

Before the  
**FEDERAL COMMUNICATIONS COMMISSION**  
Washington, DC 20554

In the Matter of )  
 )  
Expanding the Economic and Innovation ) GN Docket No. 12-268  
Opportunities of Spectrum Through Incentive )  
Auctions )  
 )  
Supplementation of the Record on the )  
600 MHz Band Plan )

To: Wireless Telecommunications Bureau

**COMMENTS OF THE CONSUMER ELECTRONICS  
ASSOCIATION**

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## SUMMARY

The 600 MHz band plan variations set forth in the *Public Notice* do not provide advantages over the “Down from 51” (“DF51”) approach. Rather, the alternatives presented would introduce substantial technical impediments and would undermine the Commission’s key policy goals for the 600 MHz band plan: utility, certainty, interchangeability, quantity and interoperability. The Commission should reject the proposed alternatives and adopt the broadly supported DF51 band plan approach.

Even before initial comments were filed in this proceeding, a consensus began to form among a wide variety of stakeholders including broadcasters, hardware manufacturers and mobile operators in favor of a DF51 approach as a means of maximizing auctioned spectrum, avoiding interference to and from licensed services, and enabling devices with the size and performance expected of smartphones and tablets. These assertions were backed by solid technical considerations. The initial comments and reply comments built on this approach, reflecting a very broad consensus that the Commission’s leading band plan proposal in the *NPRM* presented significant interference issues, and that some form of DF51 would better serve the public interest.

The following principles, which underpinned the consensus around the DF51 band plan, should guide the Commission as it develops a 600 MHz band plan:

- The band plan should be DF51, premised on frequency division duplexing (“FDD”), placing the uplink block at the top, adjacent to the 700 MHz uplink block, eliminating any need for a guard band between those operations;
- All paired spectrum should be above Channel 37, and additional unpaired spectrum should be offered for supplemental downlink where available;
- Use 5 MHz building blocks;
- Employ a duplex gap no larger than necessary for separation of the uplink and downlink bands, in order to maximize the amount of spectrum cleared and reallocated;
- Avoid television operations in the duplex gap, to significantly reduce the risk of interference between TV and mobile operations;
- Prohibit operations in the duplex gap or guard bands that would cause harmful interference to licensed services;
- Guard bands should be no larger than technically reasonable to prevent interference to licensed spectrum, which maximizes the amount of spectrum available for mobile broadband;
- Guard bands should be sufficient to protect wireless and TV broadcast services from interference from each other;
- Permit Channel 37 operations to remain, but minimize mobile uplink in the adjacent spectrum (DF51 achieves this goal); and
- Facilitate international harmonization (a time division duplexing (“TDD”)-based band plan makes the co-channel frequency coordination environment extremely difficult).

The band plan alternatives set forth in the *Public Notice* undercut the Commission’s goals for the band. The “Down from 51 Reversed” (“DF51R”) variant would reduce the amount of

spectrum available for redeployment and auction and adversely impact auction proceeds because it requires an additional guard band between 600 MHz downlink and 700 MHz uplink operations. This plan may cause increased interference into other bands that will be used in consumer devices to provide services simultaneously, including bands used for Wi-Fi, Global Navigation Satellite Systems (“GNSS”), Personal Communications Services (“PCS”), Wireless Communications Services (“WCS”) and Broadband Radio Service/Educational Broadband Service (“BRS/EBS”). By moving uplink operations to lower frequencies, a DF51R approach may require a larger antenna in the user device or reduce the efficiency of a smaller antenna, both of which are undesirable results. Also, the market variability in the DF51R approach will negatively impact the utility and interoperability of the 600 MHz band by increasing the potential for co-channel interference between TV and mobile operations, because spectrum used for uplinks will be used elsewhere for television broadcasts. This will create uncertainty, depress auction revenue, and negatively affect standardization and interoperability. Finally, a DF51R approach does not provide any advantage, because a DF51 approach also can maintain a uniform minimum downlink band nationwide.

The “Down from 51 with TV in the Duplex Gap in Constrained Markets” approach also creates significant challenges. Allowing TV broadcast operations within the duplex gap will result in intermodulation products that will cause harmful interference to both broadcast and mobile wireless operations. In addition, this plan would result in uncertainty, because the severity of intermodulation interference and the measures needed to address it will not be known until long after the forward auction takes place – after repacking occurs and mobile broadband service is deployed. Further, the differences between the various frequency blocks in terms of the probability of intermodulation interference will undermine the generic, interchangeable nature of the 5 MHz building blocks, negatively affect auction proceeds, and possibly result in litigation. This approach also undercuts the marketplace forces and economies of scale that drive the development of user devices that are portable and usable nationwide because the size of the duplex gap will vary between markets. Finally, the use of guard bands around the TV stations in the duplex gap would result in decreased efficiency in spectrum use.

The “Down from 51 TDD” approach would not increase spectrum efficiency because it would require guard bands at the upper and lower edges of the band, and would instead present significant disadvantages. A TDD approach would significantly undercut the utility of the broadcast spectrum being repurposed to most potential bidders since most of the mobile wireless broadband networks currently deployed in the United States are based on FDD technology. As a result, it would undermine the goal of interoperability with most other mobile broadband networks, and diminish the value of the spectrum being auctioned – thus adversely affecting auction revenues. A TDD band plan also would complicate frequency coordination within the U.S. and with adjacent countries, and increase the potential for interference. The use of TDD also results in the maximum possible harmonic and intermodulation interference to other bands operating in the same device, such as GNSS, Wi-Fi, PCS, WCS and BRS/EBS, because uplink transmissions will not be limited to the band segments least likely to cause such interference.

In light of the significant disadvantages of the alternative band plan approaches set forth in the *Public Notice*, and the existing record regarding the band plan approaches in the *NPRM*, the Commission should adopt the broadly supported DF51 band plan approach.

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**COMMENTS OF THE CONSUMER ELECTRONICS  
ASSOCIATION**

The Consumer Electronics Association (“CEA”) hereby responds to the *Public Notice*<sup>1</sup> issued by the Wireless Telecommunications Bureau (“WTB” or “Bureau”) seeking comment on variations of the “Down from 51” (DF51”) alternative 600 MHz band plan presented in the *NPRM*.<sup>2</sup> The variations set forth in the *Public Notice* do not provide advantages over the DF51 approach. Rather, the alternatives presented would introduce substantial technical impediments and would undermine the Commission’s key policy goals for the 600 MHz band plan: utility, certainty, interchangeability, quantity and interoperability. The Commission should reject the proposed alternatives and adopt the broadly supported DF51 band plan approach.

**I. THE “DOWN FROM 51” CONSENSUS APPROACH RESOLVES SEVERAL TECHNICAL ISSUES AND ADVANCES THE PUBLIC INTEREST**

Even before the initial comments were filed in this proceeding, a consensus began to form among a wide variety of stakeholders in favor of a DF51 approach, with uplink at the upper

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<sup>1</sup> *Wireless Telecommunications Bureau Seeks to Supplement the Record on the 600 MHz Band Plan*, GN Docket No. 12-268, DA 13-1157, Public Notice (rel. May 17, 2013) (“*Public Notice*”).

<sup>2</sup> *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Notice of Proposed Rulemaking, 27 FCC Rcd 12357 (2012) (“*NPRM*”).

end of the band, and no television operations in the duplex gap. The *NPRM* only briefly sought comment on the generic DF51 concept as one of several alternatives to the principal proposal that placed TV stations in the duplex gap and was discussed at length in the *NPRM*.<sup>3</sup> Even before comments were due, broadcasters, hardware manufacturers and mobile operators urged the Commission to focus on DF51 as a means of maximizing auctioned spectrum, avoiding interference to and from licensed services, and enabling devices with the size and performance expected of smartphones and tablets.<sup>4</sup> These assertions were backed by solid technical considerations.

The initial comments and reply comments built on this approach, reflecting a very broad consensus that the Commission's leading band plan proposal presented significant interference issues, and that some form of DF51 would better serve the public interest.<sup>5</sup> The record did not reflect substantial support for the *NPRM*'s principal band plan proposal, which commenters indicated would pose a significant risk of intermodulation interference to both broadcast television and licensed wireless services and unnecessarily increase the complexity of compatible devices.

The following principles, which underpinned the consensus around the DF51 band plan, should guide the Commission as it develops a 600 MHz band plan:

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<sup>3</sup> The *NPRM* devoted a single page consisting of two paragraphs to DF51, compared with some fifty paragraphs taking up 20 pages on the principal proposed band plan. *Compare NPRM*, 27 FCC Rcd at 12421, *with id.* at 12401-20.

<sup>4</sup> *See* Letter from representatives of AT&T, Inc., National Association of Broadcasters, T-Mobile, Intel Corporation, Qualcomm, and Verizon Wireless, to Gary Epstein, Incentive Auction Task Force Chair and Ruth Milkman, Wireless Bureau Chief, FCC, GN Docket No. 12-268 (Jan. 24, 2013) ("Joint Letter"). All comments and reply comments cited herein were filed in Docket No. 12-268 on Jan. 25, 2013 and Mar. 12, 2013 respectively.

<sup>5</sup> *See, e.g.*, Comments of ABC Television Affiliates Assoc. *et al.* at 43-45; Comments of AT&T Inc. ("AT&T") at 15-18; Comments of Comcast Corp. and NBCUniversal Media, LLC at 20-23; Comments of CTIA–The Wireless Association ("CTIA") at 18-22; Reply Comments of Ericsson ("Ericsson") at 3-4, 9-10, 32-34; Reply Comments of Intel Corp. at 1-3; Reply Comments of Mobile Future at 7-8; Reply Comments of the National Association of Broadcasters ("NAB") at 3-13; Reply Comments of Qualcomm Inc. ("Qualcomm") at 13-15; Reply Comments of T-Mobile USA, Inc. ("T-Mobile") at 13-17.

- The band plan should be DF51, premised on frequency division duplexing (“FDD”), placing the uplink block at the top, adjacent to the 700 MHz uplink block, eliminating any need for a guard band between those operations;
- All paired spectrum should be above Channel 37, and additional unpaired spectrum should be offered for supplemental downlink where available;<sup>6</sup>
- Use 5 MHz building blocks;
- Employ a duplex gap no larger than necessary for separation of the uplink and downlink bands, in order to maximize the amount of spectrum cleared and reallocated for mobile broadband;
- Avoid television operations in the duplex gap, to significantly reduce the risk of interference between TV and mobile operations;
- Prohibit operations in the duplex gap or guard bands that would cause harmful interference to licensed services;
- Guard bands should be no larger than technically reasonable to prevent interference to licensed spectrum, which maximizes the amount of spectrum available for mobile broadband;
- Guard bands should be sufficient to protect wireless and TV broadcast services from interference from each other;
- Permit Channel 37 operations to remain, but minimize mobile uplink in the adjacent spectrum (DF51 achieves this goal); and
- Facilitate international harmonization<sup>7</sup> (a time division duplexed (“TDD”)-based band plan makes the co-channel frequency coordination environment extremely difficult).

These band plan principles should also guide the Commission in evaluating technical issues relating to the alternative plans set forth in the *Public Notice*.

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<sup>6</sup> While those supplemental downlink bands may be subject to an increased risk of interference from co-channel TV broadcast operations in other markets where less spectrum is cleared and reallocated, this risk would not impact any paired spectrum blocks. As a result, those paired blocks would remain interchangeable, thus encouraging interoperability in the standards-setting process.

<sup>7</sup> *E.g.*, Joint Letter at 1-2.

## **II. PROS AND CONS OF THE “DOWN FROM 51” ALTERNATIVES PRESENTED IN THE PUBLIC NOTICE**

### **A. DOWN FROM 51 REVERSED**

The first band plan variant set for comment in the *Public Notice*, “Down from 51 Reversed” (“DF51R”), reverses the DF51 pattern by placing the downlink block at the upper end of the 600 MHz band, with a duplex gap and uplink spectrum below that, creating significant interference issues. According to the proposal, this allows for clearance of varying amounts of spectrum from market to market, setting a uniform minimum amount of downlink spectrum and variable amounts of uplink spectrum, without putting television in the duplex gap.<sup>8</sup> However, this band plan variant would undercut the Commission’s other goals, since it would not maximize the amount of paired spectrum available for auction and it fails to promote certainty or the utility, interchangeability, and interoperability of the spectrum.

The DF51R plan has significant disadvantages. First, a DF51R approach would reduce the amount of auctioned spectrum and adversely impact auction proceeds. The *Public Notice* acknowledges that placing the downlink operations at the top end of the 600 MHz band requires the insertion of a guard band between the 600 MHz downlink spectrum and the 700 MHz uplink spectrum at 698 MHz, in order to avoid interference between 600 MHz downlink and 700 MHz uplink operations.<sup>9</sup> Such a guard band also will likely reduce the amount of spectrum available for redeployment by 10 MHz or more, and so is contrary to the objective of maximizing the spectrum available for auction. As a result, an inevitable consequence of the DF51R plan would be to reduce the amount of licensed spectrum and the auction proceeds, as compared with DF51.

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<sup>8</sup> *Public Notice* at 4.

<sup>9</sup> *Public Notice* at 4-5.

Second, moving the uplink to lower frequencies has the potential to cause increased interference into other bands that will be used in consumer devices to provide services simultaneously, including bands used for Wi-Fi, Global Navigation Satellite Systems (“GNSS”), Personal Communications Services (“PCS”), Wireless Communications Services (“WCS”) and Broadband Radio Service/Educational Broadband Service (“BRS/EBS”). In fact, there are multiple harmonic jamming victim bands for uplinks in each 5 MHz block *except* the top five 5 MHz blocks in the 600 MHz band.<sup>10</sup> As a result, the DF51R increases the interference potential with respect to these other bands operating within the user device, as compared with DF51.

Third, the DF51R band plan may require a larger antenna in the user device (or reduce the efficiency of a smaller antenna). Antenna gain is most critical for the uplink portion of the band. Moving the uplink band lower in frequency, and thus increasing the uplink wavelength, will require a physically larger device for a given amount of gain than if the uplink band were higher. This will adversely affect device cost and form factor.

In addition, the market variability in the DF51R approach will negatively impact the utility and interoperability of the 600 MHz band. There will be a potential for co-channel interference from TV stations into wireless base station receivers in different markets, because spectrum used for uplinks will be used elsewhere for television broadcasts.<sup>11</sup> The degree to which spectrum is encumbered by the potential for such interference will vary by frequency block, undermining the utility of particular spectrum blocks and the generic, interchangeable

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<sup>10</sup> See Comments of Qualcomm at 11 (Table 2). In addition, intermodulation products affecting other bands are the least likely when using the five top 5 MHz blocks for uplinks. See Reply Comments of Qualcomm at 22-23 (Table 7).

<sup>11</sup> Differing spectrum amounts from market to market would require the development of co- and adjacent-channel separation distances to avoid interference. This is complicated by the difference in channel bandwidths (5 MHz *vs.* 6 MHz) and service areas (EAs *vs.* TV service contours) of wireless and broadcast operations. As a result, transmissions from a single TV transmitter will be co-channel with two different wireless channels, and there may be multiple markets affected on each channel.

nature of the spectrum being auctioned. This is similar to the experience faced in the 700 MHz auction as a result of continued TV broadcast operations on Channel 51. This will create uncertainty, depress auction revenue, and negatively affect standardization and interoperability. The market-to-market variability in channel clearing that the *Public Notice* sees as providing the advantage of flexibility under the D51R band plan<sup>12</sup> must be weighed against the considerable disadvantages of such variability.

Finally, while the *Public Notice* cites maintaining a uniform minimum downlink band nationwide as an advantage of this band plan, a uniform minimum downlink band likewise can be maintained under the DF51 band plan, even if spectrum clearance varies by market.<sup>13</sup> Thus, this alternative does not provide any advantage over the DF51 approach; rather, the DF51R plan just introduces significant disadvantages.

#### **B. DOWN FROM 51 WITH TV IN THE DUPLEX GAP IN CONSTRAINED MARKETS**

The second band plan variant set forth in the *Public Notice* – “Down from 51 with TV in the Duplex Gap in Constrained Markets” – also creates significant challenges. The *Public Notice* acknowledges the considerable criticism that has been leveled at allowing digital TV broadcasting operating in the duplex gap, but asks whether the Commission should follow this practice only in spectrum-constrained markets.<sup>14</sup> The Commission should not adopt this approach; it would undercut the band plan objectives of quantity, utility, certainty, interchangeability, and interoperability, and would adversely affect auction revenues.

As numerous commenters have demonstrated, allowing TV broadcast operations within the duplex gap will result in intermodulation products that will cause harmful interference to

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<sup>12</sup> *Public Notice* at 3-4.

<sup>13</sup> See Comments of Qualcomm at 18-20.

<sup>14</sup> *Id.* at 5.

both broadcast and mobile wireless operations.<sup>15</sup> That is true whether it occurs nationwide or only in so-called “constrained” markets. The spectrum-constrained markets (which tend to be the most highly populated) are likely to be where the damage caused by harmful intermodulation interference would affect the most TV viewers and wireless users. Accordingly, allowing such interference to occur only in the “constrained” markets will diminish the utility of the 600 MHz spectrum and is clearly contrary to the public interest.

In addition, the variable band plan allowing TV broadcasting within the duplex gap in “constrained” markets would result in uncertainty, because the severity of intermodulation interference and the measures needed to address it will not be known until long after the forward auction takes place – after repacking occurs and mobile broadband service is deployed. Moreover, there will be differences between the various frequency blocks with respect to probability of intermodulation interference, which in turn will reduce the generic, interchangeable nature of the 5 MHz building blocks. This uncertainty will negatively affect auction proceeds and could result in post auction litigation.

Moreover, this approach undercuts the marketplace forces and economies of scale that drive the development of user devices that are portable and usable nationwide. Allowing TV operations within the duplex gap in some markets but not others implies that the duplex gap will be much larger in the “constrained” markets than in all others. Radios designed to accommodate a large duplex gap will require additional RF circuit components (e.g., duplexers, antennas) than is otherwise required with a smaller duplex gap.<sup>16</sup> As a result, a 600 MHz handset or tablet

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<sup>15</sup> See Comments of AT&T at 24-27 & Ex. A; *see also, e.g.*, Comments of Alcatel-Lucent at 14-16; Comments of CTIA at 24-25; Comments of NAB at 36-37; Comments of T-Mobile at 8; Comments of Verizon and Verizon Wireless at 10, 19; Reply Comments of CEA at 26; Reply Comments of Ericsson at 9-10.

<sup>16</sup> As the comments observed, there are antenna design challenges entailed in developing radios with a large duplex gap. *See, e.g.*, Comments of AT&T at 17-18, 20, 30-31, 33; Comments of Motorola Mobility LLC at 9. To achieve adequate performance, multiple antennas may be necessary, increasing the size and weight of devices.

capable of working in New York could not be used in, say, Louisville, and *vice versa*. These differences will create significant challenges to achieving economies of scale and are contrary to the Commission's goal of interoperability.

Finally, the use of guard bands around the TV stations in the duplex gap would result in decreased efficiency in spectrum use. And those guard bands would be imposed only in the most spectrum-constrained markets, resulting in an unnecessarily diminished pool of auctionable spectrum in the markets where there is likely to be the greatest need for additional licensed wireless broadband spectrum. A wider duplex gap also has negative consequences for the bandwidth of the antenna, which either hurts capacity or increases the device dimension, both of which are undesirable.

### **C. DOWN FROM 51 TIME DIVISION DUPLEX (“TDD”)**

The third variant explored in the *Public Notice* is the “Down from 51 TDD” approach. This approach would not increase spectrum efficiency, and would instead present significant disadvantages compared with an FDD-based plan. A TDD approach would significantly undercut the utility of the broadcast spectrum being repurposed to most potential bidders. As a result, it would diminish the value of the auctioned spectrum and reduce auction revenues.

Most of the mobile wireless broadband networks currently deployed in the United States are based on FDD technology, using paired spectrum for separate up- and downlinks. TDD technology instead uses unpaired spectrum, with up-and downlinks using the same spectrum at different times. An obvious advantage of TDD is that there is no duplex gap.<sup>17</sup> However, TDD systems require additional guard bands to protect adjacent operations, because each frequency is

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<sup>17</sup> The lack of a duplex gap means that there is no need to impose limits on how the duplex gap spectrum can be used. It also means that the total span of the spectrum from the lower edge to the upper edge of the 600 MHz wireless band will be narrower, thus simplifying mobile antenna design.

used for both uplink and downlink transmissions. As a result, the Down from 51 TDD plan is not inherently more spectrally efficient.

A TDD-based band plan also would increase the potential for interference. Mobile uplink transmissions will take place on any and all frequencies within the band. This maximizes the difficulty of frequency coordination with both adjacent countries and among markets with variable spectrum availability. The co-channel interference separation distance for uplink spectrum can be double that for TV-to-TV stations, and four times that for TV-to-downlink operations. The use of TDD also results in the maximum possible harmonic and intermodulation interference to other bands operating in the same device, such as GNSS, Wi-Fi, PCS, WCS and BRS/EBS, because uplink transmissions will not be limited to the band segments least likely to cause such interference.<sup>18</sup> Moreover, like the D51 Reversed plan, a TDD- based plan takes away spectrum that is ideally suited for uplink. Because it is adjacent to the 700 MHz uplink spectrum and can be used for uplinks without needing a guard band (and uses it inefficiently), an additional guard band is needed to protect the 700 MHz uplink receivers from 600 MHz downlink transmissions and the downlink receivers in 600 MHz user devices from 700 MHz uplink transmission. This plan also requires a guard band at the lower end of the band to protect the TV and/or Channel 37 operations below the mobile operations.

Finally, the Down from 51 TDD approach would not be interoperable with most other mobile broadband networks. In the United States, networks employing the cellular, PCS, 700 MHz, and AWS spectrum currently use FDD technology. User devices that incorporate these bands are designed to utilize FDD technologies. There would be significant challenges to the seamless incorporation of 600 MHz TDD technology into a device that uses FDD technology on

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<sup>18</sup> See *supra* note 10 above and accompanying text.

these other bands for communication between the mobile and network. As a result, multi-mode operation would be questionable, and there would be diminished, if any, interoperability among 600 MHz and other networks. The 600 MHz spectrum will have greater utility to operators of current mobile networks if it uses FDD technology than if it were configured for TDD. The Commission's band plan must be responsive to marketplace demand; the Commission should not adopt a band plan that is tailored specifically to a small number of providers.

### III. CONCLUSION

The 600 MHz band plan variations set forth in the *Public Notice* do not provide advantages over the DF51 approach. Rather, the alternatives presented would introduce substantial technical impediments and would undermine the Commission's key policy goals for the 600 MHz band plan. It is critical to a successful incentive auction that the 600 MHz band plan be technically viable, minimize uncertainty and the potential for interference to post-auction licensed operations, and be attractive to a broad base of potential auction participants. The Commission should reject the proposed alternatives and adopt the widely supported DF51 band plan approach.

Respectfully submitted,

CONSUMER ELECTRONICS ASSOCIATION

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