessary to set in motion a U.S. proposal for international allocation of the band for IMT in the WRC process. As Chairman Wheeler points out, "the United States will be the first country in the world to open up high-band

[14] MDS Operations, Inc., Request for Extension of Time, MVDDS Station WQAR560 (Jun. 20, 2014).

[15] Chairman Wheeler 5G Leadership Speech at 3.

[16] Intelsat Comments at 3.

[17] Chairman Wheeler Satellite Leadership Speech at 3.

spectrum for 5G networks and applications. And that's damn important because it means U.S. companies will be first out of the gate."[18]

In that regard, as CCIA and CCA note, the MVDDS band would meet the four criteria established for 5G by the Commission in the Spectrum Frontiers proceeding.[19] In that proceeding, the Commission is searching for spectrum bands that have: (1) at least 500 MHz of contiguous spectrum; (2) a flexible regulatory environment; (3) international spectrum allocations; and (4) the ability to share with existing users.[20] MVDDS meets all four criteria.[21] It has the contiguous 500 MHz. It will have a flexible regulatory environment if the Petition's proposals are adopted. Most of the band is allocated for mobile use internationally. And the band can support both DBS and mobile use without raising harmful interference concerns.

II. THE PETITION PROTECTS DBS OPERATIONS

Both supporters and opponents of the Petition share one core principle, which is that MVDDS service must be compatible with protecting DBS operations. DISH would have never been a member of the Coalition otherwise, as DISH would not have tolerated the risk of degrading its service to its millions of customers, let alone a realistic chance of such degradation. It is ironic in that regard that SES expresses concerns about the protection of two of its

[18] Chairman Wheeler 5G Leadership Speech at 3.

[19] CCA Comments at 2, 9; CCIA Comments at 3.

[20] Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, *Notice of Proposed Rulemaking*, 30 FCC Rcd. 11878, 11887-88 ¶¶ 20-23 (2015) ("*Spectrum Frontiers NPRM*").

[21] CCIA Comments at 3.

satellites—QuetzSat-1 and Ciel-2—serving the U.S.[22] Both of these SES satellites are used exclusively to support DISH's service.[23]

AT&T, Intelsat, and SES base their opposition on an asserted lack of analysis of whether the proposed rule changes will adequately protect DBS operations.[24] AT&T, the only other DBS provider in the United States besides Coalition member DISH, indicates that it "favors finding additional spectrum that can be made available for 5G mobile use" and "remains open to reviewing possibilities for increased sharing in the 12 GHz band."[25] The detailed analysis that AT&T, Intelsat, and SES seek was provided in the "MVDDS 12.2-12.7 GHz Co-Primary Service Coexistence" study ("Coexistence Study"), authored by former Wireless Telecommunications Bureau Chief Engineer Tom Peters and submitted with the Coalition's comments.[26] That study reviewed the MITRE Report the Commission relied on in 2002, advances in technology and spectrum planning tools since then and three likely 5G deployments: (1) point-to-point communications for fixed wireless access; (2) mobile broadband in high-density urban canyons; and (3) indoor mobile broadband.[27] The Coexistence Study concludes that "MVDDS licensees can deploy two-way 5G services in the 12.2-12.7 GHz band even with the current level of

---

[22] SES Comments at 1-2.

[23] DISH DBS Corp., Annual Report (Form 10-K) at F-26, F-55 (Mar. 25, 2016), http://dish.client.shareholder.com/secfiling.cfm?filingID=1558370-16-4380; Lyngsat, http://www.lyngsat.com/QuetzSat-1.html.

[24] AT&T Comments at 3; Intelsat Comments at 2-3; SES Comments at 1.

[25] AT&T Comments at 3.

[26] Tom Peters, MVDDS 12.2-12.7 GHz Co-Primary Service Coexistence (Jun. 8, 2016) (Attachment 1 to MVDDS 5G Coalition Comments) ("Coexistence Study").

[27] *Id.* at 2.

protection that DBS enjoys today from MVDDS licensees."[28] Notably, that conclusion relied on conservative assumptions and a worst-case analysis.

Attached to this submission as Appendix A is a supplemental technical analysis of the potential for coexistence between DBS and 5G MVDDS operations. The supplemental technical analysis, entitled "MVDDS 12.2-12.7 GHz Co-Primary Service Coexistence II" (" Coexistence Study II"), uses similar analytical techniques as the original Coexistence Study, but applies them to the markedly different building environment of the downtown area of the nations' capital.[29] The Coexistence Study II tests the validity of the conclusions reached in the original Coexistence Study in several ways. The Coexistence Study II:

- employs even more detailed 0.7-meter resolution LIDAR data of the study area;
- adopts more conservative operating and deployment assumptions; and
- accounts for potentially meaningful EPFD effects, such as for co-channel signal aggregation, in the indoor deployment model.[30]

Despite these and other factors that might seem likely to produce a *less* promising EPFD environment in the 12.2-12.7 GHz band, the Coexistence Study II has found just the opposite: the occurrence of excess EPFD is low in absolute terms and in many respects superior to the

---

[28] *Id*. AT&T inaccurately contends that the points of excess EPFD identified in the Coexistence Study are "larger than they would be under the existing rules due to the increased E.I.R.P. that was assumed." AT&T Reply at 2. In fact, even under the current rules and existing EIRP limits, applying the same coexistence analysis would result in much the same points of excess EPFD. The Part 101 EPFD protection limits, in other words, will be as effective under the proposed rules as they are now. And MVDDS operators can reduce EPFD levels through sound network and site engineering in the few spots where EPFD limits may be exceeded, even assuming DBS receive antennas might realistically operate in such spots. *See* Tom Peters, MVDDS 12.2-12.7 GHz Co-Primary Service Coexistence II at 21 & n.28 (Jun. 23, 2016) (Attached hereto as Appendix A) ("Coexistence Study II").

[29] *Id*. at 1.

[30] *Id*. at 2.

results shown in the original Coexistence Study.[31] The Coexistence Study II thus increases confidence that a notice-and-comment rulemaking proceeding would promote more intensive use of the 12.2-12.7 GHz band.

Intelsat and SES argue that there is no basis for re-examining the existing regulatory framework for DBS.[32] But three key factors have changed since 2002 and justify reevaluation of the rules by the Commission. First, we now have experience with the existing MVDDS rules: they are not working. Second, 5G mobile broadband systems are expected to use transmitters in urban canyons, indoors, and for point-to-point links instead of the macrocell transmitters envisioned for MVDDS in 2002.[33] As demonstrated in both the original Coexistence Study and the companion Washington Coexistence Study attached as Appendix A, 5G MVDDS base stations and mobile devices are expected to raise far less significant interference concerns than earlier generations of mobile service would have as long as sound engineering practices are employed and co-existence considerations are taken into account. Third, as T-Mobile indicates, the need to make additional spectrum capacity available is an urgent public interest need that justifies a fresh look at whether the restrictions of the current MVDDS rules can be relaxed while still protecting DBS.[34]

Two other DBS interference concerns should also be dismissed. SES asserts that the customers of its Astra subsidiary in Europe "could experience interference if ubiquitous, mobile terrestrial services were to be introduced in BSS spectrum bands."[35] However, SES never

---

[31] *Id*. at 3.

[32] Intelsat Comments at 1; SES Comments at 2.

[33] Coexistence Study at 2.

[34] T-Mobile Comments at 6.

[35] SES Comments at 4.

explains how a 12 GHz terrestrial system in the United States could possibly cause interference into user terminal devices across the ocean. Similarly, Intelsat claims mobile MVDDS operations may cause harmful interference to its gateway earth station uplink in the 12.2-12.5 GHz band.[36] Intelsat offers no technical analysis showing this to be the case. In any event, as even Intelsat admits, it has no right to interference protection from a co-primary service in the band because its operations are only licensed on a non-conforming, non-interference basis.[37]

III. NGSO SYSTEMS SHOULD NOT BE PERMITTED IN THE BAND

Certain NGSO interests ask the Commission to maintain the unused primary NGSO FSS allocation for the 12.2-12.7 GHz band, even though history demonstrates that doing so would prevent MVDDS from ever becoming viable and would not necessarily advance the viability of NGSO services. Such an outcome would not be in the public interest. In the alternative, the Commission can choose to remove the primary NGSO allocation, possibly preserving a secondary allocation. This would permit a viable MVDDS 5G mobile service to emerge without threatening the viability of any potential NGSO service offering in the future (which can use other available spectrum set aside for that purpose, and perhaps even the 12.2-12.7 GHz band on a secondary basis). Given the high priority associated with 5G spectrum, the latter choice clearly must prevail. But the Commission need not make that determination now. It should commence a rulemaking necessary to evaluate these choices.

A. Maintaining the Current Rules and the NGSO Allocations Would Threaten the Viability of Both MVDDS and NGSO Services.

The current rules have resulted in a standoff of mutually assured paralysis for both MVDDS and NGSO FSS services. MVDDS licensees have been unable to effectively deploy,

[36] Intelsat Opposition at 3-4.

[37] *Id*.

and NGSO providers have not yet attempted to provide any service in the 12.2-12.7 GHz band. MVDDS services are severely constrained at present by the need to account for the protection of potential NGSO deployments in the band.[38] The particular characteristics of potential NGSO systems would only make matters worse. One proposed system, for example, seeks to allow ubiquitous fixed and mobile end user terminals, despite NGSO being solely a fixed satellite service under existing rules.[39] Given the requirement that MVDDS transmitting stations must be located 10 km away from authorized NGSO stations,[40] such a proposal would make it virtually impossible to deploy any new MVDDS stations.

NGSO operations are also severely limited in the band due to the need to protect MVDDS services. Low angle PFD limits on NGSO downlinks may not be exceeded into MVDDS receivers.[41] In addition, NGSO FSS receivers must accept any interference resulting from preexisting MVDDS transmitting antennas.[42] These restrictions and the ambiguous deployment scenarios leave NGSO operations in this spectrum subject to a high degree of uncertainty. Thus, the removal of the primary NGSO FSS allocation would not remove any rights that would have assured successful NGSO use of the band.

The Coexistence Study further demonstrates that MVDDS licensees cannot deploy two-way 5G services in the 12.2-12.7 GHz band without overwhelming NGSO FSS operations.[43] It suggests that coexistence may not be feasible between the two services "even under the current

[38] 47 C.F.R. § 101.105(a)(4).

[39] WorldVu Satellites Limited, Technical Annex, IBFS File No. SAT-LOI-20160428-00041, at 10 (Apr. 28, 2016).

[40] 47 C.F.R. § 101.129(b).

[41] 47 C.F.R. § 25.208(o).

[42] 47 C.F.R. § 101.129(b).

[43] Coexistence Study at 2.

MVDDS rules" that do not permit two-way mobile broadband services.[44] As a result, protecting the potential for future NGSO deployment in the 12.2-12.7 GHz band assures there will never be MVDDS mobile 5G service in that spectrum.

B. The Petition Would Protect and Advance Both MVDDS and NGSO Services.

The Petition would rid both MVDDS and NGSO services of these impediments. Without the need to account for in-band NGSO systems, MVDDS providers will be able to operate 5G mobile broadband systems without causing interference to other spectrum users.

As for the NGSO systems, their viability would not be lessened. Even without the 12.2-12.7 GHz band, NGSO systems will have more than enough spectrum to carry out their plans. One recent application requested 5,900 MHz of spectrum for service and gateway links, including the 500 MHz between 12.2 and 12.7 GHz as part of 2 GHz for servicing downlink operations.[45] OneWeb relies upon conclusory assertions regarding the need for an extra 500 MHz of spectrum alongside the 5.4 GHz band, whose use would remain entirely unaffected by this proposal.[46] But OneWeb does not supply any spectrum needs analysis based on take rates or throughput requirements to support those assertions.[47]

Nor does the Coalition's proposal necessarily mean the total inability of OneWeb and other NGSO systems to access the 12.2-12.7 GHz band anywhere in the world. Part of the reason for designing an NGSO constellation to use so much spectrum is frequency agility.[48] An

---

[44] *Id.*

[45] WorldVu Satellites Limited, Petition for Declaratory Ruling, IBFS File No. SAT-LOI-20160428-00041, at 8 (Apr. 28, 2016).

[46] *Id.* at 19 ("Each MHz of spectrum available increases the ability of OneWeb to accomplish its goals, and thus increases the viability of the OneWeb constellation.").

[47] *Id.*

[48] *Id.* at 4.

NGSO system can use one band over regions of the world where use is permitted and cease transmissions in that band or use the spectrum in a more limited way in another.

In short, the trade-off between mobile 5G service and NGSO service in the MVDDS spectrum is very one-sided. Allowing NGSO totally precludes 5G service in the 12.2-12.7 GHz band, but does not meaningfully increase the viability of the proposed NGSO service. But permitting 5G service in the MVDDS spectrum is entirely consistent with future NGSO deployments primarily anchored in other spectrum bands.

C. MVDDS Mobile Broadband at 12.2-12.7 GHz Is a Superior Service to NGSO for Promoting Broadband.

Even if this were just a straight choice between a two-way MVDDS mobile broadband service and an NGSO fixed broadband service, the result would remain the same. MVDDS 5G mobile broadband would still be a better choice for promoting broadband than NGSO.

As the Competitive Carriers' Association notes, 5G networks, like the ones that could be deployed terrestrially using the MVDDS service licenses, promise to revolutionize mobile technology and spur innovation.[49] 5G networks will help meet the ever-increasing demand for mobile broadband, serve as the backbone for the Internet of Things and support a host of innovative use cases because the networks will be able to deliver greater throughput, lower latency, and higher concentration density than existing networks.[50] The use cases include ultra high-definition video, virtual reality, augmented reality, remote surgery, industrial automation, smart transportation, and wearables to name only a few.[51] NGSOs have a role to play in the

[49] CCA Comments at 2.

[50] *Id.* at 4-5.

[51] *Id.* at 5-8.

provision of broadband. But NGSO systems will complement terrestrial systems, not replace them.

What is more, the terrestrial mobile spectrum can be geographically apportioned, as well as disaggregated, among a large number of different systems,[52] which can be used to apply a number of disparate technologies and business models. The band is already no stranger to sharing—it has been shared by two geostationary satellite operators for 20 years. By comparison, NGSOs are inefficient users of spectrum due to the difficulty in sharing. Because NGSOs utilize constantly moving satellites, they are unable to leverage the directional nature of satellite radios to provide isolation between systems.[53] This difficulty in sharing implies that only one, unproven NGSO system will likely consume the entire band. SpaceX cites to 35 ITU filings for NGSO FSS operations as evidence that the NGSO FSS allocation is not unused or speculative.[54] Some of these filings do not even appear immediately relevant, as they contemplate other bands or regional NGSO use of the band outside the United States.[55] But ITU filings are not evidence of actual deployment.

In sum, the Commission should not foreclose the possibility of enabling 5G use in the MVDDS band.

IV. NEW MVDDS SERVICE RULES DO NOT REQUIRE MVDDS LICENSES TO BE REVOKED AND RE-AUCTIONED

According to T-Mobile, because the Commission has "concluded that it may be appropriate in some cases to treat a major modification application as an initial application for

[52] 47 C.F.R. § 101.1415

[53] This is in contrast to DBS systems whose directional nature allows multiple DBS systems to efficiently share the same band.

[54] *See* Space Exploration Technologies Corporation Opposition at 2.

[55] Yvon Henri, BR Director's Report to WRC-15: NGSO Issues at 5-6 (October 29, 2015).

competitive bidding purposes," it follows that the Commission is required by Section 309(j) of the Communications Act to auction all the MVDDS licenses affected by the revised service rules.[56] This argument is inconsistent with Commission precedent and would freeze spectrum use for the foreseeable future if adopted.

A. There Is No Auction Requirement.

T-Mobile relies on the Commission's statement that it "*may* be appropriate" for the Commission to apply Section 309(j) and treat an application as one for an "initial" license when it receives mutually exclusive applications proposing *major* modifications.[57] But the new service rules requested here do not amount to a license modification. Even if they did, the Commission has ample authority to modify licenses under Section 316 without implicating the auction provisions of Section 309(j); and any such modification would by no means be major. Finally, even if Section 309(j) applies, it would not remove the duty of the Commission to explore all solutions other than an auction.

Service Rule Changes. The Coalition has cited numerous examples of service rule changes that did not trigger an auction. T-Mobile's attempts to distinguish them are unavailing. Just as important, T-Mobile does not cite even one case where the Commission held that rule changes triggered an auction requirement.

---

[56] T-Mobile Comments at 7-8 (citing Implementation of Section 309(j) of the Communications Act – Competitive Bidding for Commercial Broadcast and Instructional Television Fixed Service Licenses; Reexamination of the Policy Statement on Comparative Broadcast Hearings; Proposals to Reform the Commission's Comparative Hearing Process to Expedite the Resolution of Cases, *First Report and Order*, 13 FCC Rcd. 15920, 15925 ¶ 14 (1998) ("*Section 309(j) Implementation Report and Order*")).

[57] *Section 309(j) Implementation Report and Order*, 13 FCC Rcd. at 15925 ¶ 14 (emphasis added).

In the Broadband Radio Service ("BRS") and Educational Broadband Service ("EBS") proceeding, the Commission changed the rules to allow existing licensees to provide two-way services, including mobile broadband, and later further modified the technical rules to facilitate the provision of these services.[58] Similarly, in the Commission's Spectrum Frontiers proceeding, the Commission has proposed directly assigning flexible use rights, including mobile operating rights, to existing fixed service LMDS and 39 GHz licensees.[59] T-Mobile tries to distinguish both proceedings on the grounds that the Commission was merely extending previously contemplated rights and expanding the scope of two-way rights.[60] This is a distinction without a difference. These service bands were fixed service bands. The Commission granted mobile rights to ERS and BRS and plans to do the same for LMDS and 39 GHz licensees in the Spectrum Frontiers proceeding. The Petition proposes the same thing.

The Commission also changed the service rules applicable to the WCS band to modify power levels, out-of-band emissions and other technical rules to allow licensees more flexibility.[61] T-Mobile argues that WCS is distinguishable because it was already a terrestrial based service permitting two-way mobile use.[62] In other words, T-Mobile invites the

---

[58] Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands, *Report and Order and Further Notice of Proposed Rulemaking*, 19 FCC Rcd 14165 (2004); Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands, *Fifth Report and Order*, 29 FCC Rcd 6331 (2014).

[59] *Spectrum Frontiers NPRM*, 30 FCC Rcd. at 11907-16 ¶¶ 92-123.

[60] T-Mobile Comments at 11-12, 15-16.

[61] *See* Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band, *Report and Order and Second Report and Order*, 25 FCC Rcd 11710 (2010); *Order on Reconsideration*, 27 FCC Rcd 13651 (2012).

[62] T-Mobile Comments at 14.

Commission to create the following standard: rule changes expanding licensee flexibility do not trigger an auction requirement unless they expand licensee flexibility by permitting two-way service, in which case the auction requirement applies. The Commission should avoid such a construct, where the difference between the exception and the rule appears totally arbitrary. In addition, if that were the standard, MVDDS would not fall within the exception: MVDDS point-to-point links *can* be used for two-way service today.[63]

The AWS-4 proceeding, for its part, ushered in a much more far-reaching change than the ones contemplated in the Petition. In that proceeding, the Commission initially allowed MSS providers to use their satellite spectrum to provide limited ancillary terrestrial services, but imposed very restrictive gating criteria.[64] Later, the Commission added a terrestrial wireless allocation, removed barriers to mobile broadband use and issued new wireless radio licenses to the incumbents.[65] Ignoring these facts, T-Mobile claims that the new rights granted in AWS-4 were merely "ancillary" to the old rights and that the Commission, in later extending those rights, rejected the creation of certain new terrestrial licenses.[66] In reality, new wireless licenses were issued. Here, the Petition does not go nearly that far; it merely changes the service rules.

Modification. But even if the proposed rule changes somehow amounted to a modification, the Commission has wide latitude to modify licenses under Section 316 and has

---

[63] 47 C.F.R. § 101.1407 ("Two-way services may be provided by using other spectrum or media for the return or upstream path.").

[64] Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Band, *Report and Order and Notice of Proposed Rulemaking*, 18 FCC Rcd. 1962, 1965-66 ¶ 3 (2003).

[65] Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands, *Report and Order and Order of Proposed Modification*, 27 FCC Rcd 16102, 16153 ¶ 121 (2012).

[66] T-Mobile Comments at 12-13.

used that authority without conducting an auction. In the 800 MHz Rebanding proceeding, for example, the Commission assigned to Sprint/Nextel totally new spectrum, finding that even "reassignments to new spectrum are not fundamental changes to the original licenses that themselves trigger the requirement for license revocation and reissuance."[67]

Furthermore, any such modification would not be "major," contrary to T-Mobile's assertion. Section 1.929 of the Commission's rules classifies modifications as major if they add frequencies or increase the interference risk.[68] The rule changes proposed in the Petition would do neither.[69]

Finally, even if Section 309(j) applied, and even if there were a major modification rendering MVDDS licenses initial, that would not be the end of the analysis. Indeed, the Commission must consider and balance all of the objectives of Section 309(j)(3) in identifying classes of licenses to be auctioned. These include "the development and rapid deployment of new technologies, products, and services for the benefit of the public," "economic opportunity and competition," and "efficient and intensive use of the electromagnetic spectrum."[70] Moreover, Section 309(j)(6)(E) provides that the auction requirement shall not "be construed to relieve the Commission of the obligation in the public interest to continue to use engineering solutions, negotiation, threshold qualifications, service regulations, and other means in order to avoid mutually exclusivity in application and licensing proceedings."[71]

---

[67] *800 MHz Rebanding Order*, 19 FCC Rcd. at 15013 ¶ 69.

[68] 47 C.F.R. § 1.929 (a,d).

[69] MVDDS 5G Comments at 5-6; Coexistence Study at 2.

[70] 47 U.S.C. § 309(j)(3)(A)-(D).

[71] 47 U.S.C. § 309(j)(6)(E).

B. The Standard Advocated by T-Mobile Would Have Negative Policy Implications.

Even setting aside Commission precedent, it is easy to imagine the devastating policy implications of the invitation T-Mobile cavalierly issues to the Commission. Licensees would have to accept, and continue to labor under, unduly restrictive and obsolete rules for fear that a change would deprive them of their licenses. They would also have to make investment decisions under the fear that a rulemaking proceeding concerning their band would result in license revocation. And, more immediately, the Commission would have to abandon its Spectrum Frontiers proposals and re-auction the LMDS and 39 GHz bands for allowing mobile use of the bands. The Commission should not open that Pandora's box and, as discussed above, there is no legal basis to do so.

C. T-Mobile Improperly Attempts to Revisit the FCC's Decision to Extend the MVDDS Construction Deadlines.

Implicit in T-Mobile's argument is that there should be a revocation or cancellation of all current MVDDS licenses (since otherwise there are no new licenses to be auctioned). T-Mobile suggests the Commission should not improve the MVDDS service rules for the current licensees because it "should not reward current licensees' failure to deploy by granting" the Petition.[72] The implication seems to be that the existing licenses should be revoked because of the absence of current deployment under those licenses. However, in this case, the licensees were granted extensions of time by the Commission that have not expired. In granting these extension requests, the Commission explicitly held that "the public interest would best be served by granting [the] MVDDS licensees additional time…to allow the equipment market to develop further" and that "the record demonstrates the need for an extension of time due to causes

[72] T-Mobile Comments at 8.

beyond each licensee's control."[73] In other words, the Commission never found or implied any lack of attempt to build out by the MVDDS licensees, and has repeatedly recognized the deployment challenges in this spectrum. In effect, T-Mobile's argument is simply an untimely collateral attack on the extension decision, which has long since become final and no longer subject to review.

CONCLUSION

The Commission has a unique opportunity to provide U.S. consumers with access to an additional 500 MHz of terrestrial mobile broadband spectrum. Given the technical analysis provided by Mr. Peters and the record established in the proceeding, it is now time to initiate a rulemaking that proposes the rule changes contemplated by the Petition. This is the proper means for the Commission to gather input on Mr. Peters' studies and determine if a more flexible regulatory framework for MVDDS can facilitate the introduction of 5G services while protecting DBS operations.

Respectfully submitted,

MVDDS 5G Coalition

[73] Requests of Ten Licensees of 191 Licenses in the Multichannel Video and Data Distribution Service for Waiver of the Five-Year Deadline for Providing Substantial Service, *Order*, 25 FCC Rcd. 10097, 10102-04 ¶¶ 10, 13 (2010).

Braunston Spectrum LLC

By: /s/ Tim Davies
PO Box 783066
Wichita, KS 67278
(316) 239-8346

Cass Cable TV, Inc.

By: /s/ Chad Winters
100 Redbud Road
Virginia, IL 62691
(217) 452-4105

DISH Network L.L.C.

By: /s/ Alison Minea
9601 S. Meridian Boulevard
Englewood, CO 80112
202-463-3709

GO LONG WIRELESS, LTD.

By: /s/ Bruce Fox
4832 Givens Court
Sarasota, FL 34242
(941) 349-3500

MDS Operations, Inc.

By: /s/ Kirk Kilpatrick
729 South Federal Highway, Suite 212
Stuart, FL 34994
(877) 677-6372

MVD Number 53 Partners

By: /s/ A. Wray Fitch III
6139 Franklin Park Road
McLean,. VA 22101
(703) 761-5013

Satellite Receivers, Ltd.

By: /s/ David R. Charles
1740 Cofrin Drive
Green Bay, WI 54302
(920) 432-5777

SOUTH.COM LLC

By: /s/ Alison Minea
9601 S. Meridian Boulevard
Englewood, CO 80112
202-463-3709

Story Communications, LLC

By: /s/ Bobby Story
PO Box 130
Durant, OK 74702
(580) 924-2211

Vision Broadband, LLC

By: /s/ Patrick McGuinn
145 East 49th Street
Hialeah, FL 33013
(202) 255-9011

WCS Communications, Inc.

By: /s/ Larry Saunders
3562 Knickerbocker Road
San Angelo, TX 76904
(512) 794-1198

June 23, 2016

CERTIFICATE OF SERVICE

I, Matthew R. Friedman, hereby certify that on June 23, 2016, I caused true and correct copies of the foregoing to be served by first class mail upon the following:

Susan H. Crandall
Intelsat Corporation
7900 Tysons One Place
McLean, VA 22102

Linda M. Hood
Gary L. Phillips
David L. Lawson
AT&T Services, Inc.
208 S. Akard Street
Dallas, Texas 75202

Patricia Cooper
Space Exploration Technologies Corporation
1030 15th Street, NW
Washington, DC 20005

Kalpak S. Gude
WorldVu Satellites Limited
1400 Key Boulevard
Arlington, VA 22209

John A. Howes, Jr.
Computer & Communications Industry Association (CCIA)
900 17th Street, N.W., Suite 1100
Washington, D.C. 20006

Steven K. Berry
Rebecca Murphy Thompson
Elizabeth Barket
Competitive Carriers Association
805 15th Street NW, Suite 401
Washington, DC 20005

Harold Feld
John Gasparini
Public Knowledge
1818 N St. NW, Suite 410
Washington, D.C. 20036

Michael Calabrese
Open Technology Institute at New America
740 Fifteenth Street NW – 9th Floor
Washington, DC 20005

Russell H. Fox
Alyssia J. Bryant
Stephen J. Wang
Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, PC
701 Pennsylvania Avenue, N.W.
Suite 900
Washington, DC 20004

Steve B. Sharkey
John Hunter
Christopher Wieczorek
T-Mobile USA, Inc.
601 Pennsylvania Avenue, N.W.
Suite 800
Washington, DC 20004

Karis A. Hastings
SatCom Law LLC
1317 F Street, N.W., Suite 400
Washington, D.C. 20004

Petra A. Vorwig
SES S.A.
1129 20th Street NW, Suite 1000
Washington, D.C. 20036

Sincerely,

Matthew R. Friedman
Steptoe & Johnson LLP

Appendix A

MVDDS 12.2-12.7 GHz
Co-Primary Service Coexistence II

Tom Peters

June 23, 2016

Table of Contents

I. Executive Summary 1

II. Introduction and Background 2

III. Discussion of Interference Effects on Co-Primary Services 12.2-12.7 GHz 3

A. Study Area Filter Analysis 4

B. DBS Coexistence with MVDDS 5G Outdoor Sites 8

1. MVDDS 5G Base Stations 8

2. MVDDS 5G Mobile Stations 12

C. DBS Coexistence with MVDDS 5G Indoor Sites 16

1. MVDDS Indoor 5G Access Points 18

2. MVDDS Indoor 5G Mobile Devices 21

IV. Conclusion 25

Table of Figures

Figure 1: Washington, DC Study Area 3

Figure 2: The Verizon Center in Washington, DC..... 4

Figure 3: Locations for Which View to at Least One 12 GHz DBS Satellite is Not Obstructed (green)..... 5

Figure 4: Building Footprints (blue lines) 6

Figure 5: Area where the Slope is Less Than 35 degrees (pink) 7

Figure 6: Composite Filter – Areas Where DBS Antennas May Be Located (green)..... 7

Figure 7: Urban Canyon Model – Hypothetical 5G Sites in Washington, DC 9

Figure 8: 48 dBm / 100 MHz MVDDS Base Stations with Protection of DBS Antennas. 10

Figure 9: 48 dBm / 100 MHz MVDDS Base Stations with Protection of DBS Antennas – Worst-Case of Satellite Look Angles (without Underlying Image)..... 11

Figure 10: The New York Avenue Presbyterian Church, as Seen from H Street, NW.... 12

Figure 11: Location of 100 5G MVDDS Mobile Devices in Outdoor Model 14

Figure 12: Areas of Predicted Excess EPFD for 100 Mobile Devices Outdoors..... 15

Figure 13: Areas of Predicted Excess EPFD for 100 Mobile Devices Outdoors (Enlarged View)..... 16

Figure 14: Verizon Center Access Point Locations..... 17

Figure 15: Areas of Excess EPFD from Access Points Inside the Verizon Center, assuming 35 dB of building penetration loss 20

Figure 16: Areas of Excess EPFD from Access Points Inside the Verizon Center (Zoomed and without Underlying Image)..... 20

Figure 17: Locations of 80 Mobile Devices Inside the Verizon Center 22

Figure 18: Areas of Excess EPFD from Mobile Stations Inside the Verizon Center..... 23

Figure 19: Areas of Excess EPFD from Aggregate Co-Channel Mobile Stations Inside the Verizon Center assuming 45 dB Building Losses (Zoomed View without Underlying Image) 24

Figure 20: Areas of Excess EPFD from Aggregate Co-Channel Mobile Stations Inside the Verizon Center assuming 40 dB Building Losses (Zoomed View without Underlying Image) 25

About the Author

Tom Peters is a radiofrequency engineer with more than twenty years of industry and government experience in network deployment, design and regulation. Mr. Peters currently serves as a Senior Advisor at the international law firm of Hogan Lovells US LLP. He previously served as Chief Engineer of the Wireless Telecommunications Bureau of the United States Federal Communications Commission, where he helped develop the agency's National Broadband Plan and guided numerous spectrum policy proceedings to resolution. Mr. Peters started his career in wireless at LCC International, a global engineering consulting firm, where he helped design wireless networks all over the world. At LCC, Mr. Peters was a Director and responsible for Engineering Design Services in Latin America, and later in Europe and Asia-Pacific. He subsequently addressed technical regulatory and spectrum policy matters at Nextel Communications, where he served as Director of Technology Development. He then co-founded Wireless Strategy, LLC, a strategic engineering consulting firm.

Mr. Peters' analysis was aided by Alan Pate. Mr. Pate contributed to this analysis through his application of LIDAR mapping techniques to deployment models of 5G MVDDS. Mr. Pate has more than 30 years of experience in military-satellite, commercial-satellite and terrestrial-wireless communications. He founded Waverley LLC, a wireless consulting company that offers network-mapping and business-planning services across a variety of spectrum bands, including the 12 GHz band. Mr. Pate holds a BSc degree in Physics from the University of St. Andrews, Scotland.

I. Executive Summary

This study expands upon earlier analysis that examined under what conditions the 12.2-12.7 GHz band could support fifth-generation (5G) wireless broadband. Our analysis models 5G deployments in downtown Washington, DC. Comparing urban canyon and indoor deployment models in Washington, DC to those in Indianapolis, Indiana allows us to more fully explore operational variables and system design alternatives. Studying a different physical environment and employing even more conservative operational assumptions than our earlier analysis strengthens support for our initial finding that 5G operations in the 12.2-12.7 GHz band can provide meaningful broadband data services to consumers and enterprise customers within the constraints of the existing effective power flux density (EPFD) limits that apply in those frequencies.

Three separate communications services may use the 12.2-12.7 GHz band on a co-primary basis in the United States: (1) Direct Broadcast Satellite (DBS) services in the Broadcast-Satellite Service (BSS); (2) the Multichannel Video Distribution and Data Service (MVDDS); and (3) the Non-Geostationary Orbit Fixed Satellite Service (NGSO FSS). Our initial study, entitled "MVDDS 12.2-12.7 GHz Co-Primary Service Coexistence" (the "Coexistence Study"), examined the feasibility of coexistence among these services. We identified current-generation technology profiles and business cases to model three likely 5G deployments: point-to-point (PtP) fixed links; urban canyon service; and indoor service. We then employed newly available ultra-high-resolution imagery of buildings and terrain in and around Indianapolis, Indiana to analyze the degree of attenuation to signal propagation that potential 5G operations would be subjected to from obstacles, whether topographical, morphological or constructed. Our June 8, 2016 analysis found substantial radiofrequency signal attenuation in three likely deployment scenarios. For each of the three scenarios studied, we concluded that while coexistence between DBS and 5G MVDDS would prove feasible within limits, coexistence between NGSO FSS and 5G MVDDS would not prove feasible, without substantial constraints on one or both services.

In the current study, we apply the same analytical methods used in the Coexistence Study to a different physical environment: a portion of downtown Washington, DC that includes the sports-and-entertainment complex known as the Verizon Center. Studying new terrain and physical structures allows us to test our assumptions, better understand the relationships among different variables and explore the robustness of our earlier conclusions regarding the prospects for sharing between DBS and 5G MVDDS services in the 12.2-12.7 GHz band.

As in our original Coexistence Study, the current study of MVDDS coexistence in the Washington, DC area uses conservative assumptions regarding attenuation and other factors. In some cases, we adopt more conservative assumptions than we used in our original Coexistence Study to evaluate the sensitivity of our analysis to different sources of uncertainty about the natural and man-made environment in which 5G MVDDS would operate.

The different physical environment studied and the more conservative assumptions used in the current analysis yield results very similar or superior to those of our initial study. These results reinforce our earlier conclusion that MVDDS licensees can deploy two-way 5G services in the 12.2-12.7 GHz band while satisfying the current level of protection that DBS enjoys today from MVDDS licensees.

II. Introduction and Background

This study continues a technical examination of how the 12.2-12.7 GHz band could support 5G wireless broadband. By applying more conservative assumptions than used in our earlier analysis to a different physical environment, we seek to test the robustness of our prior conclusions regarding the prospects for sharing between 5G MVDDS and DBS satellite receivers in the 12.2-12.7 GHz band. We do not revisit the potential for coexistence between MVDDS and NGSO FSS, however, because the prospects for sharing appear to remain poor regardless of the deployment assumptions we use or the operating environment we model.

Our original study, entitled "MVDDS 12.2-12.7 GHz Co-Primary Service Coexistence," examined the feasibility of coexistence among the three co-primary services in the 12.2-12.7 GHz band: (1) BSS; (2) MVDDS; and (3) NGSO FSS.[1] This Coexistence Study identified current-generation technology profiles and business cases to model three likely 5G deployments: PtP fixed links; urban canyon service; and indoor service. In each deployment case studied, we found that 5G MVDDS operations could share with DBS receive antennas with few practical constraints on the 5G MVDDS deployment case examined. Just as important, these 5G MVDDS operations could occur without having to change the regime of protections for DBS receive antennas that the FCC adopted more than a decade ago. In other words, 5G MVDDS operations could satisfy the EPFD limits adopted to protect DBS receive antennas and still support robust deployments of the most probable use cases for 5G services.[2]

The outlook for same-frequency, same-geography sharing between 5G MVDDS and NGSO FSS operations was less promising, however. In our original Coexistence Study, we identified interference to potential future NGSO FSS operations in the 12.2-12.7 GHz as probable even using best-case assumptions for MVDDS operations.[3] For example, a 5G MVDDS mobile device transmitting at the lowest possible power levels would still overwhelm NGSO devices located within twenty-two meters of the 5G MVDDS mobile device. Worse, even simply maintaining the *existing* maximum EIRP level of 14 dBm per 24 MHz that currently applies to MVDDS base stations would likely cause harmful interference to an NGSO receiver located as far as eleven kilometers distance from an MVDDS base station. Worse still, the probability for interference would increase if mobile NGSO deployments are allowed in the current FSS allocation. These and related constraints required of MVDDS, NGSO FSS or both services led us to conclude that "while coexistence between DBS and MVDDS is feasible within limits, coexistence between NGSO FSS and MVDDS is not."[4]

As a result, the current study focuses on coexistence between 5G MVDDS operations and DBS receive antennas. While every analysis of potential EPFD emissions will vary in its particulars depending on the relative location of transmitters and receivers, the Washington, DC study area may present a worse case for potential EPFD emissions than Indianapolis, Indiana, because fewer portions of the study area are subject to exclusion for lack of DBS receive antenna suitability. Whereas the original Coexistence Study examined a heterogeneous environment comprised of buildings of various heights, many of which had sharply pitched roofs or other features that would tend to create more opportunities for exclusion, the current study considers

---

[1] *See* TOM PETERS, MVDDS 12.2-12.7 GHZ CO-PRIMARY SERVICE COEXISTENCE (June 8, 2016), *attached to* Comments of MVDDS 5G Coalition, RM-11768 (filed June 8, 2016) (the "Coexistence Study").
[2] *See id.* at 2.
[3] *See id.*
[4] *Id.*

an environment in which the streets and sidewalks are broad and the buildings are comprised of mid-rise structures of nearly uniform height. In addition, most of the buildings in the downtown Washington, DC study area generally feature a roof with little slope that can readily accommodate DBS receive antennas.

And while we used the same basic analytical methods as the original Coexistence Study for the current analysis, we employed some more conservative assumptions to test the reliability of our initial analysis. For example, we considered the aggregate power of indoor mobile devices simultaneously operating on the same channel in the current analysis, and we reduced the amount of signal-loss that will occur when indoor devices' signals travel outside of the building envelope and into the exterior environment.

Despite the less forgiving physical environment of Washington, DC and notwithstanding the more conservative assumptions used in the current study, our analysis of the Washington, DC study area yielded results very similar or superior to those of our initial Coexistence Study of Indianapolis, Indiana. These results lend further support to the proposition that MVDDS licensees can deploy two-way 5G services in the 12.2-12.7 GHz band while satisfying the current level of protection that DBS enjoys today from MVDDS licensees.

III. Discussion of Interference Effects on Co-Primary Services 12.2-12.7 GHz

For the current analysis, we examined a four-square-kilometer portion of the central business district of downtown Washington, DC. Figure 1 superimposes the boundaries of the study area

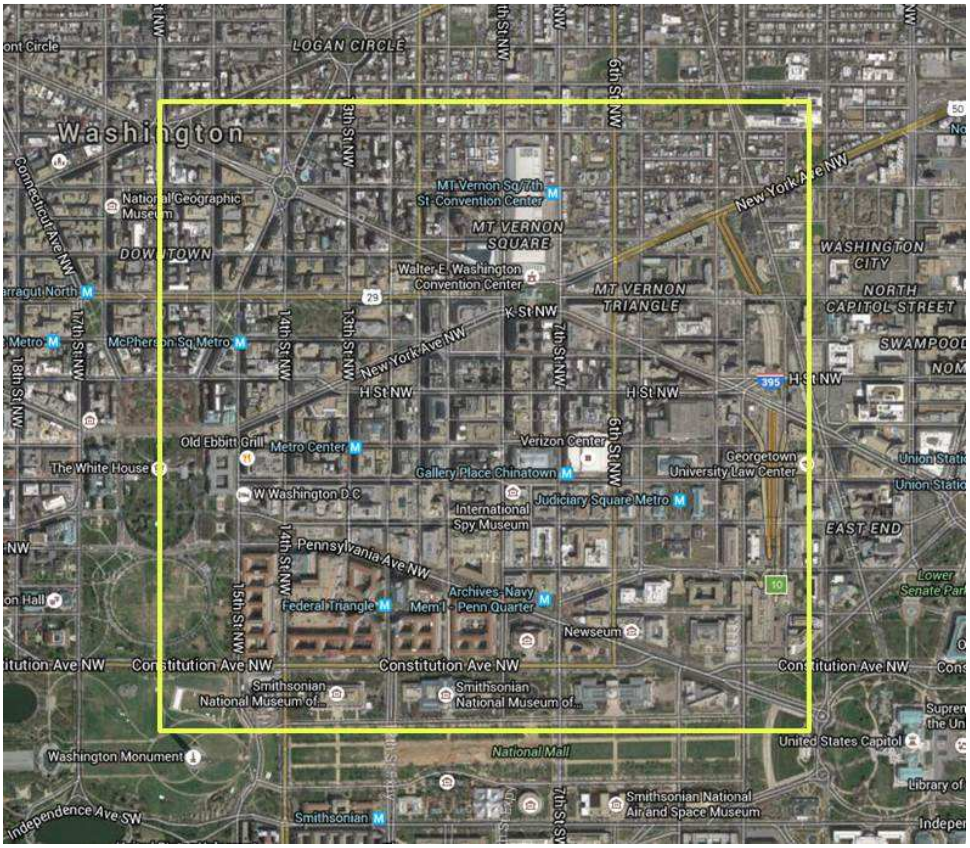

Figure 1: Washington, DC Study Area

over an aerial view of downtown Washington DC. For visual orientation, the White House is situated at the eastern edge of the study area on the left, the 2.3-million square foot Walter E. Washington Convention Center lies just below the study area's northern boundary at the top of the image, and the United States Capitol is located in the lower right-hand corner of Figure 1, just outside of the study area. The Washington, DC study area includes numerous commercial and government buildings, museums, restaurants, parks, monuments, condominiums, apartments, mixed-use developments and the Verizon Center, a major sports-and-entertainment complex. Washington DC's downtown area has a nearly uniform low skyline due to a century-old height limitation on buildings. Most buildings in the area are less than fourteen stories tall. Many of the buildings in the study area also feature large, flat roofs, which are ideal for the installation and operation of DBS satellite receivers. Figure 2 shows a street-level view of the exterior of the Verizon Center at the corner of 7th Street, Northwest and F Street, Northwest.

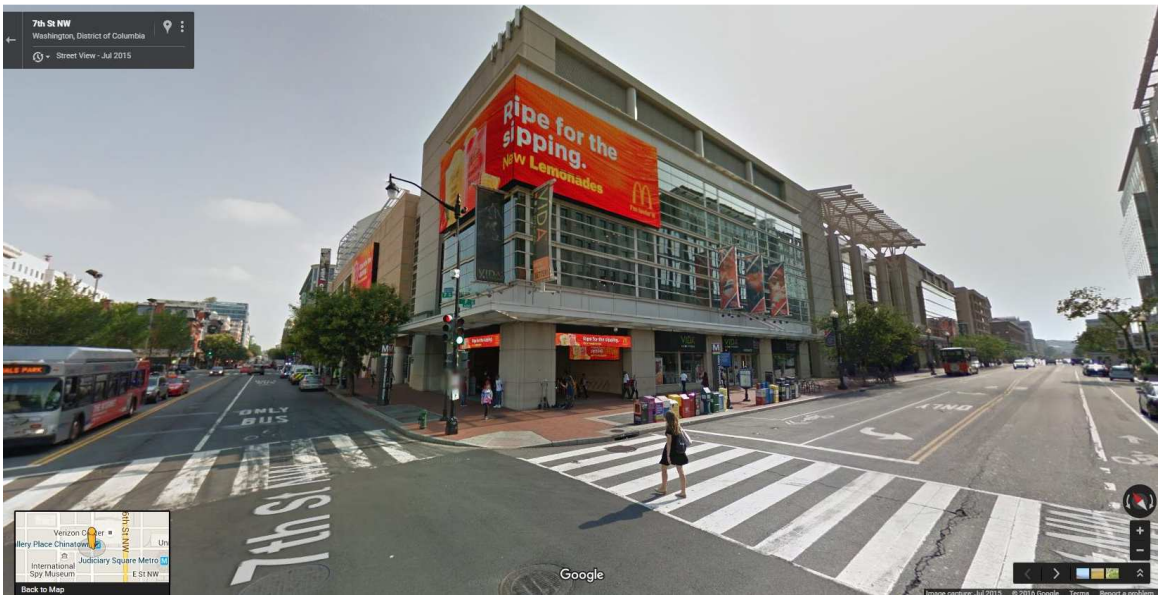

Figure 2: The Verizon Center in Washington, DC *Image: Google Streetview (July 2015).*

The relatively broad streets and sidewalks as well as the generally uniform, mid-rise buildings seen here are typical of the area. In this respect, the configuration of downtown Washington is markedly different than that of Indianapolis, which features less uniform building heights and fewer low-pitched roof structures suitable for the potential installation and operation of DBS receive antennas than Washington, DC does.

A. Study Area Filter Analysis

The current study of downtown Washington, DC considers two likely 5G deployment cases: (1) urban canyon service; and (2) indoor coverage. We modeled deployments with detailed survey data that the United States Geological Service (USGS) generated using Light Detection and Ranging or LIDAR. LIDAR offers the ability to create high-resolution, three-dimensional digital models of both terrain and constructed features. This powerful mapping tool did not exist when

the MVDDS rules were adopted in 2002,[5] but is now available in various resolutions. In our original Coexistence Study of Indianapolis, we relied on LIDAR data with a one-meter horizontal resolution.[6] In our current analysis of Washington, DC, we use more granular LIDAR data that features a 0.7 meter resolution. The additional granularity offers an even more representative model of real-world attenuation compared to one-meter resolution LIDAR data and allows for more accurate and detailed judgments about the likelihood of any particular area to experience excess EPFD levels.

In performing the study, we followed the same methodology used to evaluate 5G MVDDS EPFD employed in the original Coexistence Study.[7] First, we filtered out areas where terrestrial clutter blocked visibility to any of the otherwise-visible 12 GHz DBS satellites authorized to provide service to the United States. Figure 3 shows the effects of this filtering in the Washington, DC study area. Unlike the Indianapolis study area of the original Coexistence Study, the vast

Figure 3: Locations for Which View to at Least One 12 GHz DBS Satellite is Not Obstructed (green)

majority of the downtown Washington DC study area has visibility to at least one 12 GHz DBS satellite authorized to serve the United States.

[5] While the FCC proposed this regime in its First Report and Order and Further Notice of Proposed Rulemaking adopted in 2000, the FCC approved final service and technical rules for MVDDS service, including a sharing regime with DBS and NGSO FSS services, in 2002. *See Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range, et al*., Memorandum Opinion and Order and Second Report and Order, 17 FCC Rcd 9614 (2002).
[6] Coexistence Study at 8.
[7] *Id.* at 9-11.

Second, we excluded ground-level terrain between buildings because DBS antennas will not be situated in these locations in an urban environment. Figure 4 shows the effects of focusing our analysis on areas within the footprints of buildings located within the study area. Compared to

Figure 4: Building Footprints (blue lines)

Indianapolis, downtown, Washington, DC has more buildings and, thus, more pixels in the study area potentially suitable for the deployment of DBS receive antennas.

Third, we filtered out roofs with a pitch greater than 35 degrees, including gabled structures, domes, spires and other rooftop architectures that might have theoretical line-of-sight to MVDDS base stations or mobile device locations, but that feature such a steep pitch that the surface does not offer a suitable location for DBS satellite receive-antenna installations. Figure 5 shows the effects of filtering out rooftops with a slope greater than 35 degrees. Unlike

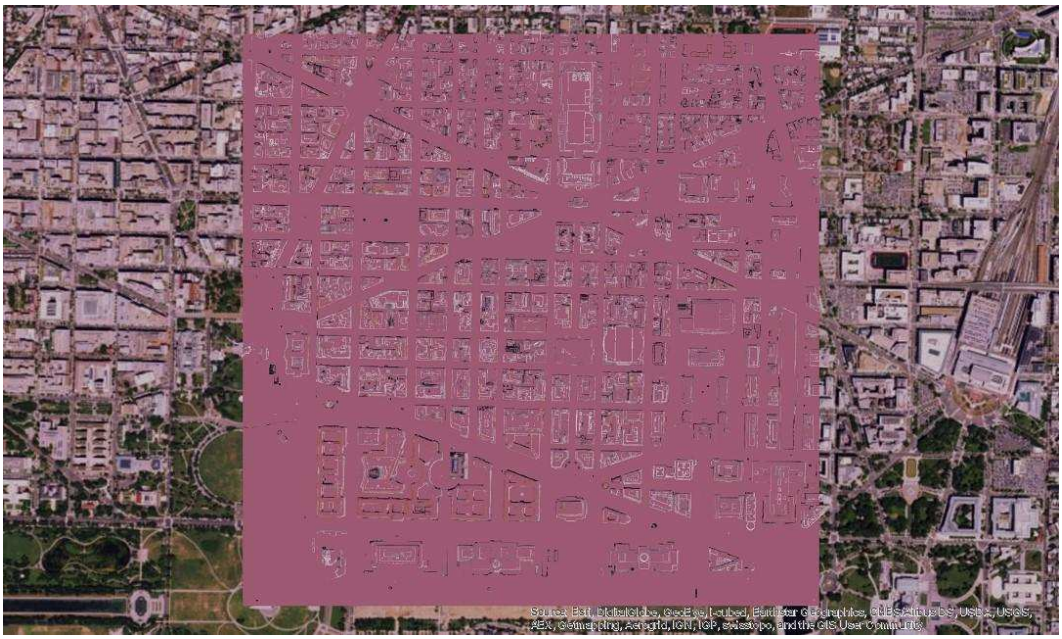

Figure 5: Area where the Slope is Less Than 35 degrees (pink)

Indianapolis, the flat rooftops that characterize the vast majority of downtown Washington, DC meant that very few pixels of the study area were filtered from the analysis. All areas in pink exhibited a pitch of less than 35 degrees and were included within the scope of analysis.

Figure 6 provides a composite view of the three filters. This composite view allows for analysis of only those pixels where the deployment of DBS receive antennas is feasible given the deployment constraints necessary to allow for practical and safe installation of DBS receive antennas as well as reception of space-to-Earth signals from geostationary DBS satellites. The

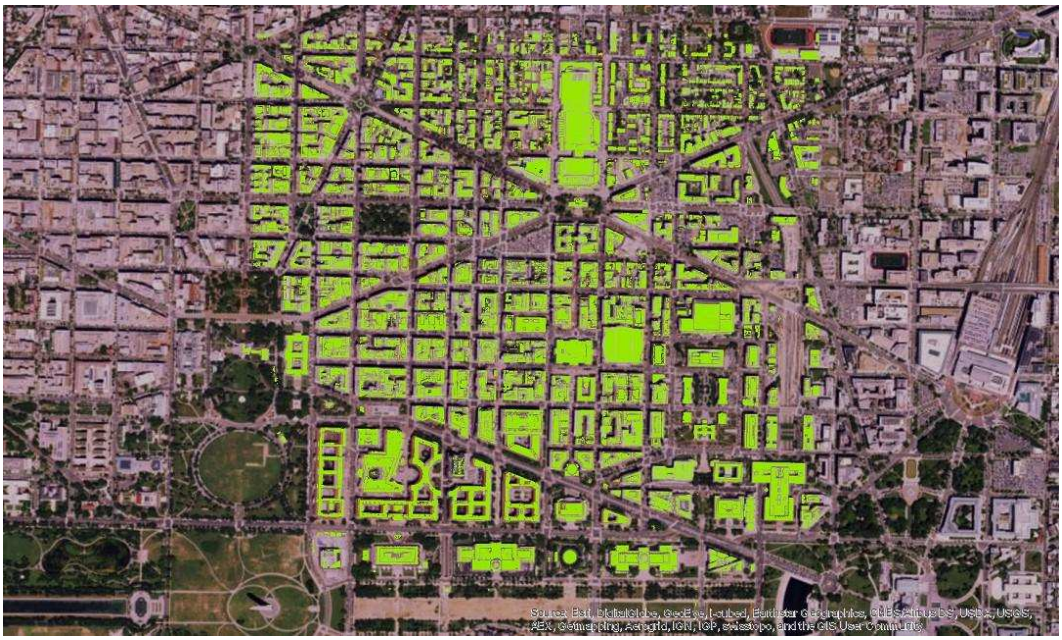

Figure 6: Composite Filter – Areas Where DBS Antennas May Be Located (green)

composite view of the applicable filters applied to Washington, DC exhibits many differences from the composite view applied to Indianapolis; the greater building density, more uniform building heights, and more flat-roofed structures mean that the Washington, DC study area has many more pixels capable of supporting DBS receive antennas than Indianapolis did.

Having identified those pixels theoretically capable of supporting DBS receive antennas, we then analyzed two likely deployment cases for the 12.2-12.7 GHz band: urban-canyon service and indoor coverage. As in the original Coexistence Study,[8] we used Rappaport's CI model[9] and employed a common outdoor propagation tool developed by Cellular Expert Company[10] to consider EPFD from co-channel sites at each one-meter pixel across the four-square-kilometer study area.[11] Each of the two deployment scenarios we modeled is discussed below.

B. DBS Coexistence with MVDDS 5G Outdoor Sites

1. MVDDS 5G Base Stations

To simulate an urban-canyon deployment in the 12.2-12.7 GHz band, we modeled 20 omnidirectional 5G MVDDS sites in downtown Washington, DC. The hypothetical base-station sites were located approximately 100 meters to 130 meters apart at or near street intersections for maximum visibility to potential end-users at street level, as shown in Figure 7. We assumed the base-station units would be deployed at a height of five meters above ground level (AGL) – one meter higher than we assumed in our Indianapolis case study. As in our original Coexistence Study, the base units in our Washington, DC case study were assumed to operate at 48 dBm per 100 MHz (42 dBm per 24 MHz), which is 28 dB higher than the power currently allowed under the FCC's part 101 rules.[12] The MVDDS 5G base station electrical downtilt was assumed to be 15 degrees, and DBS antennas were assumed to be located 0.5 meters above the elevation of each pixel subject to analysis in the study area. We assumed frequency reuse of four and each of the four co-channel frequency groups analyzed in the study are indicated by a separate color in Figure 7 below.

---

[8] Coexistence Study at 9.

[9] As explained in the Coexistence Study, the CI model reduces to FSPL + 3 dB. *Id.*

[10] *Id.* (*citing About Cellular Expert Company*, CELLULAR EXPERT, http://bit.ly/1sl4Fiq (last visited May 27, 2016)).

[11] Although the power in each pixel from each interfering channel was not linearly summed in the urban-canyon analysis, the nature of the analysis is equivalent to aggregate EPFD at each pixel. As explained in the original Coexistence Study, line-of-site free space propagation produces signal levels that are much greater than the EPFD limit, and non-line-of-site produces infinitely low EPFD. *Id.* at 20, n.67. Thus, aggregation of power from multiple base stations or mobile devices will have no discernible effect in the outdoor analysis.

[12] *See* 47 C.F.R. § 101.147(p) (stating that EIRP shall not exceed 14 dBm per 24 MHz). The power we used was 42 dBm per 24 MHz which is 28 dB greater than this (42-14=28). 42 dBm per 24 MHz + 10*log(100/24) = 48 dBm per 100 MHz.

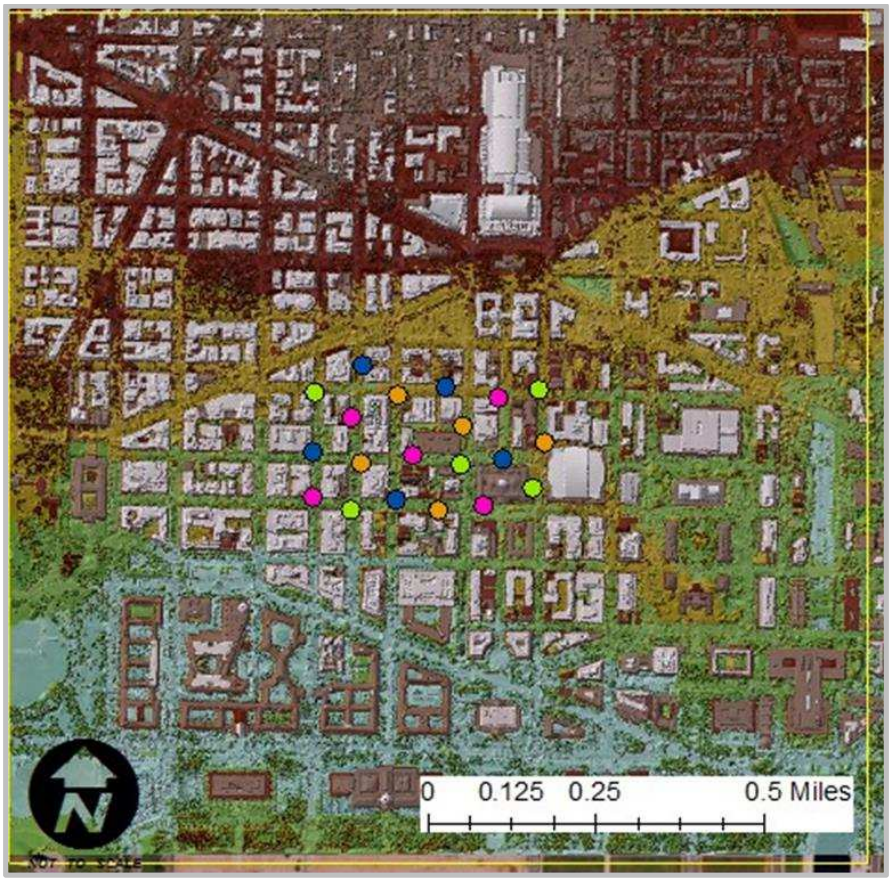

Figure 7: Urban Canyon Model – Hypothetical 5G Sites in Washington, DC

The design and operating specifications, including the antenna patterns and antenna tilts, for DBS receivers as well as for the hypothetical 5G MVDDS base stations and mobile units modeled in our Washington, DC study were the same as those used in our original Coexistence Study.[13]

Running the analysis against the 0.7-meter resolution LIDAR data available for Washington, DC, we found few pixels in which predicted levels of EPFD exceed the applicable limit. Figure 8 below shows in red the worst-case rooftop areas in which the regional EPFD limit is exceeded from any of the twenty base stations for any of the visible DBS satellite look angles. Most of the red pixels are on the building parapets, which are the low protective walls that are typically installed on apartments, condominiums and other multi-story dwelling structures, not the actual building roofs where DBS dishes would be situated. Overall, there were few areas where the worst case EPFD limit was exceeded, and any problems can likely be addressed by attentive placement of 5G MVDDS base stations and sound radiofrequency engineering of the 5G MVDDS network.

[13] *See* Coexistence Study at 19-20.

Figure 8: 48 dBm / 100 MHz MVDDS Base Stations with Protection of DBS Antennas

Figure 9 shows the same view without the underlying aerial-view image for better clarity. Although some rooftops show small areas of red where the EPFD would be exceeded, those areas were relatively minor with respect to the overall area and were mostly concentrated at the edges of the buildings. Moreover, the pixels shown in red only indicate the *potential* for harmful interference to DBS under our worst-case assumptions. Actual harmful interference could only occur if a DBS receive antenna were present in that location with realized worst-case conditions, which, given the building configurations and the likely DBS receive antenna look angles in this environment, is unlikely.[14] As in the original Coexistence Study, the areas in which 5G MVDDS sites would cause EPFD to be exceeded in the urban-canyon environment are quite limited and generally not among the more likely or desirable locations for DBS receive antennas in any case.

One building in the western portion of the study area, which is identified with a circle in Figure 9 below, exhibited higher EPFD than other structures surrounding the model deployment. That

[14] In the event the analysis were to show a red pixel at an existing DBS antenna location, then additional site engineering would be required to eliminate that pixel. If it is not possible to remedy the exceeded EPFD using operational modifications to the offending site(s), then the analysis would conclude that MVDDS could not be deployed in such a configuration.

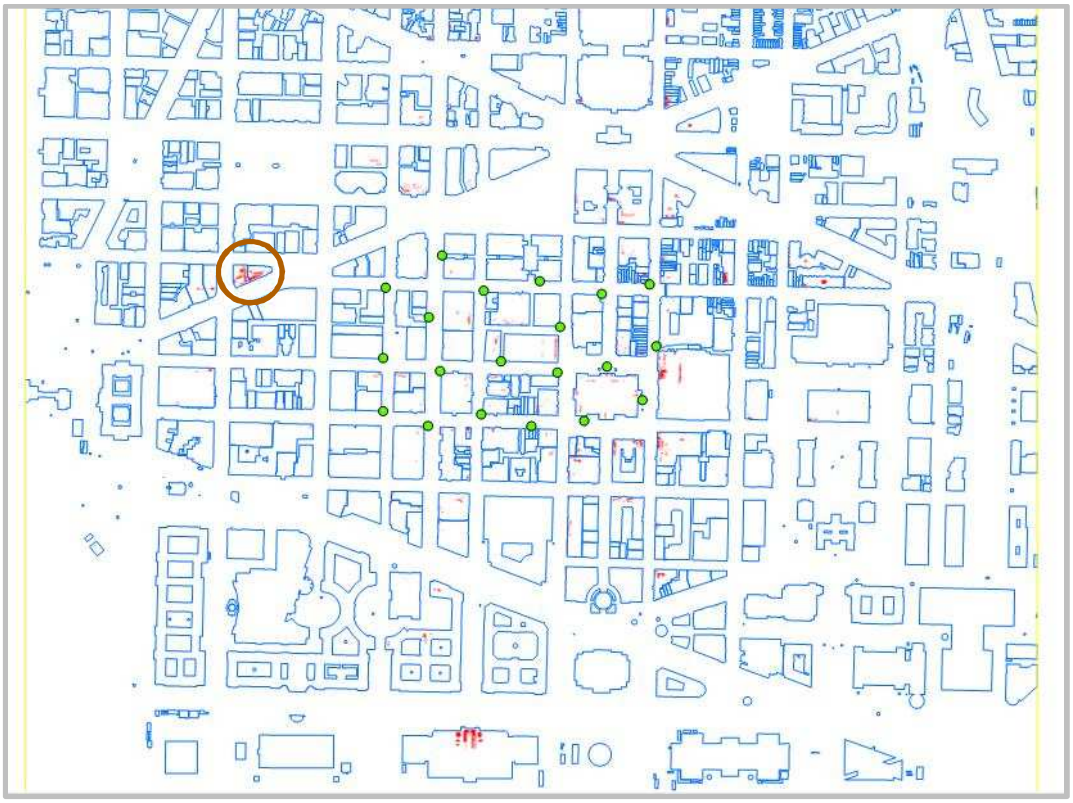

Figure 9: 48 dBm / 100 MHz MVDDS Base Stations with Protection of DBS Antennas – Worst-Case of Satellite Look Angles (without Underlying Image)

building, the New York Avenue Presbyterian Church, represents something of a perfect storm for excess EPFD. As shown in Figure 10 below, the building is a flat-roofed, four-story structure without any meaningful parapet on its roof. The building is also located inside an urban canyon on a triangular outpost of land that has a direct line of sight to the hypothetical 5G MVDDS base stations

Figure 10: The New York Avenue Presbyterian Church, as Seen from H Street, NW

located along H Street to the east. The building's configuration and its distinctive site location create one of the few areas of excess EPFD in the downtown Washington, DC study area. But from the perspective of a 5G MVDDS deployment, the potential for excess EPFD effects on the rooftop of the New York Avenue Presbyterian Church should prove readily manageable.

As a threshold matter, the Presbyterian Church is not typically a satellite television subscriber. But even if the church were to subscribe to a satellite television service, a sizeable portion of the rooftop remains unaffected by potential excess EPFD from 5G MVDDS transmissions in the H Street corridor. More importantly, if a DBS receive antenna were located on that portion of the building's roof that is predicted to experience excess EPFD, a would-be 5G MVDDS operator could still address the situation through employing any number of radiofrequency network design techniques. These techniques include power reductions, antenna downtilt or other network-design considerations that are commonly used in wireless deployments today.

Designing a radiofrequency deployment is never a one-size-fits-all proposition, and tailoring the network deployment model to avoid excess EPFD where necessary should not pose an unusually demanding challenge for network operators, especially considering the limited degree of excess EPFD observed in the models studied.

2. MVDDS 5G Mobile Stations

As explained in the original Coexistence Study, modeling the interference effects of mobile-device operation must take into account numerous practical limitations on mobile-device density, including "(1) the relatively small cell size of 12 GHz operations compared to lower-frequency services; (2) the likely market share of the licensee compared to other 5G service providers; (3) the variability in the use by the 5G devices at different times of day; and (4) the likelihood of an in-cell device operating in an active state at any given moment of time."[15] For

[15] Coexistence Study at 23.

that reason, we again used data from New York City, which has the highest population density in the United States, to identify how these factors would affect mobile-device operational density in a 5G network operating in the 12.2-12.7 GHz band.[16] Based on that model and consistent with our earlier Coexistence Study, we assumed five simultaneously transmitting mobile devices for each of the 20 base stations in our outdoor, urban-canyon model for a total of 100 mobile devices in simultaneous operation.[17] Each of these units was assumed to be simultaneously transmitting from cell edge at a maximum power of 23 dBm.

As in the original Coexistence Study, we assumed that 5G MVDDS devices would operate at maximum power not to reproduce a realistic or likely operating environment, but rather to identify and model a worst-case scenario for assessing the likelihood of interference between 5G MVDDS operations and DBS satellite receive antennas in the 12.2-12.7 GHz band.[18] A diagram showing the location of operation of 100 full-power outdoor mobile devices is shown in Figure 11 below. As seen in the diagram, five mobile devices were distributed inside the urban canyons around each of the 20 outdoor base stations we modeled for the downtown Washington, DC study area for a total of 100 mobile devices, which are indicated by green points in the Figure 11 below.

[16] Coexistence Study at 23.
[17] *Id.* at 24.
[18] While more than five devices could operate in a cell in real-world conditions, most, if not all, devices would operate at much lower power than 23 dBm. A situation in which more than five devices transmit simultaneously at maximum power would be at odds with worst-case models on traffic and usage densities explained in detail in the original Coexistence Study.

Figure 11: Location of 100 5G MVDDS Mobile Devices in Outdoor Model

Figure 12 below shows the areas where the EPFD is exceeded assuming five mobile devices per base station are transmitting at their maximum possible power. These areas are shown in red. They are small, infrequent and concentrated on building parapets. The areas of excess EPFD shown in red are small enough to be difficult to see at standard resolution. Figure 13

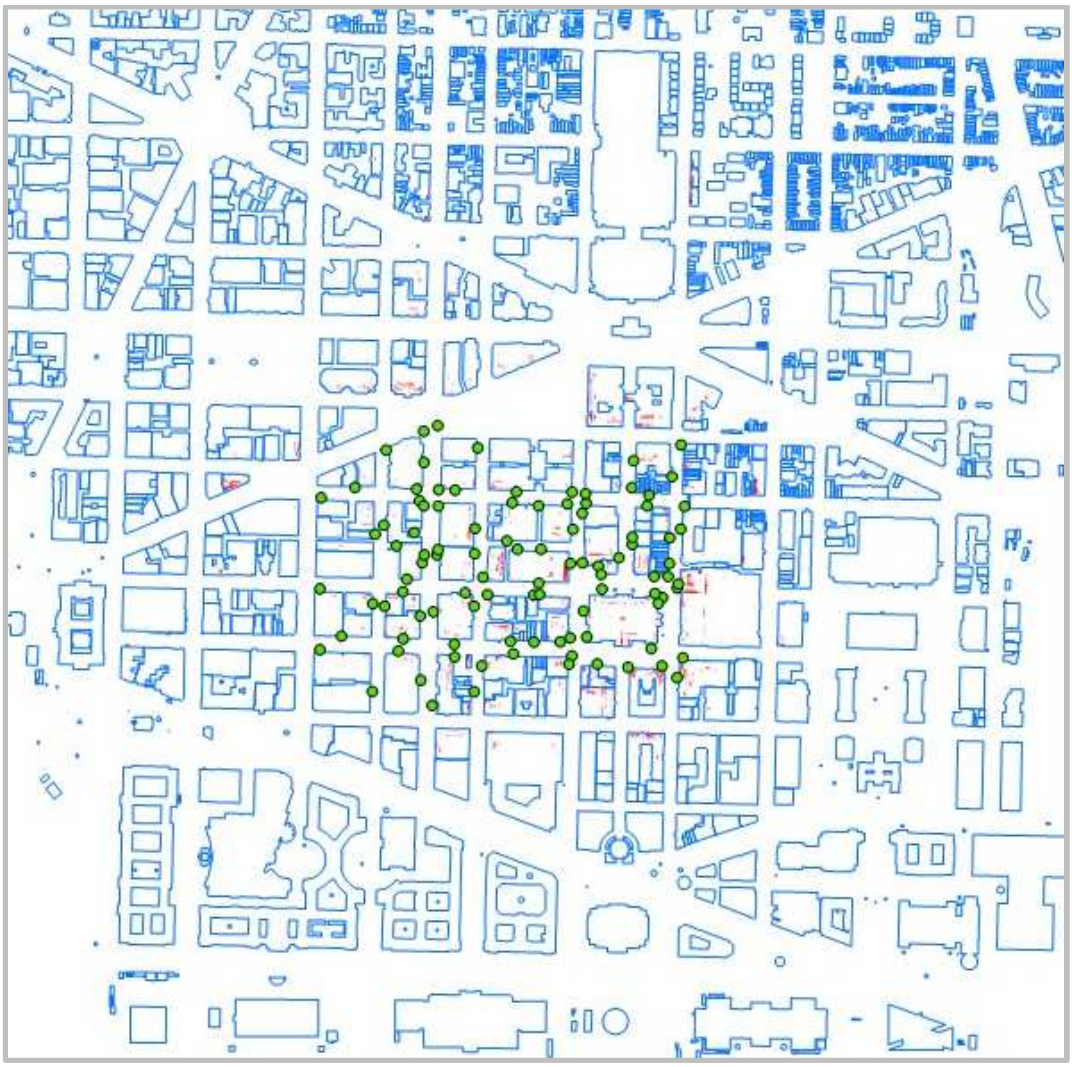

Figure 12: Areas of Predicted Excess EPFD for 100 Mobile Devices Outdoors

therefore offers an enlarged view of the area immediately surrounding the 100 5G MVDDS mobile devices that we modeled. Even in an enlarged format, however, the areas exhibiting excess EPFD remain small and the building rooftops continue to offer expansive locations without any excess EPFD. As in the original Coexistence Study, moreover, our analysis presents a worst-case environment for device operation.[19] In reality, the majority of mobile devices in a 5G MVDDS network would transmit at much lower power due to power control, which would substantially reduce the incidence of excess EPFD.

[19] Coexistence Study at 24.

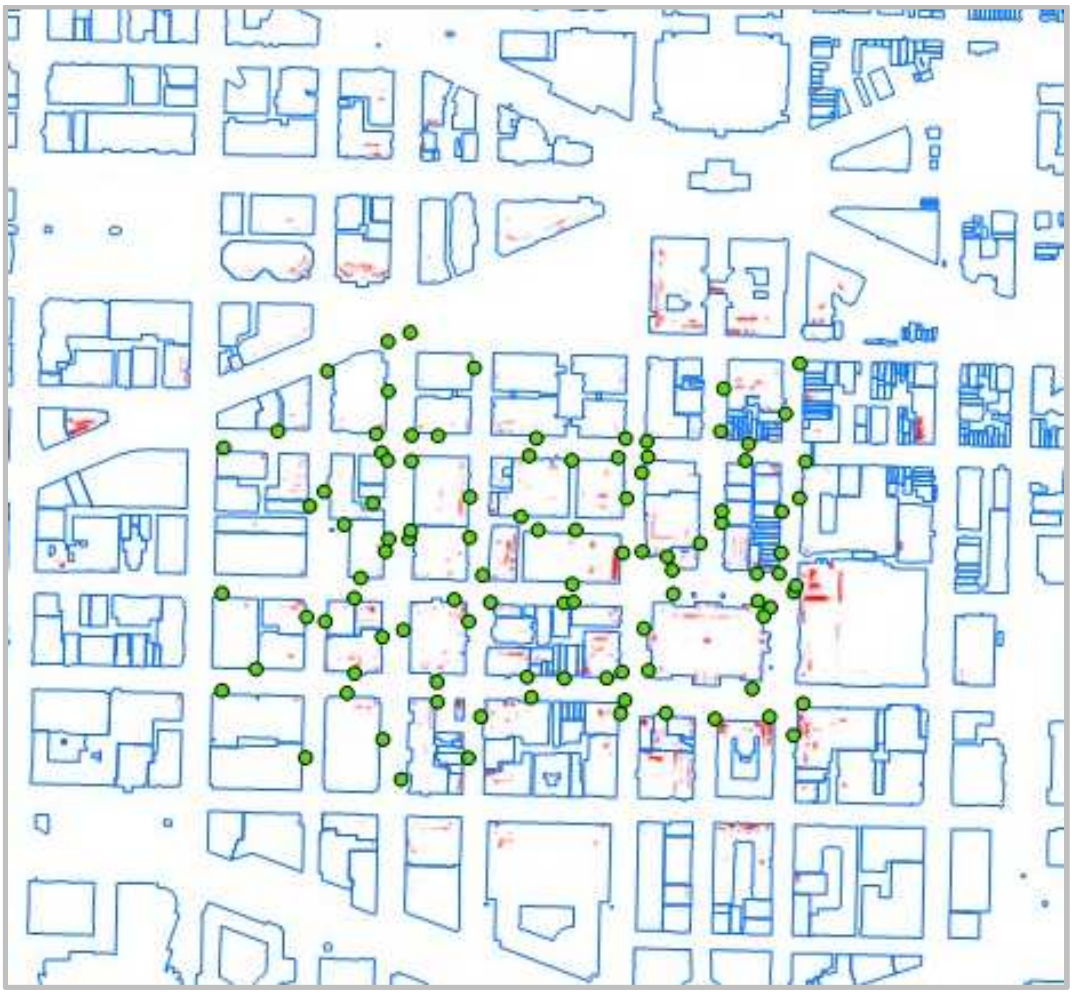

Figure 13: Areas of Predicted Excess EPFD for 100 Mobile Devices Outdoors (Enlarged View)

C. DBS Coexistence with MVDDS 5G Indoor Sites

For the indoor use case in the Washington, DC study area, we modeled 16 access points inside the Verizon Center. The roof of the Verizon Center is thirty to 35 meters above street level; therefore, the height of the access point was set at a uniform 27 meters for all 16 access points inside the arena.

Figure 14 shows the lateral locations of the 16 access points we modeled. Each access point in our model was assumed to employ a reuse of four; therefore, four access points operated on a co-channel basis at any one time. The colors of the points in Figure 13 identify each of the four frequency groups; access points with the same color were assumed to operate on a co-channel basis.

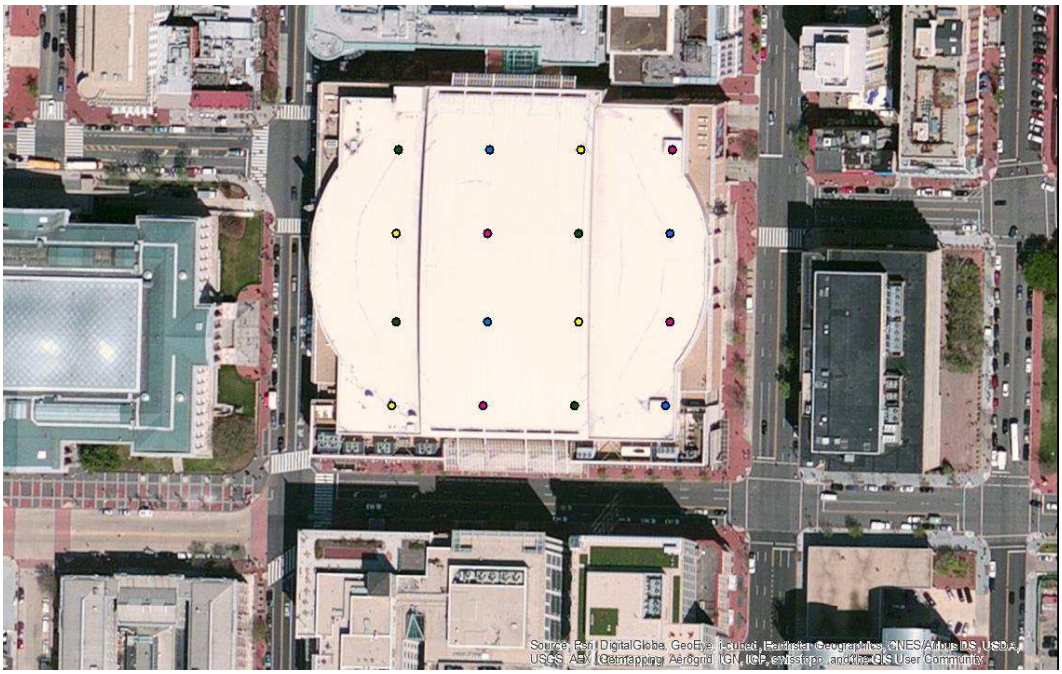

Figure 14: Verizon Center Access Point Locations

As in the original Coexistence Study, we modeled five active mobiles for each of the 16 access points for a total of 80 mobile devices, with each device operating at the maximum power of 23 dBm.[20] During an event, the Verizon Center would very likely have many more than 80 mobile devices accessing the network at any one time because it has a capacity of up to 20,356 people; however, the effect of co-channel aggregation to DBS is limited to only those mobiles that transmit on the same channel at the same time. With 16 access points and a reuse of four, only four mobiles can transmit on the same channel simultaneously, which limits the effects of co-channel EPFD aggregation.

This limitation on EPFD is somewhat counterintuitive because users *perceive* a single access point supporting multiple mobile devices on the same channel simultaneously. But the apparent simultaneity of co-channel operation from a single access point is a misperception arising from the base station's scheduler supporting one device at a time on a channel or sub-channel in extremely rapid succession. Mobile transmissions are scheduled in both the frequency domain and the time domain, with only one mobile using a given frequency at a given time. Therefore, transmissions from multiple mobiles connected to the same access point are not aggregated for purposes of analyzing the EPFD effects, and our analysis appropriately confined the effects of power aggregation to only those mobiles simultaneously transmitting co-channel to different access points.

In the interest of capturing all possible EPFD effects on the surrounding environment, however, we assumed that *all* points within the Verizon Center had a line-of-sight view to the Verizon Center's building envelope and were not obstructed by any other internal structures, which is an unrealistic and, thus, a very conservative, assumption. Analyzing 80 mobiles assuming a

[20] Coexistence Study at 23-24.

radiofrequency-transparent[21] arena allowed us to examine the EPFD results from a wide variety of different mobile locations, each of which could have a view to nearby buildings and rooftops where DBS receive antennas might be located. Introducing more than 80 mobile locations to the analysis would complicate the calculations, but would not have materially changed the results. This lack of change is attributable to the limitation of power aggregation to four mobile devices in the configuration, as described above. The four-channel limitation means that the effect of adding mobile devices in more locations inside the arena would not increase the effects of power aggregation. The effect of more mobiles in slightly different locations would only serve to provide more opportunities for line-of-sight to potential DBS antenna locations outside the Verizon Center; however, there is an effect of diminishing returns for increased line-of-sight events because the vast majority of potential DBS antenna locations are already visible by at least one of the 80 mobile devices assumed in the analysis by virtue of the presumption of a radiofrequency-transparent arena. Thus, taking into consideration more physical locations of mobile devices would have a minimal effect on possible EPFD effects.

We assumed each indoor access point would use the same EIRP we used for 5G MVDDS access points in the Circle Centre Mall featured in the original Coexistence Study. But because the open arena of the Verizon Center provided less signal attenuation than the Circle Centre Mall in Indianapolis, we noted that 5G MVDDS operators might need to reduce access point power inside the Verizon Center to mitigate self-interference among co-channel 5G MVDDS transmitters. We therefore also modeled lower power for the indoor access points and analyzed the results. We do not report the results of our analysis of lower power 5G MVDDS access points here because it should come as no surprise that reduced access-point transmitter power resulted in a reduced incidence of excess EPFD outside the building envelope and allowed for a linear reduction in the assumed amount of building attenuation needed to protect against excess EPFD. To maintain worst-case assumptions, we simply ignored the likelihood MVDDS operators would need to reduce access point power to prevent self-interference among MVDDS transmitters inside the Verizon Center and maintained power levels for access points inside the arena at the unrealistically high level of 36 dBm per 100 MHz. Even at these levels of power, we found that the 5G MVDDS access points generated little excess EPFD outside of the building envelope.

1. MVDDS Indoor 5G Access Points

As in our original Coexistence Study, our analysis of indoor 5G deployments began by modeling indoor access points.[22] Consistent with existing deployment practices, we assumed 5G indoor access points would operate from an installation point on the ceiling and would use an omnidirectional antenna pattern. We used the same radiation pattern and other technical parameters as our original Coexistence Study to model 5G MVDDS access point transmitters located inside the Verizon Center.[23]

[21] "Radiofrequency-transparent" should be understood to mean that there are no radiofrequency barriers from the interior of the building to the exterior of the building.
[22] Coexistence Study at 27-28.
[23] *Id.*

In this study, however, we also considered the effects of aggregate power from co-channel transmitters. As described above, we modeled 16 access points inside the arena and assumed a reuse of four. Thus, there were four sets of four access points inside the Verizon Center that were assumed to share the same 125-megahertz channel, and the power from each co-channel set of access points was aggregated. In addition, our analysis used the worst-case EPFD calculation of each of the four frequency groups we analyzed. That is, if any one of the four frequency groups exceeded the EPFD limit at a one-square-meter pixel within the study area, then that pixel was shown in red as having exceeded the EPFD limit that applies to the Washington, DC region.

Our model calculated the pixels in which EPFD limits were exceeded outside the building from each set of four co-channel access points located inside the Verizon Center, assuming each access point was transmitting at 36 dBm per 100 MHz (i.e., 30 dBm per 24 MHz) and assuming just 35 dB of building losses. In our original Coexistence Study, we had assumed 50 dB of loss from the envelope of the building.[24] This value for building attenuation remains reasonable; however, using that value in the Washington, DC study area produced zero pixels of excess EPFD. We therefore challenged our earlier building-loss assumption and reduced building losses by ten decibels to 40 dB. But even a ten-decibel reduction in assumed building losses produced zero pixels of excess EPFD. To press the assumption still further, we reduced the building losses a third time by five decibels to just 35 dB. Only at 35 dB did any red pixels appear in our model.[25] Figure 15 below shows the pixels with excess EPFD in red, assuming 35 dB of building losses.

[24] Coexistence Study at 28.

[25] To control self-interference to other MVDDS access points, operators would likely use less power inside the open Verizon Center than they would inside a walled mall in Indianapolis, for example. Reducing transmitter power would reduce the necessary building penetration losses on a decibel-for-decibel basis. For example, if the Verizon Center link budget called for a maximum transmit power of 26 dBm per 100 MHz (a 10 dB reduction), then the diagrams shown in Figure 15 and Figure 16 would represent a corresponding building penetration loss of just 25 dB.

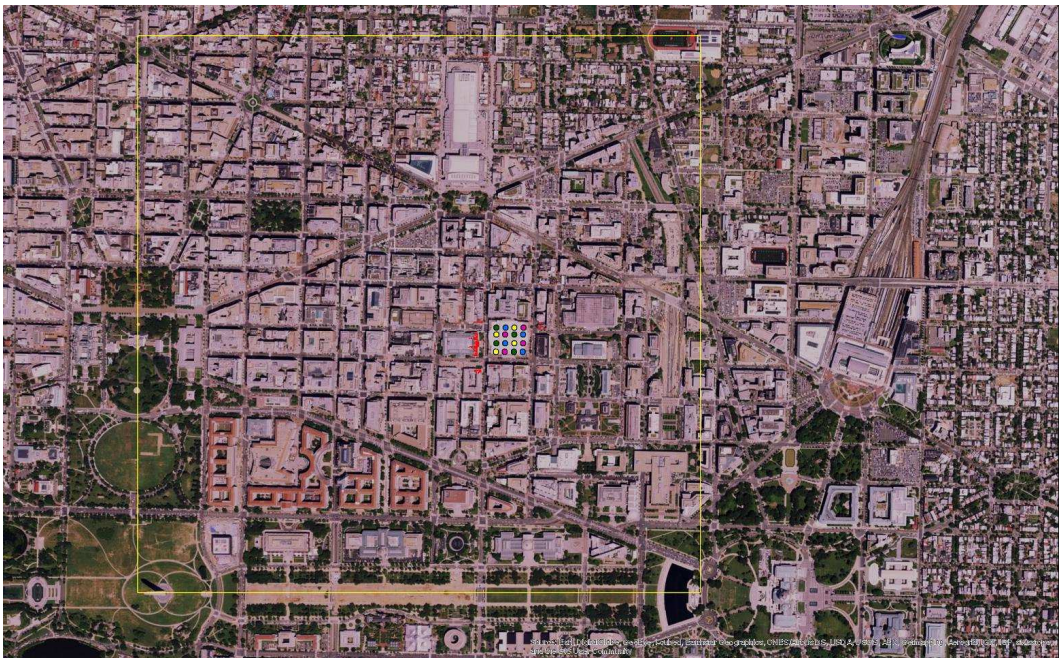

Figure 15: Areas of Excess EPFD from Access Points Inside the Verizon Center, assuming 35 dB of building penetration loss

The areas of excess EPFD are so few as to be difficult to identify on the aerial view of the Washington, DC study area. For clarity, an enlarged view of the image above is shown in Figure 16 below without the underlying aerial photograph.

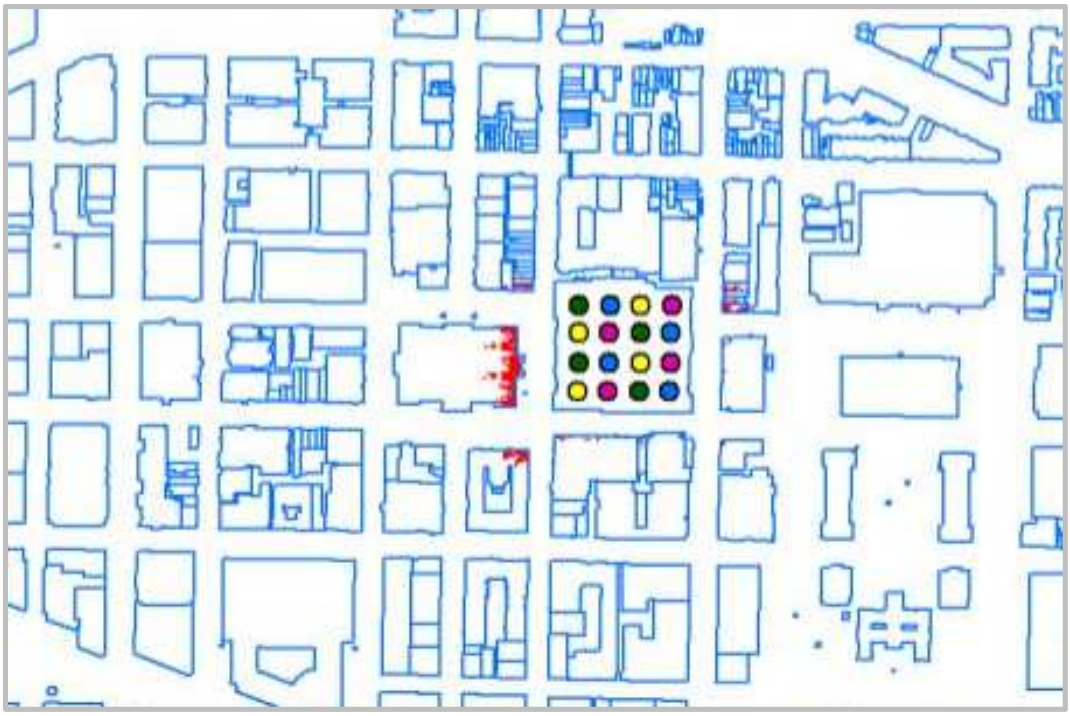

Figure 16: Areas of Excess EPFD from Access Points Inside the Verizon Center (Zoomed and without Underlying Image)

A building loss of 35 dB likely undercounts the attenuation that would occur for a 12 GHz signal that originates inside the arena and must pass through the heavy concrete construction of the facility as well as the many walls and obstructions around the building's interior perimeter. And yet, even with just 35 dB of building attenuation of indoor access point transmissions, very little excess EPFD appears associated with the indoor 5G MVDDS deployment we modeled.

As shown in Figure 16 above, the one building experiencing appreciable excess EPFD as a result of indoor access point operations inside the Verizon Center is the National Portrait Gallery, which is situated immediately to the west of the Verizon Center entertainment complex on the opposite side 7th Street, Northwest. But because the National Portrait Gallery is listed on the National Register of Historic Places, the operators of that facility are unable to install DBS receive antennas on the building. The point in identifying this practical limitation on DBS receive antenna placement is not to suggest that excess EPFD will always or even often occur in such a favorable manner from the perspective of a prospective 5G MVDDS operator. Instead, the practical limitations on DBS satellite receive installations simply highlights the context-sensitive nature of EPFD analysis in the 12.2-12.7 GHz band: areas that may feature excess EPFD may, in fact, pose no realistic threat of interference because no DBS receive antennas are present or, under current law, ever could be.

2. MVDDS Indoor 5G Mobile Devices

We also studied the EPFD effects of multiple mobile devices transmitting simultaneously from inside the Verizon Center. Similar to our outdoor study, we assumed five active 5G MVDDS mobile devices per access point in our indoor model.[26] We also accounted for co-channel power aggregation in our indoor 5G MVDDS mobile device model, just as we had with our indoor 5G MVDDS access point model. Signals from indoors penetrating outdoors experience significant degradation passing through the walls of the building. Indoor attenuation can be so great that emissions might not exceed the applicable EPFD levels without acting in concert with another co-channel emission.

We did not account for co-channel power aggregation in our outdoor urban-canyon model, however.[27] In an outdoor use case, distances are very short relative to the free space path loss required for a signal from a single transmitter to be close to the EPFD limit; therefore, power aggregation of multiple co-channel transmissions does not change the analysis. That is, the outdoor environment offers less attenuation than the indoor environment and, as a result, signals in the outdoor model tend to produce EPFD measurements in the surrounding environment that are either well below or well above the requisite level. A simplifying assumption to exclude power aggregation was therefore warranted in the outdoor use case because EPFD from an outdoor transmitter is generally either present in abundance or not present at all.[28]

---

[26] Coexistence Study at 30.
[27] *See supra* note 11.
[28] At 48 dBm per 100 MHz (i.e., 42 dBm per 24 MHz), the EPFD limit is typically exceeded by more than 28 dB due to line-of-site propagation over short distances. While the precise degree of excess EPFD possible under the current rules for MVDDS will vary depending on base station antenna patterns and other factors, the level of excess EPFD exhibited in our analysis

Figure 17 below shows the locations of 80 active mobile devices inside the Verizon Center. The color of the dot represents the height of each mobile device, which roughly corresponds to the tiered seating inside the arena for purposes of determining line-of-site to DBS antenna locations outside the arena. The blue dots represent mobile devices that are two meters above ground level (AGL); the green dots represent mobile devices 11 meters AGL; and the yellow dots represent mobile devices are 22 meters AGL.

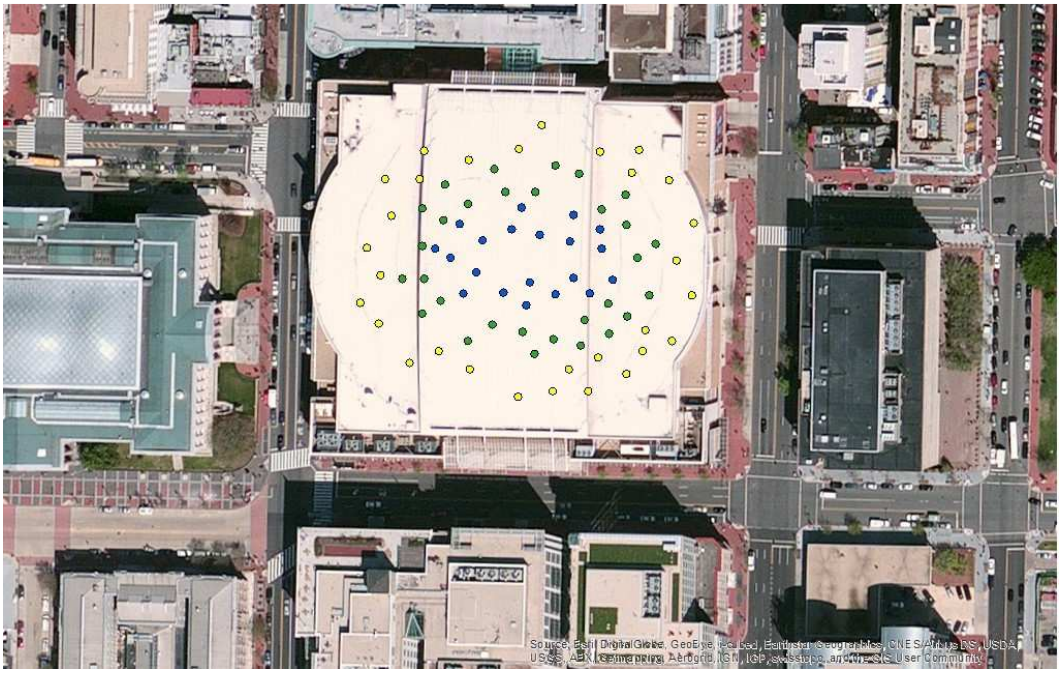

Figure 17: Locations of 80 Mobile Devices Inside the Verizon Center

In our model 5G MVDDS deployment inside the Verizon Center, we once again assumed five mobile devices per access point transmitting simultaneously at maximum power of 23 dBm EIRP per 24 MHz. In this analysis, we aggregated power from co-channel simultaneous transmissions, which required us to sum power on every frequency individually in every pixel. We identified the maximum of sums found across all frequencies and tested against different thresholds of building penetration loss, as explained above.

We note, however, that this methodology is extremely conservative because in reality most mobile devices operating inside the arena of the Verizon Center with line-of-site to an access point only meters away would not transmit at full power. Thus, there is a compound effect of aggregating overstated power levels which results in even more overstated aggregated power

---

implies that even the current MVDDS power limit of 14 dBm per 24 MHz would produce plots that look very similar to the plots shown here to model the increased power and functionality that the MVDDS Coalition has sought. In other words, models of the extent of excess EPFD produced under the current restrictive MVDDS rules would appear very similar to models of the extent of excess EPFD produced under the more flexible 5G rules that the MVDDS Coalition has proposed.

for purposes of calculating EPFD. Despite the extreme conservatism of this unrealistic approach, the results continue to demonstrate the feasibility of indoor deployments.

Figure 18 below shows the results for co-channel power aggregation involving 80 mobile devices. The image assumes a worst-case composite view of device performance and reduces building attenuation losses from the 50 dB used in our initial Coexistence Study to 45 dB.[29]

Figure 18: Areas of Excess EPFD from Mobile Stations Inside the Verizon Center

As shown above, very few pixels of the study area exhibit excess EPFD, assuming 45 dB of building losses. Figure 19 below shows an enlarged view of the same image without the aerial photograph for better clarity.

[29] Although we assumed 30 dB of building attenuation for mobile devices and 50 dB for access points in the Indianapolis indoor analysis, we assume a baseline of 50 dB for both here. In the Circle Centre Mall, the access points were assumed to be inside the first interior wall such that mobile devices could conceivably operate on the other side of that wall, closer to the exterior of the building. In the Verizon Center, however, the indoor deployment is designed to support service inside the arena only. Given the heavy-grade construction and the presence of multiple walls between the arena and the promenades that envelope the facility's perimeter, it is unlikely that mobile devices could obtain service from access points inside the arena and still operate close to the arena's exterior walls.

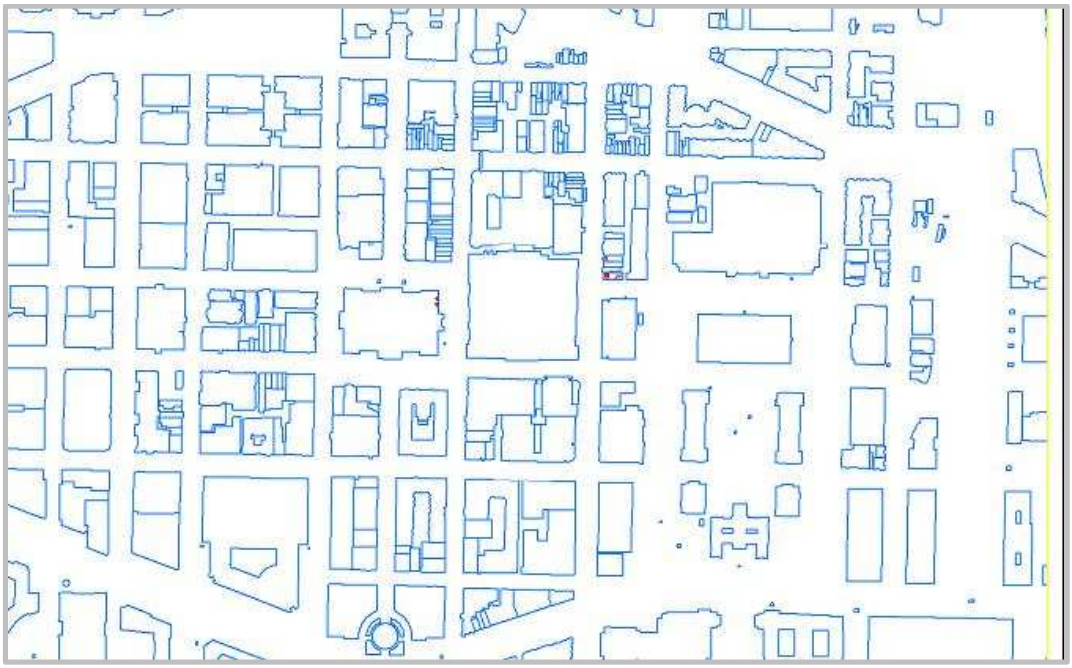

Figure 19: Areas of Excess EPFD from Aggregate Co-Channel Mobile Stations Inside the Verizon Center assuming 45 dB Building Losses (Zoomed View without Underlying Image)

Even with the image enlarged and de-cluttered, very few pixels in the study area exhibit any excess EPFD. To test the boundaries of this assumption, we reduced building penetration losses by an additional five decibels to 40 dB. Figure 20 shows the effects of this change in assumption. Areas of excess EPFD are visible, but – as in our model of 5G MVDDS indoor access points – these areas of excess EPFD are minimal and are generally confined to the National Portrait Gallery located to the west of the Verizon Center.

Figure 20: Areas of Excess EPFD from Aggregate Co-Channel Mobile Stations Inside the Verizon Center assuming 40 dB Building Losses (Zoomed View without Underlying Image)

IV. Conclusion

Our original Coexistence Study modeled a variety of likely 5G MVDDS use cases in and around Indianapolis, Indiana. The supplemental analysis provided here models two of the most likely 5G MVDDS use cases – indoor and urban canyon deployments – in the higher-density urban environment of Washington, DC.

To test the strength of our earlier findings, we employed several less forgiving assumptions in the current model than in our original Coexistence Study. For example, we considered the aggregate power of indoor access points and indoor mobile devices simultaneously operating on the same channel. We also increased the height of outdoor base stations from four meters to five meters and reduced the building penetration loss assumptions used when signals from indoor access points travel outside of the building envelope into the exterior environment. Despite these and other more demanding assumptions, our supplemental analysis of Washington, DC identified few areas of excess EPFD.

The limited extent of excess EPFD found both in the original Coexistence Study and in the current Washington, DC Coexistence Study reinforces our initial conclusion that numerous types of 5G MVDDS deployments can readily coexist with DBS receive antennas in the 12.2-12.7 GHz band.