Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions	)	GN Docket No. 12-268
	)	
	)	

COMMENTS OF SPECTRUM MANAGEMENT CONSULTING INC.

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Spectrum Management Consulting Inc. ("Spectrum Management") submits these comments in response to the Public Notice issued by the Federal Communications Commission ("FCC" or the "Commission") in the above-captioned proceeding.[1] Spectrum Management is a company focused on the efficient utilization of spectrum assets and on advising businesses on matters related to the use of spectrum. With a wealth of experience relevant to the convergence of voice, data, video, and wireless technologies, Spectrum Management provides telecommunications, media, technical, and regulatory expertise for clients throughout the world, advising them on the strategic interplay of technology, business, and competitive forces.

I. INTRODUCTION AND EXECUTIVE SUMMARY

While soliciting additional feedback regarding the 600 MHz band plan represents an important part of the deliberative process, the "Down from 51" band plan remains the best alternative for the incentive auction. The Commission's additional band plan proposals may have been motivated by the possible presence of television channels in (or just above) the duplex

[1] Wireless Telecommunications Bureau Seeks to Supplement the Record on the 600 MHz Band Plan, *Public Notice*, DA 13-1157 (rel. May 17, 2013) ("*Public Notice*").

gap.[2] However, these new plans create many additional complications that may be harder to resolve than the problems they seek to address. In this pleading we wish to bring to the Commission's attention the severity of the new problems created by the "Down from 51 Reversed" and "Down from 51 TDD" plans (the "Alternative Band Plan Proposals").[3] These new plans introduce inefficiencies and waste valuable 600 MHz spectrum by requiring a substantial guard band to provide adequate protection between neighboring 600 and 700 MHz services. Nor do these inefficiencies simply represent the opportunity cost of less spectrum being recovered: if the band plan does not build in adequate guard bands, or if the associated out-of-band-emission ("OOBE") limits and other constraints on performance are not sufficiently restrictive, the band plan will cause harmful, base-to-base and mobile-to-mobile interference between licensees in the 600 MHz and 700 MHz bands. Coupled with the potential mechanics of the incentive auction, in which forward auction participants bid on a generic block of spectrum without knowing its exact location in the band, the Alternative Band Plan Proposals could also have the effect of substantially lowering proceeds for the entire incentive auction. The uncertainty of band location and the potential for interference between 600 and 700 MHz bands could result in an "across-the-board" discount on all generic blocks of spectrum. The Commission has extensive familiarity with introducing dissimilar network architectures near existing network deployments, and experience shows that it is, at best, a difficult endeavor.[4] For

[2] *See id.* at 2.

[3] The presence of dissimilar network architectures, whether an FDD uplink channel adjacent to an FDD downlink channel or a TDD channel adjacent to an FDD channel, create similar complications and interference concerns. Spectrum Management thus addresses these proposed band plans jointly as the "Alternative Band Plan Proposals."

[4] *See, e.g.*, Promoting Interoperability in the 700 MHz Commercial Spectrum; Interoperability of Mobile User Equipment Across Paired Commercial Spectrum Blocks in the 700 MHz Band, *Notice of Proposed Rulemaking*, 27 FCC Rcd 3521 (rel. Mar. 21, 2012) ("*Interoperability NPRM*"); Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band, *Second Report and Order*, 22 FCC Rcd 15289 (rel. Aug. 10, 2007); Nextel Communications, Inc., *White Paper: Promoting Public Safety Communications – Realigning the 800 MHz Land Mobile Radio Band to Rectify Commercial Mobile Radio – Public Safety Interference and Allocating Additional Spectrum to Meet Critical Public Safety Needs*, WT Docket No. 99-87 (Nov. 21, 2001).

these reasons, the Commission should adopt a plan that it knows will work – the "Down from 51" band plan.

II. THE RISK OF INTERMODULATION INTERFERENCE THAT THE "DOWN FROM 51 REVERSED" BAND PLAN SEEKS TO ADDRESS IS UNLIKELY TO OCCUR

As part of the ongoing broadcast incentive auction of spectrum, in 2012 the Commission issued a Notice of Proposed Rulemaking ("NPRM") that contained several proposed band plans for the 600 MHz band.[5] As the Commission notes in the NPRM, one unique challenge of the 600 MHz band plan is that it must be flexible enough to allow interested wireless spectrum providers to make informed decisions about whether, and how, to bid for and subsequently use 600 MHz spectrum before the exact amount of spectrum to be auctioned can be known.[6] One plan proposed by the Commission for the 600 MHz band, which has been supported by many stakeholders, is the "Down from 51" band plan. Under this plan, the Commission would clear broadcast television channels starting at Channel 51 and expand downward, with the uplink band beginning at Channel 51, followed by a duplex gap, and then a downlink band.[7]

Following a workshop in May 2013 to evaluate and quantify the technical tradeoffs associated with configuring the uplink and downlink blocks in the 600 MHz band plan, the Commission issued a Public Notice seeking comment on two alternatives to the "Down from 51" band plan, to see which of these approaches best address the potential for market variation, particularly in markets where available spectrum is constrained: the "Down from 51 Reversed" band plan, and the "Down from 51 TDD" band plan.[8] The "Down from 51 Reversed" band plan

[5] Expanding the Economic and Innovation Opportunities of Spectrum through Incentive Auctions, *Notice of Proposed Rulemaking*, 27 FCC Rcd 12357 (2012) ("*NPRM*").

[6] *Id.* at 12401.

[7] *Id.*at 12421.

[8] *Public Notice* at 2-3.

would expand downward from a guard band at Channel 51, followed by a duplex gap, and then the uplink band; the "Down from 51 TDD" band plan would also have a guard band at Channel 51, with a guard band at the lower edge of the 600 MHz band, but no duplex gap.

Concerns raised by some commenters about the possibility of intermodulation interference appear to have prompted the Commission to seek comment on the "Down from 51 Reversed" band plan.[9] These commenters note that, in the "Down from 51" plan, 600 MHz LTE downlink transmissions could mix with a broadcast station that remains in the duplex gap or uplink spectrum of the plan and form an additional signal at the difference frequency of the two signals, which would position the intermodulation product in the receive band of the 600 MHz LTE user equipment.

History has shown that it is unwise to allocate dissimilar services or power classes in neighboring bands (e.g., WCS/SDARS, ESMR/Cellular, ESMR/Public Safety, 700 MHz A block/Channel 51, EBS/BRS Mid-band)[10] due to the interference potential and the resultant need for use of valuable spectrum as a guard band, or the need for complex filters and other technical solutions to provide protection to adjacent services. In this case allocating broadcast television adjacent to two-way operations will result in the need to allocate a significant guard band to protect both broadcast television and the two-way service from interference.

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[9] *See* Comments of National Association of Broadcasters, Docket No. 12-268, at 35-36 (Jan. 25, 2013) (stating that the Commission's proposed "split" band plan "creates a risk of harmful interference to television receivers," and that filters would not provide protection against intermodulation interference); Comments of AT&T Inc., Docket No. 12-268, at 24-26 (Jan. 25, 2013) (arguing that the "Down from 51" band plan is problematic, as it could create a risk of intermodulation interference for the 600 MHz band, among other bands, and result in degraded network performance); Comments of CTIA-The Wireless Association, GN Docket No. 12-268, at 25 (Jan. 25, 2013) ("CTIA is concerned…that the band plan that is preferred by the Commission, with any number of broadcast incumbent stations potentially in the duplex gap, would lead to extensive amounts of intermodulation products and distortion.").

[10] *See, e.g.*, *Interoperability NPRM*; *700 MHz Public Safety Second Report & Order*; *Nextel SMR White Paper*.

As a practical matter, however, the harmful effects of this intermodulation product can be minimized or eliminated by assuring that the incorporation of television anywhere above Channel 37 is the exception, not the rule. Even assuming only a relatively modest number of broadcasters exit the business following the incentive auction, most markets are not so heavily encumbered by television stations and cross-border constraints on television placement as to require the allocation of TV in spectrum above Channel 37. As a result, any challenges associated with intermodulation will be confined to local areas where broadcast congestion is high, broadcast exit is low, and cross-border constraints are extensive. These conditions will not exist in most of the country.

To the extent that there are marginally more channels in the largest markets, the greater value of the spectrum to wireless providers will likely drive up the bids for the spectrum and increase the likelihood that all broadcast channels clear.

Nor should limited repacking and interference concerns at the Canadian or Mexican borders steer the decision regarding the appropriate band plan. For example, Industry Canada has explained that "[i]t is expected that Canadian usage of the [600 MHz] band will eventually be harmonized with usage in the United States."[11] As the Commission is aware, there is likely to be an appreciable amount of time between now and when the U.S. 600 MHz spectrum is ready for deployment. The 600 MHz auction promises to shape the wireless market for years to come; the Commission should avoid adopting a band plan with a likely expiration date.

[11] *See, e.g.*, Industry Canada, Commercial Mobile Spectrum Outlook § 4 (Mar. 7, 2013), *available at* http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09444.html.

III. THE PROPOSED VARIATIONS ON THE "DOWN FROM 51" BAND PLAN WOULD BE INEFFICIENT OR INCREASE THE POTENTIAL FOR HARMFUL INTERFERENCE

A. Introducing Guard Bands into the 600 MHz Band Plan Would Be Inefficient

Unlike the "Down from 51" plan and other plans for which the FCC previously sought comment, the Alternative Band Plan Proposals require a guard band at Channel 51 to separate 600 MHz downlink operations from 700 MHz uplink operations at the 698 MHz band edge. In contrast, the "Down from 51" band plan would begin the uplink band directly at Channel 51, with no guard band necessary because positioning the 600 MHz uplinks adjacent to the 700 MHz uplinks would not create any risk of harmful interference.

Designating a guard band reduces the amount of spectrum available for either broadcasters or wireless providers.[12] Including a guard band in the 600 MHz band plan creates an artificial and avoidable loss of potential revenue from the spectrum auction. In addition, reducing the amount of spectrum available at the auction impairs the competitiveness of the mobile marketplace.[13] Numerous commenters have written in support of locating paired uplink spectrum adjacent to the lower 700 MHz band, to avoid the inefficiencies of a guard band.[14]

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[12] In the *NPRM*, the Commission noted the possibility that guard band spectrum could potentially be used by unlicensed white spaces devices. *NPRM*, 27 FCC Rcd at 12423. However, as the Commission observed, to minimize interference, such usage would probably be on a secondary basis, which could have the effect of limiting its utility. Although the unlicensed use of white spaces holds considerable promise for the future of spectrum use, the limited commercial use of such technology and already existing guard band spectrum available for such use means that the 600 MHz band plan does not need to deliberately create otherwise fallow spectrum bands.

[13] *Id.* at 12359 ("[T]he spectrum reclaimed through the incentive auction will promote economic growth and enhance America's global competitiveness, increase the speed, capacity and ubiquity of mobile broadband service, such as 4G LTE and Wi-Fi like networks, and accelerate the smartphone- and tablet-led mobile revolution, benefitting consumers and businesses throughout the country.").

[14] *See, e.g.*, Comments of Verizon and Verizon Wireless, Docket No. 12-268, at 14 (Jan. 25, 2013) ("Verizon Comments") (noting that guard bands "wast[e] spectrum"); Comments of T-Mobile USA, Inc., WT Docket No. 12-268, at iii (Jan. 25, 2013) ("Any band plan the FCC adopts should maximize the amount of paired spectrum and minimize the need for guard bands."); Comments of MetroPCS Communications, Inc., Docket No. 12-268, at 25 (Jan. 25 , 2013) (noting favorably that the paired uplink bands in the "Down from 51" band plan would eliminate the need for a guard band).

In its alternative band plan proposals, the Commission does not propose a guard band size, but seeks comment on how much broadband-capable spectrum would need to be repurposed to separate 600 MHz downlink operations from 700 MHz uplink operations.[15] Determining the proper size of a guard band between 700 MHz uplinks and 600 MHz downlinks or TDD operations is very difficult without knowing the full suite of other technical rules applicable to both sets of licensees. The size of the guard band will depend on many factors, including the nature of LTE equipment deployed in the 600 MHz band, the duplexing arrangement (viz., TDD or FDD), the operating power of the base station transmitters, the applicable OOBE limits and the precise frequencies where the OOBE limits would apply. In many of the scenarios we have reviewed, the guard band to mitigate interference and optimize use would have to be substantial. If the guard band allocated was insufficient, the resultant positioning of 600 MHz downlinks next to 700 MHz uplinks could impose costs on both 600 and 700 MHz licensees that may be ill-equipped to bear them and already suffer from a lack of interoperability in the 700 MHz band.

These costs include not only the direct costs of installing superior filters on end user devices to avoid mobile-to-mobile interference, but also the opportunity cost that 700 MHz licensees and equipment manufacturers might realize from having 700 MHz uplink adjacent to 600 MHz uplinks. Positioning 600 MHz downlink spectrum next to the 700 MHz uplink not only imposes direct interference-mitigation costs, but also forecloses possible innovations of shared uplink spectrum and economies of scale for both 600 MHz and 700 MHz licensees.

B. Interference

If the Commission were to adopt either of the Alternative Band Plan Proposals, failing to incorporate sufficient guard band spectrum between the 700 MHz uplink spectrum and the

[15] *NPRM*, 27 FCC Rcd at 12412.

proposed 600 MHz downlink spectrum would lead to harmful interference. Interference is not only a technical challenge for operators, but also has business implications, as capital and operating expenditures to avoid the most serious interference can impede planned business growth and development, while uncertainty about possible future forms of interference could hinder expansion of services.

Base-to-Base Interference. One form of interference that could arise from locating 600 MHz downlink next to the uplink bands in the lower 700 MHz band would be between base stations. As the Commission has noted, there are two possible mechanisms for base-to-base interference: receiver overload and OOBE.[16]

Receiver overload interference. An amplifier is signal agnostic and amplifies both the desired signal and any other signals similar in frequency to the desired frequency. If the undesired signal is strong, it may overload the receiver. Receiver overload is a concern when high-power downlink bands are located in close proximity to user equipment receive bands. Although overload can be addressed by filters in base stations, these filters can be sufficiently large that they do not always fit on existing towers, and can require the construction of additional infrastructure that, after installation, must be monitored and maintained. This additional hardware adds to licensee operating expenses and could be avoided by ensuring the uplink and downlink are not proximately located.

OOBE interference. Transmitters are not flawless: they emit not only the desired signal, but also signals outside the intended frequency range. OOBE appears as co-channel interference to a victim receiver. Unlike overload, OOBE cannot be filtered, because the energy is inside the channel that the base station is trying to receive. The only solutions are a more selective

[16] *NPRM*, 27 FCC Rcd at 12413 ("Interference can occur at either the television receiver or the mobile broadband base station receiver, either by out-of-band emissions (OOBE) or by receiver overload ("blocking") from the adjacent service.").

transmitter, power limits on the transmitter, or greater separation between the transmitter and the receiver to allow for more "roll off" in the signal. Without an adequate guard band or costly constraints on transmitter operations, 700 MHz licensees would suffer performance degradation, operational limits or harmful interference.

Mobile-to-Mobile Interference. Positioning downlink and uplink bands in close proximity, as proposed in the Alternative Band Plan Proposals, creates a risk of mobile-to-mobile interference. Specifically, transmissions from 700 MHz mobile user equipment could cause harmful interference into 600 MHz mobile user equipment. This scenario is probabilistic, and there are many variables, among the most important of which is that a 600 MHz end user receiver must be in close proximity to a 700 MHz end user transmitter. Given the data-intensive uses envisioned for this band, however, mobile-to-mobile interference in a "Starbuck's scenario," where two users both relying on mobile services are in close proximity to each other, or even the same individual is operating multiple mobile devices simultaneously, is fairly probable. And as the Commission recognized in the H Block proceeding, "the probabilistic nature [of mobile-to-mobile interference] can make it more important to set rules to prevent it, not less."[17] As with base-to-base interference, the options to mitigate mobile-to-mobile interference are increased spectrum separation – guard band – between the two services and/or power limits on the 700 MHz user equipment. Both of these configurations are undesirable because they introduce new inefficiencies into operations on either side of the 698 MHz band edge. Imposing new constraints on previously licensed 700 MHz operators is also inequitable since many of these licensees have already deployed or planned services and many of the 700

[17] Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands; Fixed and Mobile Services in the Mobile Satellite Service Bands at 1525-1559 MHz and 1626.5-1660.5 MHz, 1610-1626.5 MHz and 2483.5-2500 MHz, and 2000-2020 MHz and 2180-2200 MHz; Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz and 2175-2180 MHz Bands, *Report and Order and Order of Proposed Modification*, 27 FCC Rcd 16102, 16138 n.287 (2012).

MHz A Block licensees, which are closest in proximity to the proposed downlink spectrum, face deployment constraints from the presence of television downlinks in the 600 MHz spectrum as well as the Commission's continued lack of action in the 700 MHz interoperability proceeding.

Whether the Commission chooses to mitigate the potential for harmful interference that the juxtaposition of 600 MHz downlinks with 700 MHz uplinks creates through the introduction of inefficient guard band spectrum or operational limits that constrain deployment or both, these measures would limit the amount of spectrum available for auction in the 600 MHz band and could reduce the ability of wireless providers to cost effectively deploy broadband spectrum in either the 600 MHz or 700 MHz bands. Rather than imposing unnecessary constraints on licensees, the Commission should adopt the "Down from 51" band plan and create contiguous uplink bands, which will not give rise to harmful and disruptive interference.

IV. CONCLUSION

The Commission should adopt the "Down from 51" band plan proposed in the original *NPRM*, and reject the Alternative Band Plan Proposals as inefficient and disruptive to existing uses of spectrum. The use of guard bands and lack of adjacent uplink bands in both of the Alternative Band Plan Proposals not only decreases the total amount of spectrum available for both broadcast television operations and for auction, but also introduces uncertainty surrounding the potential for interference due to improperly configured guard bands. In addition to the loss of valuable spectrum, the "Down from 51 Reversed" channel plan places additional burden on mobile operators and stifles innovation in the use of spectrum for mobile devices. The "Down from 51" plan places 700 MHz and upper 600 MHz uplink bands next to one another, which eliminates the need for guard bands, eliminates the possibility of base-to-base or mobile-to-mobile interference, and promotes efficient spectrum use that will allow for maximum flexibility

and certainty in the mobile marketplace. Therefore we urge the Commission to adopt the originally conceived "Down from 51" band plan.

Respectfully submitted,

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