

spectrum band to be put to its highest and best use, we also further Congress's objectives related to the use of public safety broadband spectrum in the 700 MHz band. The Spectrum Act directs that the proceeds from the auction of licenses in the 1995-2000 MHz band be deposited into the Public Safety Trust Fund, which will be used to fund FirstNet.<sup>196</sup>

66. In considering the rules that should govern potential interference between the 1995-2000 MHz band, which the Commission envisions as a downlink band,<sup>197</sup> and the adjacent AWS-4 uplink band, the Commission must consider the public interest benefits associated with potential uses in both bands, including, but not limited to, the net effect on the economic values of these bands, and adopt technical rules accordingly. The public interest in the 1995-2000 MHz band is almost certainly maximized if the band is used as an additional PCS band.<sup>198</sup> DISH, conversely, argued first that the Commission should effectively treat the 1995-2000 MHz band as a guard band, which would eliminate most of its value.<sup>199</sup> DISH then argued that the H block should not be made available for full power use,<sup>200</sup> and instead could be auctioned for air-to-ground or small cell use,<sup>201</sup> although both of these uses would, in our assessment, have considerably less economic value and other public interest benefits than an additional PCS downlink band.<sup>202</sup> Limiting the use of the band to air-to-ground operations would be inconsistent with the Spectrum

<sup>196</sup> See Spectrum Act §§ 6401(f), 6413.

<sup>197</sup> *H Block NPRM*, at ¶ 23-25 (proposing the 1995-2000 MHz band be made available as a downlink band). In addition, in 2008, the Commission specifically proposed that the 1995-2000 MHz band be made available for downlink transmissions only. *2008 Further Notice*, 23 FCC Rcd at 9860-61 ¶ 4 ("Prohibit mobile transmissions in the 1995-2000 MHz band); see also *AWS Sixth Report and Order*, 19 FCC Rcd at 20739 ¶ 39 ("We also find that due to similar characteristics and proximity to broadband PCS, the 1915-1920 MHz and 1995-2000 MHz band pairings is comparable to the 1910-1915 MHz and 1990-1995 MHz band pairing.").

<sup>198</sup> See *H Block NPRM*, at ¶¶ 1, 8.

<sup>199</sup> See, e.g., DISH Comments at 28 (arguing for strict emissions and power limits on 1995-2000 MHz).

<sup>200</sup> Letter from Jeffrey H. Blum, Senior Vice President and Deputy General Counsel, DISH, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 2 (filed Oct. 11, 2012) (*DISH Oct. 11 Letter*).

<sup>201</sup> See e.g., Letter from Jeffrey H. Blum, Senior Vice President and Deputy General Counsel, DISH, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 3 (filed Oct. 3, 2012) (*DISH Oct. 3 Letter*); Letter from Jeffrey H. Blum, Senior Vice President and Deputy General Counsel, DISH, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 5-6 (filed Oct. 17, 2012) (*DISH Oct. 17 Letter*).

<sup>202</sup> See Letter from Marc S. Martin, Counsel for Sprint Nextel Corporation, K&L Gates LLP, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 1-2 (filed Nov. 2, 2012) (*Sprint Nov. 2 Letter*); Letter from Marc S. Martin, Counsel for Sprint Nextel Corporation, K&L Gates LLP, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 1-2 (filed Oct. 31, 2012) (*Sprint Oct. 31 Letter*). DISH argues that limiting the band to small cells would not reduce its value. See Letter from Jeffrey H. Blum, Senior Vice President and Deputy General Counsel, DISH to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142 at 2 (filed Nov. 6, 2012) (*DISH Nov. 6 Letter*). However, DISH bases its argument, in part, on the inappropriate assumption that the 1995-2000 MHz band will be limited to low power in any case, arguing that this band will need to parallel power limitations DISH presumes will be adopted in the 1915-1920 MHz band. See *id.* at 2. First, although commenters have suggested power limitations in the 1915-1920 MHz band, (See e.g., Joint Reply Comments of Sprint Corporation, Verizon Wireless and Nextel Communications, WT Docket Nos. 04-356, 02-353 at 2-3 (filed Feb. 8, 2005) (*Joint Reply Comments on H Block*)) we have not yet adopted H block rules. Second, and more importantly, even if such power limits are adopted, parallel limits will not necessarily be needed for 1995-2000 MHz in the event the band is paired. Rather, with data technologies, more power can be used to increase data speeds, and higher speeds are needed on the downlink than on the uplink [see (continued...)]

Act's direction to license the 1995-2000 MHz band for flexible use. Additionally, both the air-to-ground and small cell proposals, by precluding the possibility of full power cellular operations, would restrict the value of the band in a way that we believe does not promote the public interest in this particular instance given specific characteristics of the band and the available alternative of higher power use. All four nationwide wireless providers have broadband PCS spectrum, as do regional and rural providers, and any of these providers could use additional PCS spectrum to expand capacity. One analyst projected that the value of the paired H block would be \$2-3 billion, which implies a price of at least \$0.67-\$1.00 per MHz POP, or \$1-\$1.5 billion for the downlink band.<sup>203</sup> We note that economists frequently consider it a rule of thumb that the public benefit of a licensed spectrum band typically equates to about ten times its value at auction.<sup>204</sup> Although as a matter of practice the Commission does not predict auction prices, we reference these figures as an indicator of the economic value or public benefit that could be derived from the spectrum, if it is usable for high power commercial services.<sup>205</sup> Indeed, Sprint suggests that auctioning the H block will produce "enormous public benefits,"<sup>206</sup> that the H block will be highly valued because it is cleared and ready for deployment,<sup>207</sup> and that it will help carriers meet needs for throughput, peak speeds, and capacity.<sup>208</sup>

67. The public interest benefits of the AWS-4 spectrum, including its economic value,<sup>209</sup> will also increase significantly once it is available for terrestrial use. The largest increase in value would occur if AWS-4 operations did not need to protect any adjacent bands. But that is not the case here. For example, DISH has acknowledged the need for AWS-4 operations to comply with technical rules designed to prevent harmful interference below 2180 MHz and above 2200 MHz.<sup>210</sup> However, DISH argues that, while licensees of AWS-4 authority should also be subject to technical rules for operations

(Continued from previous page)

*infra* ¶ 80, so there is no need to balance the uplink and downlink as suggested by DISH. See *DISH Nov. 6 Letter* at 3 (indicating downlink power will be "wasted").

<sup>203</sup> Jonathan Chaplin, Spencer Kurn, *Sprint/Softbank Details Emerge; Positive For Sprint And Other Carriers; Mixed For Towers*, Credit Suisse, Equity Research - Wireless Telecommunication Services, at 3 (Oct. 15, 2012); see also Philip Cusick, CFA, Eric Pan CFA, Richard Choe, Derya Erdemli, CFA, *DISH Network, Wireless Business Update: We Estimate \$5.5b NPV of Business Based on Shared Network Buildout*, at 2, 4 (Nov. 26, 2012) (estimating the value of the paired H block at \$1-2 billion).

<sup>204</sup> See e.g., Gregory L. Rosston, *The Long and Winding Road: The FCC Paves the Path with Good Intentions*, 27 *Telecomms. Pol'y* 501 (2003).

<sup>205</sup> Thus, contrary to DISH's suggestion, auction revenues are not dictating our public interest determination. See Letter from Jeffrey H. Blum, Senior Vice President & Deputy General Counsel, DISH, to Marlene H. Dortch, Sec'y, Federal Communications Commission, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 3-4 (filed Nov. 26, 2012) (*DISH Nov. 26 Ex Parte Letter*).

<sup>206</sup> Letter from Rafi Martina, Staff Attorney, Government Affairs, Sprint, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 1 (filed Jul. 2, 2012) (*Sprint Jul. 2 Letter*).

<sup>207</sup> See e.g., Letter from Trey Hanbury, Director, Government Affairs, Sprint, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 1 (filed Jul. 24, 2012) (*Sprint Jul. 24 Letter*).

<sup>208</sup> Letter from Rafi Martina, Staff Attorney, Government Affairs, Sprint, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 1 (filed Sep. 17, 2012) (*Sprint Second Sep. 17 Letter*).

<sup>209</sup> See Stifel Nicolaus, *FCC Staff Eyes Limits on Dish MSS/AWS-4 Spectrum Lower Edge to Shield H Block*, at 1, Nov. 13, 2012 ("But even with added limitations on the lower end, we still expect FCC approval of broad terrestrial wireless rights would make the MSS spectrum worth much more than the roughly \$3 billion Dish paid for it."); see also Wells Fargo Securities, *DISH: The Spectrum Story Just Got A LOT MORE Interesting!*, at 6, Nov. 19, 2012.

<sup>210</sup> See e.g., DISH Comments at 29.

below 2000 MHz, these rules should not restrict AWS-4 operations even if they limit the efficient use of the spectrum below 2000 MHz.<sup>211</sup> DISH identifies certain costs associated with such technical rules, including the claimed loss of the ability to use 5 MHz of uplink spectrum.<sup>212</sup> Sprint suggests that this impact can be mitigated through base station receive filters, co-location of base stations, and LTE interference mitigations.<sup>213</sup> DISH counters that filters would require 5 megahertz of transition band, co-location is not possible in all cases, and the LTE features mentioned by Sprint are more effective for UE-to-UE interference than base-to-base interference.<sup>214</sup> DISH has not attempted to quantify the economic value of its possible loss of some of the use of this 5 MHz to society, but simply argues that there is no net gain in spectrum because the Commission would be trading 5 MHz of AWS-4 uplink spectrum for 5 MHz of H block downlink spectrum.<sup>215</sup> This argument ignores the possibility of the Commission pairing 1995-2000 MHz with 1915-1920 MHz, as previously proposed<sup>216</sup> and proposed again in the *H Block NPRM*,<sup>217</sup> in which case making the 1995-2000 MHz band available may enable a total of 10 megahertz of spectrum by completing the pairing. Moreover, the 1915-1920 MHz and 1995-2000 MHz bands could be used by PCS operators to expand, for example, from 5 + 5 megahertz blocks to 10 + 10 megahertz blocks, or to otherwise aggregate PCS blocks. Also, as explained below, the technical rules we adopt do not prevent the use of 5 megahertz of spectrum; rather, they merely limit its use, and make provisions for improving its usability.<sup>218</sup>

68. More importantly, as explained above, the amount of spectrum is not the only question that the Commission must consider as we evaluate the rules that will govern the AWS-4 band. Rather, we must evaluate how best to serve and maximize the public interest with respect to all relevant bands. Because, as explained below, companies tend to use more downlink than uplink spectrum today,<sup>219</sup> it is not clear that the loss of some uplink spectrum would significantly diminish the utility (and economic value) of the paired AWS-4 spectrum. At a minimum, it appears that the public interest benefit (including economic value) of a fully usable 1995-2000 MHz band, which the Commission envisions as a downlink PCS band, is substantially greater than that of a fully usable additional 5 MHz of AWS-4 uplink—perhaps an order of magnitude greater. This may be particularly so if the 1995-2000 MHz band is ultimately paired with the 1915-1920 MHz band and the paired band is combined with other PCS spectrum to create, for example, 10+10 megahertz of PCS spectrum.

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<sup>211</sup> *DISH Sep. 24 Letter* at 4-5; *DISH Oct. 17 Letter* at 5.

<sup>212</sup> *See DISH Oct. 17 Letter*, at 3.

<sup>213</sup> *Sprint Nov. 2 Letter*, at 2-3.

<sup>214</sup> *DISH Nov. 6 Letter*, at 7-8.

<sup>215</sup> *See e.g., DISH Oct. 17 Letter*, at 4. Similarly, DISH states that impacting 5 megahertz of AWS-4 uplink to enable full power H block may be against the public interest; *see DISH Nov. 6 Letter*, at 7. In addition to this argument, DISH also argues that the network build costs for AWS-4 will be increased by 15-30%. *DISH Oct. 17 Letter*, at 4). *See infra* ¶ 84.

<sup>216</sup> *AWS Sixth Report and Order* at 20739 ¶ 39 (“We also find that due to similar characteristics and proximity to broadband PCS, the 1915-1920 MHz and 1995-2000 MHz band pairings is comparable to the 1910-1915 MHz and 1990-1995 MHz band pairing.”)

<sup>217</sup> *See H Block NPRM*, ¶ 25.

<sup>218</sup> *See infra* ¶¶ 89, 90, 91, 96.

<sup>219</sup> *See infra* ¶ 80.

69. Further, DISH incorrectly argues that the Spectrum Act precludes auctioning the 1995-2000 MHz band.<sup>220</sup> DISH reaches this conclusion by claiming the record shows that 1915-1920 MHz will interfere with the 1930-1995 MHz band, that the Commission has paired 1915-1920 MHz with 1995-2000 MHz, and therefore that the 1995-2000 MHz band is precluded from auction.<sup>221</sup> DISH similarly states that engineering analysis showing that interference to the 1930-1995 MHz band has not been done, and may preclude auction of the 1995-2000 MHz band when completed.<sup>222</sup> Conversely, Sprint argues that the Spectrum Act requires the auction of the 1995-2000 MHz band,<sup>223</sup> that the record shows that interference from 1915-1920 MHz is avoidable,<sup>224</sup> and that the deployment of LTE technology will further mitigate any potential interference.<sup>225</sup> DISH responds that is premature to reach any conclusions on the use of the 1995-2000 MHz band, and that its future is uncertain.<sup>226</sup> We do not reach any conclusions on the specific future use of the 1995-2000 MHz band in this proceeding; such determinations are outside its scope.<sup>227</sup> However, in our role as spectrum managers we do establish rules for AWS-4 that do not preclude uses of the 1995-2000 MHz band, or prejudge it to be unusable. And, although we do not make a final determination on the use of 1995-2000 MHz, we note that DISH's arguments have several flaws. First, many commenters on the H block proceeding have suggested that with appropriate technical limitations, the 1915-1920 MHz band will not interfere with the 1930-1995 MHz band.<sup>228</sup> Thus, such interference may not present a problem, or, if it does, the problem may be partially overcome. Second, although the Commission has proposed pairing 1915-1920 MHz with 1995-2000 MHz, the Spectrum Act does not require this, and a finding that 1915-1920 MHz cannot be auctioned due to interference with 1930-1995 MHz does not, in and of itself, release us from our obligation to auction the 1995-2000 MHz band.

70. DISH has put forward a technical proposal that it feels balances the usability of the 1995-2000 MHz band with the usability of the AWS-4 uplink band, while also speeding deployment in AWS-4 by minimizing the impact of our rulemaking on the 3GPP standards body.<sup>229</sup> This proposal includes

<sup>220</sup> *DISH Sep. 24 Letter* at 4-5; *DISH Oct. 3 Letter* at n.3.

<sup>221</sup> *DISH Sep. 24 Letter* at 4-5.

<sup>222</sup> *DISH Oct. 17 Letter* at 4.

<sup>223</sup> See e.g., *Sprint Jul. 2 Letter* at 1; *Sprint Jul. 24 Letter* at 1.

<sup>224</sup> See e.g., *Sprint Jul. 2 Letter* at 2; *Sprint Jul. 24 Letter* at 2.

<sup>225</sup> *Sprint Jul. 2 Letter* at 2.

<sup>226</sup> *DISH Oct. 11 Letter* at 2; Letter from Jeffrey H. Blum, Senior Vice President and Deputy General Counsel, DISH, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 5 (filed Oct. 10, 2012) (*DISH Oct. 10 Letter*); Letter from Jeffrey H. Blum, Senior Vice President and Deputy General Counsel, DISH, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 3 (filed Oct. 15, 2012) (*DISH Oct. 15 Letter*); *DISH Nov. 26 Ex Parte Letter* at 1-2; but see Letter from Lawrence R. Krevor, Vice President, Legal and Government Affairs - Spectrum, Rafi Martina, Staff Attorney, Government Affairs, Sprint, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 3 (filed Oct. 22, 2012) (*Sprint Oct. 22 Letter*) (arguing that DISH is effectively urging that consequences of AWS-4 rules for H block be ignored.).

<sup>227</sup> See *H Block NPRM*.

<sup>228</sup> *Joint Reply Comments on H Block* at 2.

<sup>229</sup> Letter from Jeffrey H. Blum, Senior Vice President and Deputy General Counsel, DISH, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 2 (filed Dec. 3, 2012) (*DISH Dec. 3 Letter*); Letter from Jeffrey H. Blum, Senior Vice President and Deputy General Counsel, DISH, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 2 (filed Dec. 7, 2012) (*DISH Dec. 7 Letter*).

DISH voluntarily designating 2000-2005 MHz as a terrestrial guard band, proposing the Commission set an emissions limit of  $60 + 10 \log_{10}(P)$  dB for AWS-4 emissions into the 1995-2000 MHz band, and asking the Commission to limit any emissions from the 1995-2000 MHz band by  $79 + 10 \log_{10}(P)$  dB above 2005 MHz. As discussed further below, we decline to adopt this proposal because we find that it will not speed deployment of the AWS-4 band or allow for full flexible use of the 1995-2000 MHz band.<sup>230</sup> Moreover, DISH's request that we establish OOB limits for the 1995-2000 MHz band is not within the scope of this proceeding. Rather these limits will be addressed in our companion *H Block NPRM*.<sup>231</sup>

71. Consequently, while the Commission has not adopted rules for the 1995-2000 MHz band, we are adopting technical rules for the AWS-4 uplink band that we predict will, in light of the record and of our assessment of the nature and characteristics of both bands, ensure efficient use of the AWS-4 band while preserving our ability to auction licenses for operations in the 1995-2000 MHz band. Moreover, we find that the approach and the technical rules we adopt will best serve the public interest by striking an appropriate balance that will enable both the AWS-4 band and the 1995-2000 MHz band that is adjacent to the AWS-4 uplink band (2000-2020 MHz) to be used for providing flexible use services in the most efficient manner possible.<sup>232</sup> In this way, we further and fully comply with our statutory mandates, including our responsibilities under the Communications Act to manage the spectrum in the public interest and Congress's specific direction regarding the 1995-2000 MHz band in the Spectrum Act. Furthermore, we recognize that in establishing rules that will enable the 1995-2000 MHz spectrum to be put to its highest and best use, we also further Congress's objectives related to the use of public safety broadband spectrum in the 700 MHz band. The Spectrum Act directs that the proceeds from the auction of licenses in the H Block, including 1995-2000 MHz, be deposited into the Public Safety Trust Fund, which will be used to fund FirstNet.<sup>233</sup>

72. Therefore, as explained below, we establish carefully calibrated, limited technical restrictions on AWS-4 operations in 2000-2005 MHz, the lowest five megahertz of the AWS-4 uplink band. In particular, as explained below, we are imposing (1) increased OOB limits at and below 2000 MHz, (2) reduced power limits for mobile terrestrial operations in 2000-2005 MHz, and (3) requirements that a licensee of AWS-4 terrestrial rights or of 2 GHz MSS rights must accept harmful OOB interference, if any occurs, from future operations in the 1995-2000 MHz band into the 2000-2005 MHz portion of the AWS-4 and 2 GHz MSS uplink bands and harmful overload interference, if any occurs, from operators in the 1995-2000 MHz band into the AWS-4 and 2 GHz MSS uplink bands.<sup>234</sup> We do this to protect future operations in the 1995-2000 MHz band from harmful interference; to ensure the possibility of flexible commercial use of that band, consistent with Congressional direction; and to strike a balance in ensuring the efficient use of both the AWS-4 and the 1995-2000 MHz bands. The Communications Act established "that the Commission's powers are not limited to the engineering and technical aspects of radio communications."<sup>235</sup> Rather, the Communications Act directs the Commission

<sup>230</sup> See *infra* ¶¶ 86, 87, 95, 147.

<sup>231</sup> See *H Block NPRM*, at ¶ 37.

<sup>232</sup> We disagree with DISH's assertion that the Commission has a "first-in-time" policy that requires us to grant DISH "full rights" to use AWS-4 spectrum and, only thereafter, begin to examine the rules for the 1995-2000 MHz band. See *DISH Nov. 26 Ex Parte Letter* at 3. We are aware of no Commission rule requiring the application of a generic first-in-time priority between adjacent spectrum bands.

<sup>233</sup> Spectrum Act.

<sup>234</sup> See *infra* Section III.B.5. (Acceptance of Interference into the AWS-4 Uplink Band).

<sup>235</sup> *National Broadcasting Co. v. United States*, 319 U.S. 190, 215 (1943) (*NBC*).

to “encourage the larger and more effective use of radio in the public interest” and to adopt “such rules and regulations and prescribe such restrictions and conditions . . . as may be necessary to carry out the provisions of this Act.”<sup>236</sup> As explained below, we deem it necessary to set these technical limits to best maximize AWS-4 and 1995-2000 MHz spectrum for flexible terrestrial use by minimizing harmful interference between the bands. We believe that the technical rules we adopt today to protect against harmful interference will promote more effective and efficient use of the 1995-2000 MHz band and the AWS-4 band and we believe that the benefits of these rules will outweigh any restrictions on the use of a portion of the AWS-4 uplink band. Moreover, any restrictions on the use of a portion of the AWS-4 band would be more than offset by the considerable increase in flexibility that the authorization holders will receive in obtaining overall terrestrial use rights under the Commission’s Part 27 flexible use rules instead of under the existing ATC rules.

73. Finally, we adopt rules that allow for the restrictions specified above to be modified by private agreement, thereby providing a licensee of AWS-4 operating authority with the ability to utilize this five megahertz of spectrum through deployment of higher performance technologies, commercial agreements with future 1995-2000 MHz band licensees, or other means. This will also provide greater flexibility to any operators that obtain licenses for both the AWS-4 A block and the 1995-2000 MHz band, as could be the case for a licensee of AWS-4 authority who bids on the 1995-2000 MHz band.

74. *Background:* In the *AWS-4 NPRM*, we sought comment on how licensees of AWS-4 operating authority should protect future adjacent channel H block operations at 1995-2000 MHz.<sup>237</sup> The *AWS-4 NPRM* discussed how current ATC rules, which establish a linear interpolation of OOB attenuation between  $70 + 10 \log_{10}(P)$  dB at 1995 MHz and  $43 + 10 \log_{10}(P)$  dB at 2000 MHz, do not allow for full use of the 1995-2000 MHz band by future licensees.<sup>238</sup> Against this backdrop, and recognizing that any future H block service rules may contemplate downlink (base-to-mobile) transmissions in the 1995-2000 MHz band, the Commission sought comment on three alternative OOB limits to address potential OOB interference from the AWS-4 uplink band into the 1995-2000 MHz band.<sup>239</sup>

75. First, the Commission sought comment on maintaining the existing ATC rule, which sets an OOB limit of  $70 + 10 \log_{10}(P)$  dB at 1995 MHz and an OOB limit of  $43 + 10 \log_{10}(P)$  dB at 2000 MHz with a linear interpolation between these two frequencies.<sup>240</sup> Second, the Commission sought comment on requiring fixed and mobile transmitters operating in 2000-2020 MHz to attenuate emissions below 2000 MHz by  $70 + 10 \log_{10}(P)$  dB, consistent with the emissions limit below 1995 MHz.<sup>241</sup> Third, the Commission sought comment on requiring fixed and mobile transmitters operating in 2000-2020 MHz to attenuate emissions below 2000 MHz by  $43 + 10 \log_{10}(P)$  dB, symmetric with existing limits for PCS emissions outside the 1930-1995 MHz band and broadly consistent with Commission rules.<sup>242</sup> For all three OOB limits, the Commission proposed using the existing measurement procedure of Section 27.53(h) of the Commission’s rules.<sup>243</sup>

<sup>236</sup> 47 U.S.C. §§ 303(g), (r).

<sup>237</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3575-77 ¶¶ 36-43.

<sup>238</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3575-76 ¶ 36; see also 47 C.F.R. § 25.252(c)(2)

<sup>239</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3576-77 ¶¶ 37-41.

<sup>240</sup> *Id.* at 3576 ¶ 38.

<sup>241</sup> *Id.* at 3576 ¶ 39.

<sup>242</sup> *Id.* at 3576-77 ¶ 40.

<sup>243</sup> *Id.* at 3577 ¶ 41.

76. In addition to the proposals discussed above, the Commission also sought comment on two proposals to mitigate interference issues associated with the 1995-2000 MHz band through a shift of the 2000-2020 MHz band.<sup>244</sup> Under the first proposal, the band would be shifted up five megahertz to 2005-2025 MHz.<sup>245</sup> The second proposal involved a ten megahertz shift and band compression, which would move the band to 2010-2025 MHz.<sup>246</sup>

77. In response to the *AWS-4 NPRM*, the Commission received comments favoring and opposing the proposals discussed above. Some parties commented that using linear interpolation with a  $43 + 10 \log_{10}(P)$  dB limit at 2000 MHz tapering to  $70 + 10 \log_{10}(P)$  dB at 1995 MHz is appropriate.<sup>247</sup> Other parties proposed different approaches. For example, Greenwood suggested that no taper is required as “filters will provide the requisite roll-off as well as provide necessary attenuation between 1995-2000 MHz.”<sup>248</sup> Motorola recommended that a flat  $43 + 10 \log_{10}(P)$  dB OOB limit would allow for typical signal roll-off and normal variations in commercial filter performance and enable AWS-4 to conform with other commercial mobile bands, thereby eliminating the need to impose costly operational limits on AWS-4.<sup>249</sup> DISH suggested that the existing linear interpolation be maintained, but interpreted in watts, not dB,<sup>250</sup> that a limit of  $43 + 10 \log_{10}(P)$  dB at 2000 MHz would not preclude full use of the 1995-2000 MHz band,<sup>251</sup> and, alternatively, that a limit of  $60 + 10 \log_{10}(P)$  dB at 2000 MHz would provide adequate protection of the 1995-2000 MHz band.<sup>252</sup>

78. Additionally, commenters discussed the merits of using 1995-2000 MHz as a guard band.<sup>253</sup> For example, AT&T commented that both 1995-2000 MHz and 1915-1920 MHz should be guard bands.<sup>254</sup> In contrast, Sprint and U.S. Cellular argued that 1995-2000 MHz should not be used as a guard band, but rather made available for commercial use.<sup>255</sup> U.S. Cellular did, however, suggest using 2000-2010 MHz as a guard band, by prohibiting AWS-4 operations in that range.<sup>256</sup> Furthermore, comments regarding the proposed spectrum shifts were mixed. For example, AT&T, Greenwood, and Motorola all supported the proposed shift.<sup>257</sup> These parties suggest that a 5 megahertz shift would reduce potential interference between AWS-4 and the PCS bands.<sup>258</sup> Conversely, both Alcatel and DISH argue a

<sup>244</sup> *Id.* at 3577 ¶¶ 42-43.

<sup>245</sup> *Id.* at 3577 ¶ 42.

<sup>246</sup> *Id.* at 3577 ¶ 42.

<sup>247</sup> DISH Comments at 27; Nokia Reply at 4.

<sup>248</sup> Greenwood Reply at 7-8.

<sup>249</sup> Motorola Comments at 6.

<sup>250</sup> DISH Comments at 27-28.

<sup>251</sup> *DISH Nov. 14 Letter* at 2.

<sup>252</sup> *DISH Dec. 7 Letter* at 3-5.

<sup>253</sup> See AT&T Comments at 7-8, Reply at 5-7; DISH Comments at 28; Greenwood Comments at 18; Sprint Reply at 6-8; TIA Comments at 12; and U.S. Cellular Comments at 5-6, Reply at 4.

<sup>254</sup> AT&T Comments at 7-8, Reply at 5-7.

<sup>255</sup> Sprint Reply at 4; U.S. Cellular Comments at 3-7.

<sup>256</sup> U.S. Cellular Comments at 5.

<sup>257</sup> AT&T Comments at 3, 5-8; Greenwood Comments at 19; Motorola Comments at 2-4.

<sup>258</sup> AT&T Comments at 3, 5-8; Greenwood Comments at 19; Motorola Comments at 2-4.

5 megahertz shift is unnecessary as it would curtail the rights of the 2 GHz MSS licensees by effectively making portions of the 2 GHz MSS spectrum unusable for the existing satellites, cause delays in deployment, and create additional interference issues.<sup>259</sup>

79. *Discussion:* For AWS-4 operations in 2000-2020 MHz, we adopt an OOB limit of  $70 + 10 \log_{10}(P)$  dB at and below 2000 MHz, which is the second of the three proposals from the *AWS-4 NPRM*, discussed above.<sup>260</sup> This limit promotes the public interest for several reasons: (1) it promotes the best and highest use of spectrum, (2) it fulfills our statutory obligations, (3) it provides consistent levels of protection for the adjacent 1990-1995 MHz and 1995-2000 MHz downlink bands, and (4) it maintains consistency with past Commission actions.

80. *Best and highest use of adjacent spectrum.* DISH has stated that a required attenuation of  $70 + 10 \log_{10}(P)$  dB below 2000 MHz would have a negative impact on operations in the AWS-4 uplink band.<sup>261</sup> While this is correct, we seek to balance this negative impact on a portion of the AWS-4 uplink spectrum with the positive impact on the usability of the 1995-2000 MHz band, to obtain the most efficient use of both bands, and to maximize the overall public interest. To this end, we observe that mobile broadband uses far more downlink than uplink spectrum. For example, at an FCC forum on the future of wireless band plans, Nokia Siemens Networks presented data showing a typical LTE network producing 13 times more downlink data than uplink data, while Alcatel Lucent showed 17 to 30 times more downlink data than uplink data.<sup>262</sup> Accordingly, there is a more pressing need for downlink spectrum than for uplink spectrum. Therefore, a possible limited reduction in uplink capacity may not present a hardship to a licensee of AWS-4 operating authority. In addition, as discussed further below, while some of the uplink spectrum may be restricted in power, our rules do not eliminate the use of any uplink spectrum.<sup>263</sup> Furthermore, extensions of existing bands can typically be put to use more cost-effectively than new bands.<sup>264</sup> Finally, to the extent some spectrum may have reduced utility to address interference issues, a fixed spectrum impact will represent a larger fraction of the 5 megahertz band from 1995 to 2000 MHz than of the lower 10 megahertz block in the 2000-2020 MHz band. Therefore, because 1995-2000 MHz can be used as a small downlink expansion of the existing PCS band, while 2000-2020 MHz is the larger uplink of a new band, these factors indicate that more efficient use of spectrum can be realized by promoting usability of 1995-2000 MHz even if it decreases the usability of a limited portion of the 2000-2020 MHz AWS-4 band.<sup>265</sup>

<sup>259</sup> Alcatel Comments at 9, 12-13; DISH Comments at 34, Reply at 24-28.

<sup>260</sup> See *supra* ¶ 75.

<sup>261</sup> DISH Comments at 27.

<sup>262</sup> See Nokia Siemens Networks presentation at FCC forum on the future of wireless band plans at 2, available at <http://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting71612/PANEL2.1-Jette-NokiaSiemensNetworks.pdf> (last visited Dec. 4, 2012) and Alcatel Lucent presentation at FCC forum on the future of wireless band plans at 2, available at <http://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting71612/PANEL2.2-Wilkus-Alcatel-Lucent.pdf> (last visited Dec. 4, 2012).

<sup>263</sup> See *infra* ¶¶ 89, 91, 138.

<sup>264</sup> For example, a new device supporting an extended band may be able to replace existing components one-for-one maintaining existing cost and size, while a device supporting a new band may have to add components for the new band while keeping previous components. Also, a new network being built in an extension of a band can reuse the site locations of existing band networks.

<sup>265</sup> In a 2003 notice of proposed rulemaking the Commission envisaged that new operations in the 1990-2000 MHz band would “need to take into account” MSS operations, including ATC, above 2000 MHz and that these licensees “should take measures both to ensure that their operations are protected from MSS/ATC operations and will protect (continued....)”

81. *Statutory obligations.* We find this OOB limit, combined with the mobile power limits and requirement to accept interference within the 2000-2005 MHz band from lawful operations in the 1995-2000 MHz band, which we establish below,<sup>266</sup> allows us to fulfill our spectrum manager role under the Communications Act by balancing the public interest goals of enabling efficient use of both the 1995-2000 MHz band and the AWS-4 band. Moreover, this limit enables us to fulfill our obligations under the Spectrum Act with regard to the 1995-2000 MHz band. The Spectrum Act requires the Commission, among other things, to make available via a system of competitive bidding the 1995-2000 MHz band.<sup>267</sup> We believe it is consistent with Congress's specific direction to auction this spectrum to preserve our ability to reach a possible finding that this band should support the deployment of full, robust, commercial service—including for mobile broadband. DISH suggests that we could restrict an auction of 1995-2000 MHz to small cell operations or as part of a paired air-to-ground / ground-to-air band.<sup>268</sup> We decline to so limit the potential uses of the 1995-2000 MHz band at this time, because this would likely diminish the efficiency and usefulness of the spectrum given the significant value we believe exists for high power uses in the 1995-2000 MHz band.<sup>269</sup> Further, the Spectrum Act specifically calls for flexible use of 1995-2000 MHz, and limiting the band to be suitable only for small cell or air-to-ground services may improperly curtail such flexible use if full terrestrial use remains a reasonable possibility for the band. While flexible use rules that permit higher power terrestrial use could also permit small cell or air-to-ground services, the reverse is not true—a band limited to either of those uses could not also be used for full power terrestrial operations.<sup>270</sup> DISH fails to explain how we can fulfill our statutory obligation to make the 1995-2000 MHz band available for flexible use via a system of competitive bidding without a strong OOB limit. Moreover, it is not clear if either small cell or air-to-ground use would result in an improved interference environment as compared to full power use.<sup>271</sup> Should the Commission ultimately

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MSS and ATC operations from interference.” Amendment of Part 2 of the Commission’s Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems, ET Docket No. 00-258, IB Docket No. 99-81, *Third Report and Order, Third Notice of Proposed Rulemaking and Second Memorandum Opinion and Order*, 18 FCC Rcd 2223, 2249 ¶ 51 (2003) (*AWS Third Report and Order*). The Commission sought comment on this matter and did not subsequently adopt rules or otherwise decide the matter.

<sup>266</sup> See *infra* Section III.B.4.b. (Mobile Stations), Section III.B.5. (Acceptance of Interference into the AWS-4 Uplink Band).

<sup>267</sup> The Spectrum Act makes an exception in the case of interference to the 1930-1995 MHz PCS band, however, no technical information in the record indicates that the 1995-2000 MHz band would cause interference to the 1930-1995 MHz band. See Spectrum Act § 6401(b)(4).

<sup>268</sup> See *e.g.*, *DISH Oct. 3 Letter* at 2-3.

<sup>269</sup> See *e.g.*, *Sprint Oct. 31 Letter* at 2; *Sprint Nov. 2 Letter* at 2.

<sup>270</sup> See *e.g.*, *Sprint Oct. 31 Letter* at 2.

<sup>271</sup> Sprint argues that due to the difficulty of co-location with small cells and the potentially large number of small cells, interference could be worse, not better, in the small cell scenario. See *Sprint Oct. 31 Letter* at 2. DISH counters with calculations showing at least 60 dB less signal from small cells, implying at least a million small cells would be needed to generate as much interference as one macro cell. *DISH Nov. 6 Letter* at 3. However DISH’s calculations assume small cells are limited to 200 mW, limited to indoor use, and deployed only at low heights, all of which are significant restrictions on the flexible use of 1995-2000 MHz. In addition, DISH’s calculation includes 30-50 dB of attenuation due to the indoor use and low antenna height restrictions, but does not explain how DISH obtained this range, including what antenna heights, penetration losses, or propagation models it has assumed. No parties addressed the interference characteristics of air-to-ground systems in any detail.

determine, in the forthcoming proceeding on this band, to limit the permissible services in this band, DISH or any other party is free to petition us to revisit the technical rules we adopt herein.<sup>272</sup>

82. *Consistent Protection Levels.* To promote more effective and efficient use of the 1995-2000 MHz band, we believe the same OOB limit the Commission adopted to protect current PCS operations below 1995 MHz— $70 + 10 \log_{10}(P)$  dB—will be both necessary and sufficient to protect future operations in the 1995-2000 MHz band.<sup>273</sup> This creates consistency in our rules, by affording the 1995-2000 MHz band the same protections as the existing PCS band.

83. *Past Commission Actions.* The Commission has long sought to put the 1995-2000 MHz band to productive commercial use. In 2004, 2007, and 2008, the Commission undertook efforts to make this spectrum available for full flexible use.<sup>274</sup> We therefore reject the approach advocated by some that the 1995-2000 MHz band should be used as a guard band between the extended PCS downlink band from 1990-1995 MHz and the AWS-4 uplink band.<sup>275</sup> Setting aside this block for no use is directly at odds with the Commission's past actions. Further, in 2010, the National Broadband Plan recommended that the Commission make this band available through auction.<sup>276</sup> Thus, the public has long been on notice that the 1995-2000 MHz band is not intended for use as a guard band.<sup>277</sup> Such notice significantly predates the current MSS licensee's acquisition of DBSD and TerreStar in 2011.

84. *The Record.* The proposed OOB limit of  $70 + 10 \log_{10}(P)$  dB at and below 2000 MHz received some support in the record. For example, Sprint supports this OOB level as necessary to protect the 1995-2000 MHz band.<sup>278</sup> U.S. Cellular proposed a limit of  $70 + 10 \log_{10}(P)$  dB at and below 2000 MHz to protect the 1995-2000 MHz band.<sup>279</sup> Several other commenters indirectly support an OOB limit of  $70 + 10 \log_{10}(P)$  at 2000 MHz, which will be five megahertz away from full power use of the AWS-4 uplink band,<sup>280</sup> by stating that this level is necessary to protect PCS operations below 1995 MHz without assuming any reduction in power between 2000-2005 MHz.<sup>281</sup> To achieve this level of protection for the 1995-2000 MHz band without applying this OOB limit at 2000 MHz and lower power limits in 2000-2005 MHz, we would need to create frequency separation between the 1995-2000 MHz

<sup>272</sup> We could also have delayed establishing AWS-4 rules until we first established services rules for the 1995-2000 MHz band, but decline to take this route.

<sup>273</sup> See e.g., 47 CFR 25.252(c)(2).

<sup>274</sup> See AWS-2 NPRM, AWS-3 NPRM, 2008 Further Notice, and National Broadband Plan. We observe in all cases 1995-2000 MHz was proposed for licensed, full power, terrestrial use. See e.g. AWS-2 NPRM, 19 FCC Rcd at 19305 ¶110; 2008 Further Notice, 23 FCC Rcd at 9860-61 ¶4.

<sup>275</sup> See e.g. AT&T Comments at 7-8, Reply at 5-7; TIA Comments at 12.

<sup>276</sup> National Broadband Plan, Recommendation 5.8.3 at p. 86.

<sup>277</sup> In general, designating spectrum for guard bands reduces their utility. See e.g. DISH Comments at 28. Therefore, it is generally good spectrum management to minimize the designation of spectrum to guard bands. However, in some circumstances it may be in the public interest to designate spectrum for guard bands. For example, we propose technically reasonable guard bands between different high-power services in our incentive auction NPRM. Incentive Auction NPRM, 27 FCC Rcd at 12412-15 ¶¶ 152-159. However, we find that the balance of the record before us in this proceeding does not require allocation 1995-2000 MHz as a guard band.

<sup>278</sup> Sprint Sep. 17 Letter at 6.

<sup>279</sup> U.S. Cellular Comments at 5.

<sup>280</sup> See *infra* Section III.B.4.b (Mobile Stations).

<sup>281</sup> *Id.*

band and the AWS-4 uplink band. For the reasons explained above, however, we decline to shift the AWS-4 uplink band up 5 megahertz (or more) to 2005-2025 MHz. DISH makes several arguments objecting to this OOB limit as unprecedented, unnecessary, and restrictive.<sup>282</sup> DISH also asserts that this limit would affect AWS-4 operations, including negative impacts for AWS-4 devices, rendering 25% of the AWS-4 uplink unusable, slowing DISH's deployment due to delays in the 3GPP standards process, requiring as many as 15-30% additional sites for licensees of AWS-4 authority, and not creating a net gain of spectrum for broadband.<sup>283</sup> DISH proposed that we instead adopt an OOB limit of  $43 + 10 \log_{10}(P)$  dB at 2000 MHz<sup>284</sup> and separately that we adopt an OOB limit of  $60 + 10 \log_{10}(P)$  dB at 2000 MHz.<sup>285</sup> We are not persuaded by these arguments.

85. We adopt the specific level of  $70 + 10 \log_{10}(P)$  dB because it provides a reasonable level of protection for the 1995-2000 MHz band, there is directly applicable precedent in the existing protection of the PCS G block from MSS/ATC, and it is superior to other attenuation levels raised in the record. As DISH correctly notes,<sup>286</sup> the interference from the AWS-4 uplink to operations in the 1995-2000 MHz band is likely to be mobile-to-mobile interference, and is therefore probabilistic, meaning the probability of interference depends on the likelihood of the interfering and victim mobiles passing close enough to each other under the right conditions. However, determining that interference is probabilistic does not mean that it should be ignored; rather, it means that rules should be set to ensure that the probability of interference is reasonably low.<sup>287</sup> To evaluate this probability, we make reasonable assumptions about interference and look at the separation needed between mobile devices to prevent interference with those assumptions. A larger resulting separation indicates a higher likelihood of interference. In its comments on this proceeding, Motorola proposes assumptions for the protection of the 1930-1995 MHz band that we find reasonable, with one modification, and applicable to the 1995-2000 MHz band.<sup>288</sup> Using the proposed assumptions with this modification,  $70 + 10 \log_{10}(P)$  dB yields a separation of 1.4 meters (under 5 feet), similar to the separation of 2 meters (about 6 feet) proposed by Motorola and the separations

<sup>282</sup> See e.g., DISH Nov. 6 Letter at 1, 4.

<sup>283</sup> See DISH Comments at 27; DISH Oct. 17 Letter at 3.

<sup>284</sup> See e.g., DISH Nov. 6 Letter at 4.

<sup>285</sup> See DISH Dec. 7 Letter at 3-5.

<sup>286</sup> See e.g., DISH Nov. 6 Letter at 6.

<sup>287</sup> In fact, this unpredictability of a mobile interferer makes this type of interference hard to identify and mitigate, so the probabilistic nature can make it more important to set rules to prevent it, not less. For example, DISH argued in the case of possible BAS interference that DISH would need to plan for the worst case when a mobile electronic news gathering (ENG) truck set up with a DISH base station in the line between the truck and the receive site, even though the probability of such an event is low. See e.g., Letter from Jeffrey H. Blum, Senior Vice President and Deputy General Counsel, DISH, to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142 at attached Wireless Strategy study 7. (filed Sep. 17, 2012).

<sup>288</sup> The exception is that Motorola applies body loss only to the transmitting mobile, and fails to apply it to the receiving mobile. See Motorola Comments, Technical App. at A-1. Applying it to both handsets is more reasonable, and is in fact the approach that Motorola takes in their own submissions to 3GPP. See e.g., 3GPP R4-080710, available at [http://www.3gpp.org/ftp/tsg\\_ran/wg4\\_radio/TSGR4\\_46bis/Docs/R4-080710.zip](http://www.3gpp.org/ftp/tsg_ran/wg4_radio/TSGR4_46bis/Docs/R4-080710.zip) (3GPP R4-080710) (last visited Dec. 4, 2012); 3GPP R4-114592, available at [http://www.3gpp.org/ftp/tsg\\_ran/wg4\\_radio/TSGR4\\_60/Docs/R4-114592.zip](http://www.3gpp.org/ftp/tsg_ran/wg4_radio/TSGR4_60/Docs/R4-114592.zip) (3GPP R4-114592) (last visited Dec. 7, 2012). Motorola concludes that a level of  $77 + 10 \log_{10}(P)$  dB is appropriate (this is equivalent to -47 dBm / MHz). Motorola Comments, Technical App. at A-1. However, adjusting their calculation by applying body loss to both devices lowers this to  $67 + 10 \log_{10}(P)$  dB, very close to our proposal of  $70 + 10 \log_{10}(P)$  dB.

typically used in 3GPP standards.<sup>289</sup>  $70 + 10 \log_{10}(P)$  dB is also the level that Sprint recommends as necessary to protect the 1995-2000 MHz band.<sup>290</sup> As another reference point, 3GPP adopts a similar but more stringent level of  $80 + 10 \log_{10}(P)$  dB for the protection of mobile receivers from mobile transmitters in most cases.<sup>291</sup>

86. DISH's initial proposal of  $43 + 10 \log_{10}(P)$  dB does not provide adequate protection to the 1995-2000 MHz band. Applying the same calculations to the level of  $43 + 10 \log_{10}(P)$  dB yields a separation of 32 meters (over 100 feet).<sup>292</sup> This represents a dramatic increase in the probability in interference, because it is far more likely that two mobiles will pass within 100 feet of each other, rather than 5 feet of each other.<sup>293</sup>

87. Although DISH provides more technical support for its later proposal of  $60 + 10 \log_{10}(P)$  dB, including references to two 3GPP submissions, from Qualcomm and Intel respectively, and one CEPT (European Conference of Postal and Telecommunications Administrations) study that proposed levels less stringent than  $60 + 10 \log_{10}(P)$  dB in various situations,<sup>294</sup> we observe that applying the above assumptions to the  $60 + 10 \log_{10}(P)$  dB level would result in a separation of 14 meters (about 46 feet), an unacceptably high separation compared to industry norms.<sup>295</sup> In addition, each of these studies considers a different case than we consider here, and thus is not directly applicable.<sup>296</sup> Finally, we note that despite

<sup>289</sup> See e.g., 3GPP R4-080710; 3GPP R4-114592.

<sup>290</sup> Sprint Sep. 17 Letter at 6.

<sup>291</sup> See LTE RF Standard for UEs at 68-71. (-50 dBm / MHz is equivalent to  $80 + 10 \log_{10}(P)$ ).

<sup>292</sup> See e.g., DISH Nov. 6 Letter at 8; Letter from Jeffrey H. Blum, Senior Vice President and Deputy General Counsel, DISH to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142 at 2 (filed Nov. 8, 2012) (DISH Nov. 8 Letter); DISH Nov. 14 Letter at 2 (where DISH argues that a limit of  $43 + 10 \log_{10}(P)$  dB does not preclude use of the 1995-2000 MHz band. DISH also argues that setting symmetric limits of  $43 + 10 \log_{10}(P)$  dB both from AWS-4 to the 1995-2000 MHz band and vice-versa will facilitate market-based solutions, as suggested in the AWS-4 NPRM.) See DISH Nov. 6 Letter at 4; AWS-4 NPRM, 27 FCC Rcd at 3567 ¶ 39. However, since we conclude that this level does not adequately protect the 1995-2000 MHz band, it is not clear if operators would take the risk of acquiring 1995-2000 MHz, and therefore it is not clear if these market forces would come into play.

<sup>293</sup> The area over which a mobile can cause interference is proportional to the square of this number. Since  $100^2 / 5^2 = 400$ , interference may be 400 times more likely with a limit of  $43 + 10 \log_{10}(P)$  dB than with a limit of  $40 + 10 \log_{10}(P)$  dB.

<sup>294</sup> See DISH Dec. 7 Letter at 4.

<sup>295</sup> See e.g., 3GPP R4-080710; 3GPP R4-114592, see also Letter from Marc S. Martin, K&L Gates LLP, Counsel for Sprint Nextel Corporation, to Marlene H. Dortch, Sec'y, Federal Communications Commission, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 3 (filed Dec. 6, 2012) (Sprint Dec. 6, 2012 Letter) (an OBE of  $60 + 10 \log_{10}(P)$  dB would triple the separation distance and "could result in widespread interference to future H Block users").

<sup>296</sup> The Qualcomm study considers interference to narrow band public safety devices in the 800 MHz band, the Intel study considers interference between the extended 800 MHz band and the 700 MHz Asia Pacific band, and the CEPT study considers TDD-FDD coexistence in the 2.6 GHz band. See Derivation of a Block Edge Mask (BEM) for Terminal Stations in the 2.6 GHz Frequency Band (2500-2690 MHz), ECC Report 131 (Jan. 2009), available at <http://www.erocecdk.dk/Docs/doc98/official/pdf/ECCREP131.PDF> (last visited Dec. 10, 2012); 3GPP TSG RAN WG4 R4-B26ah-0009, Results of Monte Carlo Simulations for Band 26 Coexistence Scenarios, Qualcomm, Incorporated (Jan. 17-19, 2012), available at [http://www.3gpp.org/ftp/tsg\\_ran/WG4\\_Radio/TSGR4\\_AHs/R4\\_AH\\_Band-26/Docs/R4-B26ah-0009.zip](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_AHs/R4_AH_Band-26/Docs/R4-B26ah-0009.zip) (last visited Dec. 10, 2012); 3GPP TSG RAN WG4 R4-B26ah-0035, Band 26 UE Spurious Emission on 850 MHz Lower Band (continued....)

these studies, 3GPP has adopted the level of  $80 + 10 \log_{10}(P)$  dB for the protection of the vast majority of bands,<sup>297</sup> and offering a level of only  $60 + 10 \log_{10}(P)$  dB may not allow full use of the 1995-2000 MHz band.<sup>298</sup> Further, DISH argues that independent of the OOB level, interference can only occur 0.25% of the time.<sup>299</sup> However, DISH offered no data to support its conclusions.<sup>300</sup> In sum, contrary to DISH's assertions that this emission limit is not necessary to protect the 1995-2000 MHz band,<sup>301</sup> we find attenuating OOB in 1995-2000 MHz by a factor of  $70 + 10 \log_{10}(P)$  dB will provide needed protection to the 1995-2000 MHz band.

88. In addition to providing reasonable protection from interference,  $70 + 10 \log_{10}(P)$  dB is the level the Commission has already determined appropriate for protection of PCS operations below 1995 MHz, and given the expected similarity of operations in the 1995-2000 MHz band, this level is also applicable to AWS-4 emissions into the 1995-2000 MHz band. DISH suggests that this is not an applicable precedent because it was previously applied at 5 megahertz separation from the MSS/ATC band, not at the band edge.<sup>302</sup> DISH suggests that precedents such as  $60 + 10 \log_{10}(P)$  dB,  $55 + 10 \log_{10}(P)$  dB, or  $43 + 10 \log_{10}(P)$  dB are more relevant.<sup>303</sup> We disagree with DISH because we find that the interference in the 1995-2000 MHz band will be driven by the AWS-4 OOB into the 1995-2000 MHz band itself, not by the emission levels of the transmissions outside these frequencies. Therefore, the frequency separation from the band edge is not determinative of establishing the OOB limit.<sup>304</sup> In addition, the  $60 + 10 \log_{10}(P)$  dB level is from a study of TDD to FDD interference released by the Commission's Office of Engineering and Technology (OET), which did not result in the adoption of this limit into our rules.<sup>305</sup> Although this study considers a similar case of mobile-to-mobile interference, the difference results from differing assumptions, including assumptions that the victim handset is using UMTS and can tolerate an interfering signal 11.8 dB stronger than its desired signal.<sup>306</sup> LTE mobiles, however, cannot necessarily tolerate such high levels of interference, and we find, in agreement with the

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(Band 27), Intel Corporation (Jan. 17-19, 2012) ("Intel Band 26/APAC700 Study"), available at [http://www.3gpp.org/ftp/tsg\\_ran/WG4\\_Radio/TSGR4\\_AHs/R4\\_AH\\_Band-26/Docs/R4-B26ah-0035.zip](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_AHs/R4_AH_Band-26/Docs/R4-B26ah-0035.zip) (last visited Dec. 10, 2012).

<sup>297</sup> See *LTE RF Standard for UEs* at 68-71.

<sup>298</sup> See *Sprint Dec. 6, 2012 Letter* at 3 (DISH's proposed OOB limit "could lead to widespread interference to future H Block users and [could lead to] significantly decreased interest from potential H Block auction bidders").

<sup>299</sup> See *DISH Dec. 7 Letter* at 4.

<sup>300</sup> *Id.* at 3-4.

<sup>301</sup> See e.g., *DISH Oct. 11 Letter* at 1. DISH also argues that imposing this limit in 1995-2000 MHz is not necessary to protect the PCS G block at 1990-1995 MHz. See *DISH Oct. 15 Letter* at 1. We agree, and our adoption of  $70 + 10 \log_{10}(P)$  in 1995-2000 MHz is to protect 1995-2000 MHz, as discussed in the previous section, we are protecting 1990-1995 MHz by adopting an OOB limit of  $70 + 10 \log_{10}(P)$  in 1990-1995 MHz.

<sup>302</sup> *DISH Nov. 6 Letter* at note 13 (inapplicability of  $70 + 10 \log_{10}(P)$ ).

<sup>303</sup> *DISH Oct. 10 Letter* at 4 ( $60 + 10 \log_{10}(P)$  in a Commission Office of Engineering and Technology study); *DISH Nov. 8 Letter* at 3 ( $55 + 10 \log_{10}(P)$  in BRS/EBS spectrum); *DISH Nov. 6 Letter* at 4 ( $43 + 10 \log_{10}(P)$  in 700 MHz spectrum).

<sup>304</sup> Emissions outside the band can cause overload interference, but this discussion is concerned with interference due to OOB. Overload interference is discussed below. See *infra* Section III.B.4.b (Mobile Stations).

<sup>305</sup> The FCC's Office of Engineering and Technology Releases Analysis of AWS-3 Interference Tests, WT Docket Nos. 07-195 and 04-356, *Public Notice*, 23 FCC Rcd 14669 at 14670 (2008) (*OET Interference Study*) (study titled "Advanced Wireless Service Interference Test Results and Analysis" released as a Public Notice.).

<sup>306</sup> *OET Interference Study*, 23 FCC Rcd at 14679.

modified Motorola assumptions discussed above, that the interfering signal should be no stronger than the mobile's noise floor. Applying this one change to the assumptions of the OET study would result in level of at least  $71 + 10 \log_{10}(P)$  dB. DISH also argues that the  $55 + 10 \log_{10}(P)$  level, used in BRS, is a similar case of TDD to FDD interference. There are many differences between the BRS band and the 1995-2000 MHz band, including the flexibility of BRS operators to synchronize their systems to avoid interference and the greater ease of achieving frequency separations in a 194 megahertz band. In addition, we note that the BRS rules apply a level of  $67 + 10 \log_{10}(P)$  to fixed stations in the event of interference complaints, much closer to the  $70 + 10 \log_{10}(P)$  level we adopt here. Further, as discussed above, the  $43 + 10 \log_{10}(P)$  dB level does not provide adequate protection from interference in this case and so is not appropriate here.<sup>307</sup>

89. Although applying this limit of  $70 + 10 \log_{10}(P)$  dB at the edge of the AWS-4 band may be more restrictive than applying it at 1995 MHz and below, we find DISH's assertions that adopting this limit at and below 2000 MHz would increase the cost of mobile devices, require significant power reductions, and require a roll-off region to be poorly supported and unpersuasive.<sup>308</sup> DISH did not quantify these hardships with specific cost numbers, filter insertion losses, power reduction requirements, or the amount of spectrum impacted. Nor did DISH explain what factors would increase the cost of the mobile devices, so it is not clear if these impacts would be independent of or additive to one another. For example, there is a trade-off between filter roll-off and filter cost (and therefore device cost), so it may not be reasonable to assert both hardships will result. Further, we note that to the extent there is a roll-off region or power reduction region, these reduce the power in the lower part of the AWS-4 uplink band, but do not necessarily render it unusable. For example, if there is reduced coverage in the first 5 megahertz, it may still be usable for capacity in areas of good coverage. In fact, with technological advancements it may be put to use dynamically. For example, a base station scheduler using a 10 megahertz carrier in 2000-2010 MHz could assign mobiles in good signal conditions (and therefore requiring less power to close the link) to the lower 5 megahertz, and mobiles in poor signal conditions (requiring higher power) to the upper 5 megahertz, thereby making use of all of the spectrum.

90. Similarly, we find to be flawed DISH's arguments that the limit of  $70 + 10 \log_{10}(P)$  dB at and below 2000 MHz would render 25% of the AWS-4 uplink spectrum unusable and increase AWS-4 deployment costs by 15-30%.<sup>309</sup> DISH's argument for rendering 25% of the uplink unusable actually asserts that base station operations in the 1995-2000 MHz band would potentially overload its AWS-4 base station receivers; DISH does not make an argument based on the AWS-4 uplink OOB limit.<sup>310</sup> Therefore, this argument is not relevant to the OOB limits on AWS-4 devices. However, we do discuss potential interference from the 1995-2000 MHz band to AWS-4 base stations below.<sup>311</sup> Similarly, DISH argues that the anticipated OOB from 1995-2000 MHz band transmitters above 2005 MHz will require

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<sup>307</sup> DISH argues that  $43 + 10 \log_{10}(P)$  maintains flexibility, referring to the use of this limit in the 700 MHz band. See *DISH Nov. 6 Letter* at 4-5. However, it is inadequate protection against interference, and therefore would greatly reduce the flexibility of use of 1995-2000 MHz. The flexible use of the AWS-4 is discussed below. See *infra* Section III.G.1.a. (Flexible Use).

<sup>308</sup> DISH comments at 27.

<sup>309</sup> See e.g., *DISH Oct. 17 Letter* at 3-4.

<sup>310</sup> *Id.* at 3.

<sup>311</sup> Although we do not establish rules for the 1995-2000 MHz band here, below we require AWS-4 operators to accept some interference from future 1995-2000 MHz operations. See *infra* Section III.B.5. (Acceptance of Interference into the AWS-4 Uplink Band).

additional site builds where colocation is not possible,<sup>312</sup> and makes some high-level, general statements that the impact represents about a 15% increase in the number of sites to be built.<sup>313</sup> This is also not relevant to the limit of  $70 + 10 \log_{10}(P)$  dB at 2000 MHz for the AWS-4 uplink. The technical requirements for base stations in the 1995-2000 MHz band are outside the scope of this Report and Order and will be addressed in the *H Block NPRM*.<sup>314</sup>

91. We also find for the reasons stated above that, to the extent imposing a limit of  $70 + 10 \log_{10}(P)$  dB at and below 2000 MHz does have some negative impact on the usability of the AWS-4 uplink, this impact is balanced by the increased utility of the 1995-2000 MHz band.<sup>315</sup> DISH argues that its claimed loss of 25% of its uplink spectrum to enable the full flexible use of the 5 megahertz of the 1995-2000 MHz band will result in no net increase in the amount of spectrum available for broadband.<sup>316</sup> However, this claim overlooks the fact that if 1995-2000 MHz is paired with 1915-1920 MHz, the calibrated restrictions we place on AWS-4 may enable the Commission to make available 10 megahertz of broadband spectrum. Moreover, the restrictions would still allow the full use of at least 5 megahertz (if not more) of uplink (*i.e.*, at least 2005-2010 MHz of the 2000-2010 MHz uplink segment) and the full 10 megahertz of paired downlink spectrum (*i.e.*, 2180-2190 MHz). This would not be the case if the restrictions at issue were imposed on 1995-2000 MHz in a scenario where that spectrum is only paired with another 5 megahertz. And, even if 1995-2000 MHz becomes an unpaired downlink band, DISH's argument rests on the assumption that 5 megahertz of uplink in the 2000-2020 MHz band is equivalent to 5 megahertz of downlink in the 1995-2000 MHz. As discussed above, this argument is flawed, because (1) there is more need for downlink spectrum than uplink spectrum, (2) the restricted use of 5 megahertz would have less of an impact to a 10 or 20 megahertz carrier in the AWS-4 band than it would to a 5 megahertz carrier in the 1995-2000 MHz band, including a carrier that would use the 1995-2000 MHz band to expand an existing use of the PCS band, (3) given the downlink-limited nature of broadband capacity, the loss of 5 megahertz of uplink spectrum in a band with two paired 10 + 10 megahertz blocks may have no impact on actual network capacity,<sup>317</sup> and (4) an extension of an existing band is more easily utilized than a new band.<sup>318</sup>

92. We are also not convinced by DISH's argument that adopting this limit will protect and favor an unassigned band over an assigned band.<sup>319</sup> Because there has been no deployment of terrestrial services, devices, or base stations in either band, we find this argument unpersuasive. DISH further argues that adopting this limit places "the entire burden" on AWS-4,<sup>320</sup> and that imposing this limit is premature and an attempt to predetermine the rules for the 1995-2000 MHz band.<sup>321</sup> We disagree. We do

<sup>312</sup> DISH refers only to the OOBE above 2005 MHz, apparently since they argue earlier in the letter that 2000-2005 MHz will be unusable due to overload interference from 1995-2000 MHz band transmitters.

<sup>313</sup> DISH Oct. 17 Letter at 3.

<sup>314</sup> See *H Block NPRM*, at ¶¶ 34-37.

<sup>315</sup> See *supra* ¶¶ 64-73, 80.

<sup>316</sup> See *e.g.*, DISH Oct. 17 Letter at 4. DISH also argues further, but without explanation, that new emissions limits would result in a net loss of spectrum in all bands. DISH Oct. 11 Letter at 1.

<sup>317</sup> This is due to the asymmetry of downlink and uplink traffic. See *supra* ¶ 80.

<sup>318</sup> See *id.*

<sup>319</sup> DISH Nov. 6 Letter at 4.

<sup>320</sup> *Id.* at 6.

<sup>321</sup> DISH Oct. 15 Letter at 3.

not set rules for 1995-2000 MHz in this proceeding; rather, we set some limitations on AWS-4 which are balanced by promoting the usability of the 1995-2000 MHz band.

93. In addition, the likely practical impact of technical protections for the 1995-2000 MHz band in the AWS-4 uplink is small. We are not reclaiming any spectrum; rather, we are implementing an OOB limit that may reduce the power levels on some uplink spectrum.<sup>322</sup> As discussed above, with newer technologies such as LTE, power reductions of a portion of a carrier do not prevent it from being put to use in some portions of a cell and augmenting capacity. Further, current broadband networks use far more downlink capacity than uplink capacity.<sup>323</sup> Based on prevailing traffic patterns, a licensee of AWS-4 authority with 20 MHz of downlink capacity is very likely to have excess uplink capacity in any case. DISH states that this line of reasoning is “misguided”,<sup>324</sup> because DISH needs 40 megahertz to compete,<sup>325</sup> and needs “more spectrum, not less”.<sup>326</sup> However, DISH fails to address the asymmetry of traffic, and only makes the blanket statement that it needs more spectrum. Of course, like all operators, DISH is free to acquire more spectrum as needed, and in fact we observe that DISH has spectrum in other bands, including in the 700 MHz Band. In any case, we are creating 40 megahertz of terrestrial rights. Although the rules we adopt may limit the power levels in part of the uplink spectrum, they do not prohibit its use, and as discussed below, they leave room for the licensee of AWS-4 operating authority to find technical or business approaches to increase the utility of the uplink spectrum if needed.

94. Finally, we find DISH’s arguments that adopting this emission limit would delay its deployment time frame by causing delay in equipment standards in 3GPP to be unpersuasive.<sup>327</sup> First, the Commission has historically not based its decisions regarding the appropriate technical rules for a wireless service merely on the potential of those decisions to delay the development of private party technical standards. Second, DISH is not required to await 3GPP standards resolution to design, test, and deploy equipment, particularly if it is the only operator in the band. Rather, a decision to wait until 3GPP has established final standards is an internal business decision, not a delay imposed by the Commission’s development of technical rules for the service. Third, the only change necessary in the 3GPP standard would be modifying band 23 to accommodate the emission limit at 2000 MHz (and the power limits for operations in 2000-2005 MHz); many of the other parameters for this band (*e.g.*, OOB at 2020 MHz; duplex spacing; frequencies; channel numbers; and so forth) could remain the same.<sup>328</sup> Sprint has indicated that this additional work should take less than 6 months,<sup>329</sup> and it has stated its commitment to

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<sup>322</sup> And, as discussed below, imposing a power restriction on the first 5 megahertz. *See infra* Section III.B.4.b. (Mobile Stations).

<sup>323</sup> *See e.g.*, *Sprint Nov. 2 Letter* at 3, n.3.

<sup>324</sup> *DISH Nov. 6 Letter* at 7.

<sup>325</sup> *DISH Oct. 11 Letter* at 2.

<sup>326</sup> *DISH Oct. 17 Letter* at 7.

<sup>327</sup> *See e.g. DISH Oct. 17 Letter* at 3.

<sup>328</sup> We also note Sprint’s commitment to facilitate the 3GPP process, and the recent agreement of 3GPP on Band 23 emissions limits. *See e.g.* *Sprint Nov.4 Letter*; *Letter from Marc S. Martin, to Julius Genachowski, Chairman, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 1 (filed Oct. 2, 2012) (Sprint Oct. 2 Letter)*; *Sprint Nov. 14 Letter*.

<sup>329</sup> *Letter from Stephen Bye, Chief Technology Officer and Vice President of Technology Development and Strategy, Lawrence R. Krevor, Vice President, Legal and Government Affairs - Spectrum, Sprint, to Julius Genachowski, Chairman, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 1 (filed Oct. 2, 2012) (Sprint Oct. 2 Letter)*.

facilitating relevant work in 3GPP.<sup>330</sup> Fourth, DISH can also mitigate a delay in obtaining final standards in several ways. For example, in its comments, DISH identifies several groups of tasks that would need to be completed prior to the launch of service, but states that the task groups must be performed serially, taking four years in sum.<sup>331</sup> We do not believe that either engineering or business practices require these tasks be completed in a serial process; rather, we believe that they can be accomplished in part in parallel. Indeed, in the WCS proceeding, AT&T indicated that about half of the time needed to develop standards would overlap with equipment design and equipment testing.<sup>332</sup> If DISH were to apply a similar level of overlap to the tasks it outlines, it would still be able to meet its proposed 4 year timeline for launching service.<sup>333</sup> In sum, while DISH makes unsupported, speculative, and vague statements as to the possible impact of 3GPP timing on its market entry, the impact of not adopting these rules is clear and detrimental to the public interest.

95. As discussed above,<sup>334</sup> DISH also proposed a combination of rules and commitments that it says will allow full use of the 1995-2000 MHz band while preventing any 3GPP delay.<sup>335</sup> In addition to finding above that this proposal does not facilitate full flexible use of the 1995-2000 MHz band,<sup>336</sup> we also find that it does not reduce the likelihood of 3GPP delays. DISH bases its argument on its assertion that integration of an external duplexer will allow it to meet a level of  $60 + 10 \log_{10}(P)$  dB without changing the design of its chipset.<sup>337</sup> However, as DISH has pointed out, the 3GPP standards contain the current ATC rule for OOB in 1995-2000 MHz in the device co-existence table,<sup>338</sup> and regardless as to whether the limit is  $60 + 10 \log_{10}(P)$  dB or  $70 + 10 \log_{10}(P)$  dB, 3GPP may choose to update this table and evaluate the impact of the new level on device design. Further, since the level of  $60 + 10 \log_{10}(P)$  dB affords less protection than  $70 + 10 \log_{10}(P)$  dB, it may create more contention and delay in 3GPP than our proposal. In summary, we do not find support in the record that adopting a level of  $60 + 10 \log_{10}(P)$  dB will bring operations in the AWS-4 band to market sooner than the attenuation of  $70 + 10 \log_{10}(P)$  dB that we do adopt.

<sup>330</sup> See e.g., Letter from Richard B. Engelman, Director, Spectrum Resources, Sprint to Marlene H. Dortch, Sec'y, FCC, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142 at 2 (filed Oct. 5, 2012). We observe that Sprint and DISH have recently been able to resolve previously contentious Band 23 emissions limits in 3GPP, see *Sprint Nov. 14 Letter*.

<sup>331</sup> DISH Comments at 20-22. These groups of tasks generally fall into the following categories: complete standards, infrastructure and device development, develop and test retail and billing operations, and deployment/launch service. DISH claims that these tasks will take 48 months after standards are set (or 30, 9, and 9 months respectively for the later 3 task groups). *Id.*

<sup>332</sup> See Letter from Joan Marsh, Vice President – Federal Regulatory, AT&T Services, Inc., to Marlene H. Dortch, Sec'y, FCC, WT Docket No. 07-293, IB Docket No. 95-91, GEN Docket No. 90-357, at 3-6 (filed June 15, 2012).

<sup>333</sup> See DISH Comments at 20-22.

<sup>334</sup> See *supra* ¶ 70.

<sup>335</sup> See *DISH Dec. 3 Letter*; *DISH Dec. 7 Letter*.

<sup>336</sup> See *supra* Section ¶ 86-87.

<sup>337</sup> See *DISH Dec. 7 Letter* at 2-3. Although DISH does not explain exactly what is meant here, it appears to be an assumption that the A-MPR tables would not need to be updated. DISH also does not provide any technical support, such as duplexer curves, showing why it believes  $60 + 10 \log_{10}(P)$  dB is achievable without modification of the A-MPR tables, but  $70 + 10 \log_{10}(P)$  dB is not.

<sup>338</sup> See *DISH Oct. 10 letter* at 3.

96. *Private Agreements.* We recognize that technological improvements in devices in the 1995-2000 MHz band, as well as willingness on the part of licensees of the 1995-2000 MHz band to accept a higher probability of interference, could reduce the need for OOB restrictions in 1995-2000 MHz. Therefore, we allow for licensees of AWS-4 authority to enter into private operator-to-operator agreements with all 1995-2000 MHz licensees to operate in 1995-2000 MHz at OOB levels above  $70 + 10 \log_{10}(P)$  dB.

97. *Summary.* We find that while DISH argues that the imposition of an OOB limit of  $70 + 10 \log_{10}(P)$  dB on AWS-4 uplink operations will render 5 megahertz of the AWS-4 uplink unusable and create delays in 3GPP, these arguments are unsupported, speculative, and vague, and in some cases not relevant to the uplink OOB limit. Similarly, we do not find DISH's recent proposal of  $60 + 10 \log_{10}(P)$  dB at 2000 MHz to be an appropriate limit. While we acknowledge that imposition of the limit of  $70 + 10 \log_{10}(P)$  dB may have a negative impact on the usability of a portion of the AWS-4 uplink band, this is more than offset by the public interest benefits of increasing the usability of the 1995-2000 MHz band. Moreover, some of DISH's objections are not relevant to the OOB limit on the AWS-4 uplink, but instead have to do with power and OOB for operations in the 1995-2000 MHz band. As discussed below, DISH in fact does also suggest OOB and power limitations for the 1995-2000 MHz band. As discussed elsewhere,<sup>339</sup> we have had an open proceeding since 2004 that proposed full power use in 1995-2000 MHz, and an OOB limit of  $43 + 10 \log_{10}(P)$  dB for H block transmitters.<sup>340</sup> Therefore, DISH has been aware of these issues for some time. These issues, moreover, can be addressed in the *H Block NPRM*.<sup>341</sup> Further, even if our actions do in fact create only 15 megahertz of usable uplink for terrestrial use, this Report and Order still creates a large increase in the overall utility of this spectrum. That is, 15 megahertz of full usable terrestrial uplink can be put to more productive use than 20 megahertz of MSS/ATC uplink spectrum. For example, one commenter suggested that this conversion creates billions of dollars in value.<sup>342</sup> For all these reasons, we find that requiring an attenuation of  $70 + 10 \log_{10}(P)$  dB at and below 2000 MHz is appropriate for the AWS-4 uplink.

98. Finally, we decline to address the request by DISH that we clarify that the existing linear interpolation of the OOB between 2000 MHz and 1995 MHz should be calculated in watts, rather than in dB.<sup>343</sup> Because we adopt a flat OOB limit across 1995-2000 MHz, this issue is moot, and we do not make a determination on it.

99. *Measurement Procedure.* We adopt the measurement procedure set forth in Section 27.53(h) of our rules to determine compliance with this limit. This section requires a measurement bandwidth of 1 megahertz or greater with an exception allowing a smaller measurement bandwidth in the first megahertz adjacent to the channel.<sup>344</sup>

100. In sum, in order to maximize the public interest, comply with Congressional direction, and best balance the most efficient use of all relevant spectrum bands, including enabling future operations in the 1995-2000 MHz band and creating a useful AWS-4 band, we set the OOB limit of  $70 + 10 \log_{10}(P)$  dB at all frequencies at or below 2000 MHz.

<sup>339</sup> See *supra* ¶ 83; see *infra* Section III.B.1.viii. (Interference with Other Bands).

<sup>340</sup> See e.g., *AWS-2 NPRM*, 19 FCC Rcd at 19035 ¶110.

<sup>341</sup> See *H Block NPRM*, at ¶¶ 34-37.

<sup>342</sup> PIO Comments at 2.

<sup>343</sup> DISH Comments at 27-28; Greenwood Reply Comments at 7-8.

<sup>344</sup> See 47 C.F.R. § 27.53(h)

**(iii) Interference with operations in 2020-2025 MHz**

101. *Background.* The AWS-4 uplink band will be adjacent to the AWS-2 Lower J block (2020-2025 MHz). Although the Part 25 ATC rules adopted in 2003 originally attenuated the mobile station emissions in this frequency range by a linear interpolation from  $43 + 10 \log_{10}(P)$  dB at 2020 MHz to  $70 + 10 \log_{10}(P)$  dB at 2025 MHz,<sup>345</sup> the Commission separately proposed in 2004 to apply a standard of  $43 + 10 \log_{10}(P)$  to the 2020-2025 MHz (AWS-2 lower J) block.<sup>346</sup> In 2009, in the *ICO Waiver Order*, the Commission waived the Part 25 ATC rules and instead applied the  $43 + 10 \log_{10}(P)$  limit to OOB in 2020-2025 MHz from transmitters operating in the 2000-2020 MHz band.<sup>347</sup> In the *AWS-4 NPRM*, the Commission proposed that no additional attenuation beyond  $43 + 10 \log_{10}(P)$  dB is needed to protect services in the 2020-2025 MHz band. The *AWS-4 NPRM* also noted that the *ICO Waiver Order* modified the measurement procedure for determining AWS-4 compliance with the OOB to conform to the procedure for both broadband PCS and AWS-1 mobiles.<sup>348</sup>

102. *Discussion.* We conclude that the  $43 + 10 \log_{10}(P)$  dB OOB limit and the measurement procedure set forth in Section 27.53(h) are appropriate for protecting the 2020-2025 MHz band. No commenters opposed this proposal. Thus, for the reasons articulated in the *AWS-4 NPRM* and in the *ICO Waiver Order*, we find that this OOB limit remains appropriate.

**(iv) Interference with operations above 2025 MHz**

103. *Background.* The AWS-4 uplink band is 5 megahertz from the 2025-2110 MHz band. That band is utilized by non-Federal broadcast auxiliary service (BAS) and cable television service (CARS) operations, as well as certain Federal government operations.<sup>349</sup> The MSS/ATC rules originally limited the mobile emissions from operations in the ATC uplink band to  $70 + 10 \log_{10}(P)$  above 2025 MHz.<sup>350</sup> In 2009, the Commission waived the Part 25 ATC rule for a specific licensee and instead applied the  $43 + 10 \log_{10}(P)$  standard.<sup>351</sup> The Commission also modified the measurement procedure for measuring compliance with this limit to require a measurement bandwidth of 1 MHz or greater with exceptions as noted in Section 27.53(h).<sup>352</sup> Accordingly, the *AWS-4 NPRM* proposed to require AWS-4 uplink operations to attenuate operations at a level of at least  $43 + 10 \log_{10}(P)$  dB above 2025 MHz with the measurement procedure defined in the *ICO Waiver Order* and sought comment on this proposal.<sup>353</sup> We received no comments seeking a different OOB limit for mobile devices operating in the AWS-4 uplink band.

104. *Discussion:* We conclude the  $43 + 10 \log_{10}(P)$  dB OOB limit and the associated measurement procedure defined in 27.53(h) are appropriate for protecting federal operations and BAS and CARS operations at 2025-2110 MHz. This limit is consistent with the record. For example, Motorola

<sup>345</sup> See 47 C.F.R. § 25.252(c)(2).

<sup>346</sup> See e.g., *AWS-2 NPRM*, 19 FCC Rcd at 19301 ¶ 98.

<sup>347</sup> See *ICO Waiver Order*, 24 FCC Rcd at 193-194 ¶ 61.

<sup>348</sup> See *AWS-4 NPRM*, 27 FCC Rcd at 3577-78 ¶ 44; see also 47 C.F.R. § 24.238(b) and 27.53(h).

<sup>349</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3578 ¶ 45.

<sup>350</sup> See 47 C.F.R. § 25.252(c)(2).

<sup>351</sup> See *ICO Waiver Order*, 24 FCC Rcd at 193-194 ¶ 61.

<sup>352</sup> *Id.* at 183 ¶ 34.

<sup>353</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3578 ¶ 45.

supports a  $43 + 10 \log_{10}(P)$  OOB limit for the AWS-4 uplink band edge.<sup>354</sup> In addition, although EIBASS comments that an OOB limit of  $43 + 10 \log_{10}(P)$  is not sufficient for fixed or base transmissions originating in the 2020-2025 MHz band, EIBASS also states that it has no objection to an OOB limit of  $43 + 10 \log_{10}(P)$  if transmissions in the 2020-2025 MHz band are other than fixed or base station.<sup>355</sup> Here, as discussed above, the band plan calls for 2000-2020 MHz to be part of the mobile uplink band. This *Report and Order* does not authorize any services, fixed or mobile, in the 2020-2025 MHz band. No commenters disagreed with a  $43 + 10 \log_{10}(P)$  OOB limit above 2025 MHz, thus we conclude the record indicates that the benefits of the proposal outweigh any potential costs. Thus, we find it appropriate to continue to apply the  $43 + 10 \log_{10}(P)$  OOB limit and its associated measurement procedure that has effectively been in place since 2009.

(v) **Interference with operations below 2180 MHz**

105. *Background.* The AWS-4 downlink band, 2180-2200 MHz, is adjacent to the AWS-2 Upper J block, 2175-2180 MHz, which is itself adjacent to the AWS-3 band, 2155-2175 MHz.<sup>356</sup> The Spectrum Act refers to these adjacent bands as a single 2155-2180 MHz band.<sup>357</sup> The Commission observed in the *AWS-4 NPRM* that it had previously proposed an OOB attenuation of  $43 + 10 \log_{10}(P)$  dB as an appropriate base station emission limit to prevent harmful electromagnetic interference in the AWS-2 and AWS-3 bands.<sup>358</sup> This  $43 + 10 \log_{10}(P)$  dB attenuation is generally our standard prescribed OOB limit when like services are considered. Because circumstances had not changed significantly since that attenuation level was proposed for the AWS-2/3 bands, the Commission proposed that no additional attenuation beyond  $43 + 10 \log_{10}(P)$  dB was needed for AWS-4 transmissions below 2180 MHz.<sup>359</sup>

106. *Discussion:* We adopt the proposal to apply the  $43 + 10 \log_{10}(P)$  dB OOB limit as appropriate for protecting wireless systems that will operate below 2180 MHz. This conclusion is supported by the record. DISH, for example, comments that the proposed  $43 + 10 \log_{10}(P)$  dB is sufficient.<sup>360</sup> Furthermore, we anticipate future operations in the 2155-2180 MHz band will be similar in design and use to cellular and PCS systems, in which the  $43 + 10 \log_{10}(P)$  dB limit has been used effectively in limiting adjacent channel interference between systems operating in the same direction (e.g., downlink next to downlink). Indeed, Nokia commented that “[t]his level should be sufficient to protect systems in the adjacent spectrum blocks when they are deployed with the same duplex directions – meaning, uplink next to uplink and downlink next to downlink.”<sup>361</sup> We therefore adopt the  $43 + 10 \log_{10}(P)$  dB OOB limit below 2180 MHz for all transmitters operating in the 2180-2200 bands. With no commenters opposing this emission limit, we further conclude that its benefits outweigh any potential costs.

<sup>354</sup> See Motorola Comments at 4.

<sup>355</sup> See EIBASS Comments at 1-3.

<sup>356</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3578 ¶ 46.

<sup>357</sup> Spectrum Act, § 6401(b)(2)(D).

<sup>358</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3578 ¶ 46; see also, e.g., 2008 *Further Notice*, 23 FCC Rcd at 9860-9861 ¶ 4.

<sup>359</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3578 ¶ 46.

<sup>360</sup> DISH Comments at 29.

<sup>361</sup> Nokia Reply Comments at 5 n.17.

**(vi) Interference with operations above 2200 MHz**

107. *Background.* In the *AWS-4 NPRM*, the Commission sought comment on the appropriate OOB limit for licensees of AWS-4 downlink spectrum at 2180-2200 MHz in order to protect adjacent block operations, including federal operations at 2200-2290 MHz.<sup>362</sup> The Commission observed that the Part 25 rules set forth strict emission limitations (-100.6 dBW/4 kHz EIRP) in the 2180-2200 MHz band, including at the 2200 MHz band edge.<sup>363</sup> The rules also prohibit the location of 2180-2200 MHz base stations within 820 meters of a Federal earth station operating in the 2200-2290 MHz band.<sup>364</sup> In 2009, however, the Commission waived the Part 25 emission limit (-100.6 dBW/4kHz EIRP) rule for one of the 2 GHz MSS/ATC licensees with regard to operations at or above 2200 MHz; instead of the rule, that licensee was required to satisfy the terms of an operator-to-operator agreement between the MSS/ATC licensee and certain federal operators in the 2200-2290 MHz band.<sup>365</sup> That agreement specified that, in certain circumstances, the MSS/ATC licensee was required to satisfy the Part 25 emission limit, but in other circumstances, only had to satisfy the standard Commission emission limit of  $43 + 10 \log_{10}(P)$  dB.<sup>366</sup>

108. In the *AWS-4 NPRM*, the Commission sought comments on several ways that OOB limit restrictions on downlink operations in the 2180-2200 MHz band could be established so that band can be fully utilized while still adequately protecting Federal earth station receive sites.<sup>367</sup> We received few comments on this issue. Alcatel asserts the Commission should take a flexible approach.<sup>368</sup> In particular, Alcatel supports an approach of setting a power flux density (PFD) limit at Federal sites as an optional alternative to setting an emission limit applicable for all AWS-4 base stations.<sup>369</sup> Nokia states that the Part 25 emissions limit "is considerably more stringent than the standard OOB limit of  $43 + 10 \log_{10}(P)$  dB."<sup>370</sup> Nokia states that to meet this OOB limit above 2200 MHz, a filter between 1 and 5 MHz of bandwidth is needed for rolloff.<sup>371</sup> To minimize the impact of such a rolloff on AWS-4 operations and allow use of the entire 20 MHz of AWS-4 spectrum, Nokia suggests creating a guard band above 2200 MHz.

<sup>362</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3577-78 ¶ 44. The Commission identified the most prevalent Federal government uses of the 2200-2290 MHz band in the *AWS-4 NPRM*. See *AWS-4 NPRM*, 27 FCC Rcd at 3578 ¶ 47 (citing, U.S. Department of Commerce, *An Assessment of the Viability of Accommodating Wireless Broadband in the 1755-1850 MHz Band* (Mar. 2012), available at [http://www.ntia.doc.gov/files/ntia/publications/ntia\\_1755\\_1850\\_mhz\\_report\\_march2012.pdf](http://www.ntia.doc.gov/files/ntia/publications/ntia_1755_1850_mhz_report_march2012.pdf) (last visited Dec. 4, 2012).

<sup>363</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3579 ¶ 48.

<sup>364</sup> *Id.* at 3579 ¶ 48.

<sup>365</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3579 ¶ 48.

<sup>366</sup> Letter from Karl B. Nebbia, Associate Administrator, Office of Spectrum Management, National Telecommunications and Information Administration, to Julius Knapp, Chief, Office of Engineering and Technology, Federal Communications Commission, File No. SES-LIC-20071203-01646, SES-AMD-20080118-00075, SES-AMD-20080219-00172, Call Sign: E070272, Attachment at 2 (Jan. 6, 2009).

<sup>367</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3580 ¶¶ 52-54.

<sup>368</sup> Alcatel Comments at 14-15.

<sup>369</sup> *Id.*

<sup>370</sup> Nokia Reply at 4.

<sup>371</sup> *Id.* The specific size of any rolloff would depend upon the size, complexity and cost of the filter. *Id.*

109. In December 2012, DISH and federal users of the 2200-2290 MHz band entered into an operator-to-operator agreement, which the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce transmitted to the Commission.<sup>372</sup> The agreement specifies that DISH (through its subsidiaries, as appropriate) will operate each base station in the 2180-2200 MHz band such that the power spectral density (PSD) of the signal received at existing Federal earth stations and aeronautical mobile telemetry (AMT) stations shall not exceed agreed upon levels. The agreement also contains provisions for addressing the operation of 2180-2200 MHz base station relative to new federal stations to be deployed in the 2200-2290 MHz band.<sup>373</sup>

110. *Discussion.* We adopt the following approach for protecting Federal operations in the 2200-2290 MHz band from harmful interference from AWS-4 operations in the 2180-2200 MHz band. First, as discussed further below, we permit AWS-4 operators and Federal operators to enter into an operator-to-operator agreement that will specify terms of the permissible AWS-4 OOB limits and/or maximum actual AWS-4 emissions to be received at the sites of Federal operations in the 2200-2290 MHz band. Second, we establish default OOB limits for AWS-4 operations into the 2200-2290 MHz band in the event such private agreement were not in effect (*e.g.*, the agreement was terminated pursuant to its terms); AWS-4 licenses return to the Commission (*e.g.*, for a licensee's failure to meet the construction requirements).

111. We adopt this approach after careful analysis of the options before us. As explained above, the current ATC regime for protecting Federal operations in the 2200-2290 MHz band is a mix of Commission rules, waiver orders, and operator-to-operator agreements. As a result, the two MSS/ATC licensees have different interference protection requirements with respect to Federal operators in the 2200-2290 MHz band. Further, as noted above, during the course of this proceeding, the current 2 GHz MSS/ATC licensees (and prospective AWS-4 licensees) entered into an operator-to-operator agreement with Federal operators in the 2200-2290 MHz band.<sup>374</sup> It is against this backdrop that we promulgate OOB rules for AWS-4 base station emissions into the 2200-2290 MHz band, which, like the ATC regime, will both set clear rules and allow licensees of AWS-4 operating authority to deviate from those rules by entering into operator-to-operator agreements, which will be transmitted to the Commission by NTIA.

112. First, we permit, but do not require, licensees of AWS-4 authority to enter into operator-to-operator agreements with Federal operators at 2200-2290 MHz to address the attenuation of emissions from AWS-4 base stations operating at 2180-2200 MHz into the adjacent Federal band, so long as such agreements do not otherwise run afoul of other Commission rules. We observe that the existing MSS/ATC licensees and federal users of the 2200-2290 MHz band have already effectuated such an agreement on what they, as actual operators, find to be the best environment to avoid actual harmful interference. We applaud the adjacent Federal and non-Federal operators for reaching this agreement and, with this Report and Order, provide a foundation for this agreement and other similar agreements that might be reached in the future without the need for a waiver or other special permission from the Commission. Therefore, we permit the DISH-Federal Agreement to govern AWS-4 base station

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<sup>372</sup> Letter from Karl B. Nebbia, Associate Administrator, Office of Spectrum Management, National Telecommunications and Information Administration, to Julius Knapp, Chief, Office of Engineering and Technology, Federal Communications Commission, WT Docket No. 12-70; ET Docket No. 10-142; WT Docket No. 04-356, Attachment ("Operator-to-Operator Agreement between New DBSD Satellite Services G.P. and Gamma Acquisition L.L.C. and United States Federal Government Agencies Operating Earth Stations and/or Aeronautical Mobile Telemetry (AMT) Stations in the 2200-2290 MHz Band") ("DISH-Federal Agreement") (Dec. 11, 2012).

<sup>373</sup> See DISH-Federal Agreement.

<sup>374</sup> *Id.*

emissions from 2180-2200 MHz into the 2200-2290 MHz band. Specifically, when, as discussed below, the licenses held by the current 2 GHz MSS licensees are modified to include AWS-4 service, we will include as conditions to such license modifications the requirement that the licensees of AWS-4 operating authority must comply with the DISH-Federal Agreement with regard to the permissible AWS-4 emissions into the 2200-2290 MHz band and/or the maximum actual AWS-4 emissions to be received at the specified sites of Federal operations in the 2200-2290 MHz band. To ensure that this agreement, and any subsequent agreements are consistent with other Commission rules and do not impede the operation of secondary markets, we require that the licensee of AWS-4 authority who is a party to an operator-to-operator agreement maintain a copy of the agreement(s) in its station files and disclose it, upon request, to prospective AWS-4 assignees, transferees, or spectrum lessees, to Federal operators in the 2200-2290 MHz band, and to the Commission.<sup>375</sup>

113. Second, to ensure that OOB limits are established in the event such private agreements are not entered into or do not address all situations between AWS-4 operations in the 2180-2200 MHz band and Federal operations in the 2200-2290 MHz band, we establish default OOB limits for AWS-4 emissions into the 2200-2290 MHz band. Because the record does not contain any technical justification to support any specific OOB limit, and because the Commission did not propose a specific limit in the *AWS-4 NPRM*, we adopt the protection levels contained in the ATC rules relative to protection of Federal operations in the 2200-2290 MHz band.<sup>376</sup> Accordingly, AWS-4 base stations operating in 2180-2200 MHz shall not exceed an EIRP of -100.6 dBW/4 kHz for emissions into the 2200-2290 MHz band. Further AWS-4 base stations operating in 2180-2200 MHz may not be located less than 820 meters from a U.S. Earth Station facility operating in the 2200-2290 MHz band.

114. Finally, to avoid possible confusion between the operation of an operator-to-operator agreement and the default OOB limit, we clarify the application of our rules in the event that (1) an operator-to-operator agreement ceases to operate (for whatever reason) or (2) is operative for less than the entire universe of AWS-4 licenses or Federal operations in the 2200-2290 MHz band. In either case where the agreement is not in effect, the licensee of AWS-4 operating authority must comply with the default rule. For example, should the DISH-Federal Agreement terminate for any reason, DISH (assuming it is the licensee of AWS-4 authority) would be required to operate pursuant to the default rule.

115. To ensure that AWS-4 base stations would be able to operate pursuant both to an operator-to-operator agreement and to the default rule, equipment manufacturers may seek equipment authorization for equipment designed against either the OOB limit in the default rule, the OOB limit in an executed operator-to-operator agreement between a licensee of AWS-4 authority and Federal operators in the 2200-2290 MHz band (which must provide at least  $43 + 10 \log_{10}(P)$  dB of attenuation), or both, except as specified below. We shall approve or deny the equipment authorization, based on testing against whichever (or both) OOB the manufacturer requests.

116. We recognize, however, that equipment designed to operate to the stricter default OOB limits will also comply with any more relaxed OOB limit contained in an operator-to-operator agreement. In the case where equipment is intended to be operated at either the default or the relaxed limits, we believe the equipment will be either modified or adjusted by the manufacturer or in the field. That is, we expect the equipment to have more than one mode of operation in this case. We require the application for equipment authorization for such equipment to clearly demonstrate compliance with both limits. If at the time of authorization the equipment is only approved for compliance with one limit, but is expected to be modified subsequently by the manufacturer to operate in another mode either in the factory

<sup>375</sup> See 47 C.F.R. § 27.53(a)(10).

<sup>376</sup> See 47 C.F.R. § 25.252(a)(1).

or in the field, the original equipment must be approved to permit such changes or meet such changes as allowed in the permissive change rules for equipment authorization.<sup>377</sup>

117. In addition, a licensee in the AWS-4 band may operate its base stations consistent with its operator-to-operator agreement only if such an agreement is in effect. In any other situation, including where such an agreement existed, but has been terminated (for whatever reason), the licensee must operate AWS-4 base stations that have obtained equipment authorization based on the default rule. To the extent that a licensee of AWS-4 authority that is a party to an operator-to-operator agreement installs and operates base stations that are authorized against an OOB limit that is less stringent than the default rule, that licensee is solely responsible for ensuring that its equipment would be authorized to operate in the event that the agreement terminates (for whatever reason).

**(vii) Interference with Global Positioning Systems (GPS) operations**

118. *Background:* In the *AWS-4 NPRM*, the Commission observed that the current Part 25 MSS/ATC rules require certain protection limits over the GPS band at 1559-1610 MHz.<sup>378</sup> Specifically, the current rules require 2 GHz MSS/ATC base stations and mobile terminals to provide an EIRP limit of -70 dBW/MHz or -80 dBW/700Hz, measured over any two millisecond active transmission interval, in the 1559-1610 MHz band.<sup>379</sup> The Commission also observed that different MSS/ATC bands have different frequency separations from the GPS band and sought comment on whether any special interference rules should apply to AWS-4 operations to protect GPS service.<sup>380</sup>

119. Some parties submitted comments asking for tighter emissions limits over the GPS band. USGIC argued that the current Part 25 OOB limits for the protection of GPS operations at 1559-1610 MHz from terrestrial operations in the 2 GHz band are obsolete and proposed that the Commission adopt the EIRP emission limits agreed to by TerreStar and DBSD in their ATC authorization proceedings—EIRP emission limits for mobile transmitters of -95dBW/MHz for wideband signals and of -105dBW/kHz for narrowband signals, and EIRP emission limits for fixed or base station of -100dBW/MHz for wideband signals and of -110dBW/kHz for narrowband signals.<sup>381</sup> Deere similarly asserted that the OOB limits in the Part 25 rules are not sufficient to protect GPS operations at 1559-1610 MHz, observed that TerreStar and DBSD had agreed to more stringent limits, and recommended that the Commission “further study this issue and consider an update to the OOB limit” that should be applied to AWS-4 operations.<sup>382</sup> On September 27, 2012, DISH and USGIC submitted a letter agreement in which DISH agreed to limit its OOB EIRP densities over the 1559-1610 MHz band to the limits contained in USGIC’s comments.<sup>383</sup>

<sup>377</sup> See 47 C.F.R. §§ 2.944, 2.1043.

<sup>378</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3580 ¶ 55.

<sup>379</sup> See 47 C.F.R. § 25.252(a)(7), (b)(3).

<sup>380</sup> *AWS-4 NPRM*, 27 FCC Rcd at 3580 ¶ 55.

<sup>381</sup> USGIC Comments at 4-9, Exh. A; see Letter from F. Michael Swiek, Executive Director, U.S. GPS Industry Council, to Marlene H. Dortch, Sec’y, Federal Communications Commission, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 1-4 (filed Nov. 8, 2012) (*USGIC Nov. 8, 2012 Letter*).

<sup>382</sup> Deere Comments at 4-7.

<sup>383</sup> Letter from Jeffrey H. Blum, Deputy General Counsel, DISH Network Corporation, and F. Michael Swiek, Executive Director, The U.S. GPS Industry Council, to Marlene H. Dortch, Sec’y, Federal Communications Commission, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, at 1-2 (filed Sept. 27, 2012) (*DISH-USGIC Sept. 2012 Letter Agreement*).