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May 5, 2014

WRITTEN *EX PARTE* PRESENTATION

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, S.W., Room TW-A325
Washington, D.C. 20554

Re: *Policies Regarding Mobile Spectrum Holdings*, WT Docket No. 12-269

Dear Ms. Dortch:

In the attached analysis, Sprint Corporation ("Sprint") further explains why the staff's proposal for an unweighted screen would thwart competition, misdirect investment, and ultimately harm consumers. Despite overwhelming evidence identifying the current spectrum screen's indifference to material differences among spectrum bands as its critical defect, the staff proposal currently under consideration both retains the existing screen's analytical flaw and exacerbates it with the inclusion of significant additional mid- and high-band spectrum without differentiation. The staff proposal would treat high- and mid-band spectrum the same as low-band spectrum for purposes of analyzing the competitive effects of a transaction, even though the competitive utility – and risk of concentration – of each band is demonstrably different and has been well-documented in this proceeding.

The Federal Communications Commission ("Commission") can nonetheless rectify the inadequacies of the current – and proposed – spectrum screen by adopting a screen that reflects the material differences among broadly defined categories of spectrum. Specifically, adoption of a simplified, three-tiered weighting system for low-, medium-, and high-band spectrum would better reflect the competitive effects of concentration resulting from any given spectrum acquisition and return the screen to its purpose of correctly identifying potentially damaging exercises of market power.

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Pursuant to Section 1.1206 of the Commission's rules, this letter is being electronically filed with your office. Please let me know if you have any questions regarding this filing.

Respectfully submitted,

/s/ Lawrence R. Krevor
Lawrence R. Krevor
Vice President
Legal and Government Affairs – Spectrum

Attachment

Differences Between Frequencies Do Not End at 1 GHz:
The Screen Must Account for Differences Between Mid- and High-Band Spectrum

WT Docket No. 12-269

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May 5, 2014

Executive Summary

The current spectrum screen is broken, and the Commission staff's proposal for an unweighted spectrum screen would make the situation worse, not better. The revised spectrum screen under consideration would introduce additional regulatory uncertainty and establish new barriers to investment. Instead of promoting competition, the proposed spectrum screen would clear a path for the two firms currently dominating the market to entrench their commanding market position. At the same time, one of the only providers offering wide-scale competition to these market-dominating providers – Sprint – would receive additional regulatory scrutiny almost any time it attempts to acquire new spectrum.

In developing a competition policy, the Commission has concluded that spectrum concentration directly implicates market power. An analysis of spectrum concentration, therefore, should reliably predict when acquisitions of spectrum are anticompetitive and when they are not. The current proposal to adopt an unweighted spectrum screen fails this test. For example, the proposed screen would permit Verizon to acquire T-Mobile without triggering the screen in 92% of counties nationwide, even though federal regulators recently blocked the comparable planned merger of AT&T and T-Mobile because it would gravely harm competition. Meanwhile, if Sprint were to attempt to acquire almost any single term-limited lease for 2.5 GHz spectrum, that acquisition would receive additional regulatory scrutiny even though the competitive effect of such a transaction would be entirely inconsequential.

Not all spectrum is created equal. The nation's mobile radio spectrum falls fairly neatly into three distinct band segments – low-, mid-, and high- band spectrum – each separated by hundreds of megahertz and each exhibiting substantially different propagation characteristics. The decay rate of high-band spectrum means it can take up to eighteen times as many cell sites for a high-band operator to provide the same coverage as a low-band operator and 5.5 times as many cell sites to replicate the coverage of a mid-band operator, resulting in similarly greater proportions in terms of a carrier's operating expenses. Likewise, the poorer building penetration of high-band spectrum means that customers of low-band carriers can get better service deep inside a building than high-band consumers get in a perimeter room. Moreover, the poorer propagation and building penetration means that high-band spectrum suffers a Signal to Interference and Noise Ratio (SINR) disadvantage as compared to both mid- and low-band spectrum that directly impairs the amount of throughput a high-band network can achieve. The Commission's screen should account for these and related differences if it is to be a reliable indicator of when additional competitive scrutiny of a transaction is warranted.

Operators using Educational Broadband Service (EBS) spectrum, such as Sprint, face additional challenges on top of the technical limitations of operating using a higher frequency. They are required to lease the vast majority of the spectrum they use, which in Sprint's case means entering into several hundred additional EBS licensee-lessor agreements in order to aggregate sufficient spectrum to provision a single 60 MHz TDD channel covering approximately two-thirds of the population. And every EBS lease entered into since 2006 can be revisited every five years after the fifteenth year of the lease. The resulting uncertainty creates large transaction costs and introduces the severe and recurring risk of a holdout problem. Worse yet, a wireless operator is often forced to lease an EBS licensee's entire EBS portfolio, resulting in the acquisition of material excess spectrum simply to secure access to one or more useful broadband channels.

Thus, the proposed spectrum screen currently under consideration fails to reliably identify improper exercises of market power. Applying weights of 1.5 for low-band spectrum, 1.0 for mid-band spectrum, and 0.5 for high-band spectrum offers a means of distinguishing among the different utility of different bands of spectrum. A simplified, three-tiered weighting system would better reflect the competitive impact of the respective frequencies and the technical limitations of each band, while also protecting competition by providing room for each of the national carriers to acquire additional spectrum without running afoul of the Commission's initial screen.

If, however, EBS spectrum is added to the screen on an unweighted basis despite the extensive record evidence to the contrary, the Commission would have no basis for not also adding to the screen other spectrum bands being used today for commercial broadband services. Spectrum that is currently lightly licensed or unlicensed is being widely used for commercial purposes, including providing broadband to rural areas, to provide national Cable WiFi service, and to provide a WiFi alternative to traditional cellular service. A screen that includes the challenged EBS spectrum on a nearly equal basis to low-band spectrum should not ignore these other bands that are potential substitutes for traditional licensed spectrum.

The Commission's spectrum screen should focus on market power. A simplified three-tiered weighting mechanism for different categories of spectrum would better identify potentially excessive concentrations of critical spectrum resources and thereby promote the Commission's wireless broadband competition goals. The staff's proposed undifferentiated analysis, treating all spectrum bands the same, fails this threshold requirement. Adopting Sprint's three-tiered weighting proposal would correct this mistake.

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I. Introduction

The Federal Communications Commission staff's proposal for an undifferentiated spectrum screen that treats all spectrum the same creates new regulatory barriers to broadband deployment that have the potential to thwart competition, misdirect investment, and harm consumers.[1] The Commission's spectrum screen is a diagnostic aid used to identify acquisitions of spectrum that have the potential to undermine the competitive ability of rival firms and thereby pose a threat to downstream mobile broadband competition. When triggered, the spectrum screen consequently prompts further regulatory scrutiny. As the weight of the evidence in the record indicates, however, critical differences in spectrum inputs influence the cost and feasibility of their deployment, which, in turn, affects downstream competition.

A spectrum screen that treats 2.5 GHz Educational Broadband Service (EBS) and Broadcast Radio Service (BRS) spectrum on par with beachfront below-1 GHz spectrum is fraught with errors and offers little or no value to the Commission or the public: the revised screen would *not* identify potentially anti-competitive transactions that warrant careful review, while flagging for scrutiny transactions that pose no risk to competition. For example, the proposed spectrum screen would clear a Verizon acquisition of T-Mobile in the vast majority of U.S. markets, even though the Commission recently determined that a similar AT&T and T-Mobile merger would gravely harm competition.[2] At the same time, the proposed screen would flag for additional regulatory scrutiny almost any attempt by Sprint to enter into even a single term-limited 2.5 GHz spectrum lease in the hopes of assembling sufficient spectrum depth and breadth to offer high-capacity broadband service.[3] The importance of minimizing such errors is underscored by the fact that permitting an anti-competitive transaction to be approved is virtually impossible to correct after the fact.

In developing its spectrum holdings policies, the Commission has concluded that spectrum concentration directly implicates market power: an operator's acquisition of spectrum above a certain threshold offers a preliminary indication that those holdings could enable it to

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[1] Sprint is basing these comments on an informal description provided to Sprint by FCC staff of their proposal to revise the existing spectrum screen. The Commission is scheduled to consider adoption of a revised spectrum screen at its May 15th meeting. Sprint appreciates the transparency that Chairman Wheeler and his staff have provided regarding the proposal, and also appreciates the opportunity to provide comments on that proposal. We understand that staff have proposed to modify the total amount of broadband spectrum under the screen by adding 65 MHz of AWS-3 spectrum (once the spectrum is available), 40 MHz of AWS-4 spectrum, 10 MHz of H Block spectrum, 12 MHz of BRS spectrum (but continuing to exclude BRS-1), and 89 MHz of EBS spectrum (to reflect a 5% discount for the educational reserve and a 16.5% discount for EBS white spaces from the total 112.5 MHz of EBS spectrum) and by subtracting 12.5 MHz of SMR spectrum and 10 MHz of 700 MHz D Block spectrum. Under the proposed screen, the FCC will undertake a more detailed and in-depth competitive analysis when a transaction exceeds one-third of the 580.5 MHz total available broadband spectrum, or 194 MHz.

[2] Sprint's calculations, based on Sprint's understanding of the staff proposed screen, indicate that a Verizon/T-Mobile merger would exceed the staff proposed spectrum screen in less than 8% of the U.S. counties covering less than 24% of the U.S. population. The proposed screen would not be exceeded in seven of the Top 10 CMAs.

[3] Sprint's calculations indicate that, based on its existing spectrum holdings, it exceeds the proposed spectrum screen in nearly 25% of U.S. counties covering 66% of the U.S. population, including each of the Top 10 CMAs.

exert market power, triggering closer scrutiny.[4] Under the revised spectrum screen proposal currently under consideration, however, this nexus is turned on its head: the third largest and significantly less profitable firm would already exceed the screen in markets covering the majority of the U.S. population, while the two firms exhibiting the greatest potential for market dominance would gain significant headroom for further acquisitions.[5]

Failing to account for the unique complexity of the fragmented and non-contiguous licensing environment and limited propagation of the 2.5 GHz EBS band is at odds with the facts presented in the record, and could encourage the very types of potentially anti-competitive transactions that the spectrum screen is intended to deter. Just as the Commission has proposed to formally recognize the propagation and deployment advantages of low-band spectrum by incorporating those considerations into its competition policy, most pointedly with a 600 MHz auction "reserve" for competitors with limited low-band access, the Commission should also recognize the significant challenges of using 2.5 GHz spectrum for competitive mobile deployments. Substantial evidence in the record shows that operators relying on high-band spectrum must overcome additional obstacles to provide in-building and wide-area coverage; moreover, the unique licensing and regulatory environment of the EBS band imposes further

[4] *See, e.g., Applications of AT&T Inc. and Dobson Communications Corporation*, Memorandum Opinion and Order, 22 FCC Rcd 20295 ¶ 16 (2007) (explaining that the screen provides the beginning of the competitive analysis and that "[u]ltimately [the Commission] must assess whether it is likely that the combined firm could exercise market power in any particular market").

[5] The following tables compare the spectrum holdings of the four national U.S. carriers under the existing spectrum screen and the staff proposal currently under consideration.

Holdings Under Current Screen				
	Sprint	**AT&T**	**T-Mobile**	**Verizon**
Threshold (MHz)	151	151	151	151
Exceeds Screen - Counties	0 (0%)	178 (5.5%)	0 (0%)	2 (0.1%)
Exceeds Screen - Population	0 (0%)	16.9 M (5.4%)	0 (0%)	42 K (0.0%)
Avg MHz	110.6	122.3	70.6	102.3
Avg MHz (Top 100 CMA)	112.9	126.0	77.3	104.9
Avg MHz (Top 10 CMA)	115.6	126.3	79.6	108.9
Headroom (Top 100 CMA)	38.1 MHz	25.0 MHz	73.7 MHz	38.3 MHz

Holdings Under Staff Proposal Currently Under Consideration				
	Sprint	**AT&T**	**T-Mobile**	**Verizon**
Threshold (MHz)	194.0	194.0	194.0	194.0
Exceeds Screen - Counties	797 (24.7%)	0 (0%)	0 (0%)	0 (0%)
Exceeds Screen - Population	205.8 M (65.6%)	0 (0%)	0 (0%)	0 (0%)
Avg MHz	187.80	122.2	70.7	102.6
Avg MHz (Top 100 CMA)	202.9	125.4	77.5	104.9
Avg MHz (Top 10 CMA)	206.1	125.0	80.2	108.9
Headroom (Top 100 CMA)	-8.9 MHz	68.6 MHz	116.5 MHz	89.1 MHz

constraints on spectrum utility. Adopting Sprint's weighted screen proposal,[6] a modified weighting approach, or otherwise discounting 2.5 GHz spectrum would not only provide a more accurate and reliable mechanism to identify those transactions that pose a competitive threat, but would also avoid the errors and anti-competitive pitfalls of the proposal currently under consideration.

II. The Proposed Revisions Do Nothing to Repair the Screen's Current Flaws and Instead Exacerbate Them.

By treating all available commercial spectrum as equally useful in broadband wireless networks, regardless of substantial differences in propagation and deployment costs, the current effort at reform has not only failed to repair the "broken screen," but also exacerbated the screen's existing problems.[7] By adding 2.5 GHz spectrum to the screen on an unweighted basis, the Commission would give the two carriers with the largest market shares and the highest-utility spectrum portfolios additional headroom to make further spectrum acquisitions with less regulatory review. At the same time, the proposed screen would deny the one carrier with an amalgam of lower utility spectrum any additional headroom under the screen. These results subvert the very idea that the spectrum screen is indicative in any meaningful way of underlying market power within the mobile broadband industry.[8] The proposal leaves Sprint with the least amount of headroom of the four nationwide carriers – virtually none on an average nationwide basis – and both complicates and jeopardizes Sprint's ability to aggregate small 2.5 GHz TDD channels into sufficient bandwidth to compete with the AT&T and Verizon FDD deployments in low-band spectrum and mid-band spectrum.[9]

Analyzing several previous and potential transactions indicates just how unworkable the new screen would be. The errors inherent in the FCC's revised screen would result in a detailed competitive analysis of, or even prevent, acquisitions that present no particular competitive risk (i.e., false positives) yet allow several anti-competitive acquisitions (i.e., false negatives). To take just a few examples:

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[6] *Sprint's Competition-Based Framework for A Weighted Wireless Broadband Spectrum Screen, attached to* Letter from Lawrence Krevor, Vice President, Sprint Corp., to Marlene H. Dortch, Secretary, FCC, Docket No. 12-269, at ii (Feb. 11, 2014) ("*Sprint Spectrum Screen Proposal*").

[7] *See, e.g.*, Comments of Competitive Carriers Association, Docket No. 12-269 at 3 (Nov. 28, 2012) ("The current spectrum screen is broken and in need of reform."); Comments of Free Press, Docket No. 12-269 at 20 (Nov. 28, 2012) ("[A] broken spectrum allocation policy is almost as bad for consumers, competition and innovation as no policy at all. And there should be no doubt that the Commission's current spectrum screen is a failed, broken policy."); Reply Comments of the National Telecommunications Cooperative Association, Docket No. 12-269 (Jan. 7, 2014) ("The Commission's competitive screen is broken and must be replaced with a process that protects competition and consumers.").

[8] *See supra* n.4.

[9] The 2.5 GHz band is primarily composed of 5.5 MHz channels, more than half of which must be leased from educational organizations and which, due to disparate licensed coverage areas, cannot be paired into uplink and downlink channels like other bands. Sprint must combine adjacent 5.5 MHz channels to create the 20, 30 and 40 MHz-wide channels necessary to compete with the broadband speeds and network stability that its competitors enjoy with their 10x10 (20 MHz) and 20x20 (40 MHz) exclusive low-and mid-band spectrum licenses.

- Verizon and T-Mobile could merge without triggering the screen in over 92% of U.S. counties, even though Commission staff and the Department of Justice recently concluded that the competitive harms of an AT&T-T-Mobile combination would outweigh its potential competitive benefits.
- AT&T, Verizon, and T-Mobile could each acquire DISH Network's commercial spectrum licenses without triggering the screen in the vast majority of U.S. counties. However, Sprint would trigger the screen in almost 58% of U.S. counties if it attempted to acquire or enter a long-term leasing relationship with DISH.
- AT&T and T-Mobile could merge operations in many, mostly smaller, markets, (and in at least two of the Top 10 CMAs) despite the Commission's recent determination that the acquisition would harm competition and consumers.
- If the proposed screen were in place at the time Sprint acquired Clearwire, the transaction would have triggered the screen in markets covering more than 65% of the U.S. population, even though the Commission concluded that the transaction posed no competition or aggregation concerns.
- Sprint would trigger the screen even if it tried to acquire a modest amount of mid- or high-band spectrum (e.g., even 10 MHz in many markets).

As these and other examples illustrate, the proposed screen is both significantly over- and under-inclusive in identifying acquisitions that trigger competitive concerns. A screen that so often fails to predict exercises of market power adds even greater uncertainty to the spectrum marketplace.[10] This outcome can and should be avoided.

III. The Commission Has Recognized That Below-1 GHz Spectrum Is Unique, But Basic Physical and Economic Differences Between Spectrum Bands Do Not Stop at 1 GHz.

As Chairman Wheeler recognized in discussing the proposed mobile spectrum holdings rules, "not all spectrum frequencies are created equal."[11] For example, "[s]pectrum below 1 GHz, referred to as 'low-band' spectrum, has physical properties that increase the reach of mobile networks over long distances at far less cost than spectrum above 1 GHz, while also reaching deep into buildings and urban canyons."[12] The fundamental physical and economic differences that make low-band spectrum so advantageous as compared to spectrum above 1 GHz do not suddenly end at 1 GHz; these basic physical and economic differences are similarly apparent when comparing, for example, AWS-1 and PCS spectrum in the 1.7-2.1 GHz range to EBS spectrum in the 2.5-2.7 GHz range. Just as the Commission has been "guided by

[10] Sprint recognizes that the spectrum screen is *not* in-and-of-itself dispositive of the Commission's ultimate decision on a proposed spectrum transaction and that its competitive review would not necessarily produce all of the outcomes described above. That the Commission may ultimately "get it right" does not, however, justify screen revisions at odds with the well-developed technical and legal record in this proceeding that would exacerbate rather than reduce regulatory and transactional uncertainty.

[11] Letter from Tom Wheeler, Chairman, FCC, to the Honorable John Barrow, U.S. House of Representatives (Apr. 17, 2014).

[12] *Id.*

the rules of physics" in treating below-1 GHz spectrum differently in the proposed screen, so too should the rules of physics lead the Commission to account for the indoor and wide-area coverage disadvantages of high-band spectrum.[13]

In several filings in this proceeding, Sprint and other parties described those disadvantages in great detail.[14] Sprint proposed the adoption of a weighted spectrum screen that would assess the relative competitive usability of spectrum in different frequency bands, applying a lower weighting to higher frequency bands because of the difficulty of using those bands to respond competitively to parties using predominantly lower frequency bands.[15] In today's filing, Sprint provides additional information and support regarding why the 2.5 GHz BRS and EBS bands merit different treatment under the Commission's spectrum screen and that a three-tiered screen reflecting the competitive differences among low-, mid-, and high-band spectrum would advance the Commission's competition fostering goals while the recommendation currently under consideration would not.

A. Natural Gaps Exist Between Low-, Mid-, and High-Band Spectrum.

The nation's commercial mobile radio spectrum falls fairly neatly into three distinct band segments, each separated by hundreds of megahertz and each exhibiting substantially different propagation characteristics. These large natural gaps demarcate material physical and economic differences between these spectrum groups, which determine their relative utility for mobile broadband deployment.

As a practical matter, the limiting factor for deploying in any particular mobile wireless band is the uplink frequency. Handheld user devices necessarily operate at lower power levels with smaller antennas based on battery, safety, and other limitations. Accordingly, when comparing the physical propagation characteristics of two spectrum bands, the uplink band defines the limit of where a band can function. As depicted in the graphic below, there are natural gaps of several hundred megahertz between groupings of low-, mid-, and high-band uplink spectrum. In particular, there is an 861 MHz gap between the highest low-band uplink frequency (849 MHz) and the lowest mid-band uplink frequency (1710 MHz) while there is a similarly sized 582 MHz gap between the highest mid-band uplink frequency (1920 MHz) and lowest BRS/EBS frequency.[16]

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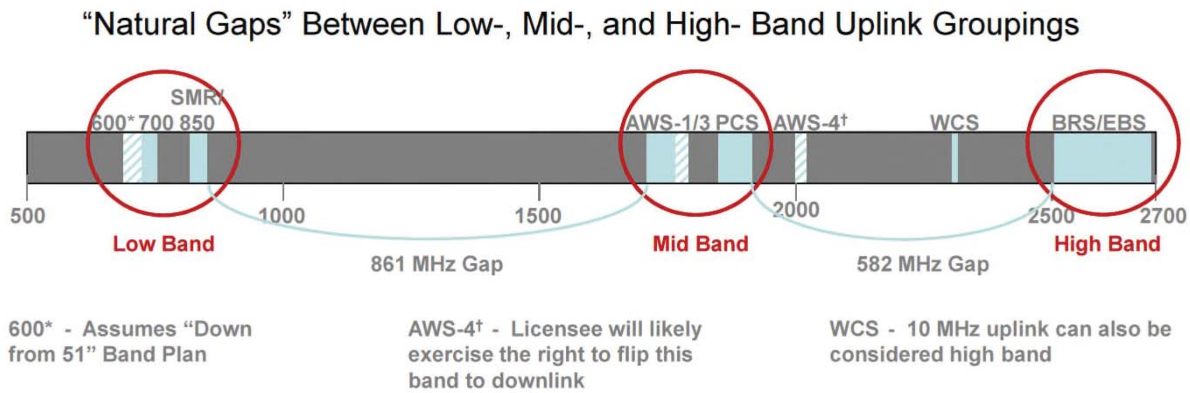
[13] *See* Chairman Wheeler, *Getting the Incentive Auction Right*, FCC Blog (Apr. 18, 2014), *available at* http://www.fcc.gov/blog/getting-incentive-auction-right.

[14] *See, e.g., The Imperative for a Weighted Spectrum Screen: Low-, Mid-, and High-Band Frequencies Are Not Freely Substitutable Market Inputs , attached to* Letter from Lawrence Krevor, Vice President, Sprint Corp., to Marlene H. Dortch, Secretary, FCC, Docket No. 12-269 (Apr. 4, 2014) ("*Sprint White Paper*"); *Sprint Spectrum Screen Proposal* at 28-30.

[15] *Sprint Spectrum Screen Proposal* at iii.

[16] This calculation reflects that use of the BRS-1 channel is compromised by its being a primary allocation for multiple services and the uncertainty of interference protection between BRS-1 and Globalstar's proposed Terrestrial Low Power Service – the subject of a current Commission rulemaking. Thus the lowest usable BRS/EBS frequency for purposes of the instant analysis is 2502 MHz, the lower edge of the A1 channel.



These natural gaps of several hundred megahertz make it easy to group low-, mid-, and high-band spectrum based on material physical and economic differences between these groups of spectrum, as explained below and reflected in substantial evidence in the record.

B. The Proposed Screen Ignores the Additional Challenges Associated With Providing Wide-Area Coverage Using High-Band Spectrum.

The revised screen appears to have failed to consider the significant evidence that shows that low-, mid-, and high-band spectrum perform differently when it comes to providing wide-area coverage. Numerous parties have explained the difference in path loss as a function of frequency and the impact this difference has on network design. Because high-frequency signals decay faster than mid- or low-frequency signals, a denser network of cell sites is needed to provide coverage over wide areas. That additional infrastructure adds significantly greater capital and operating expenses as compared to lower frequency bands, reducing the competitive utility of high-frequency bands particularly for wide-area and in-building coverage.[17] This increased densification in turn influences the timeliness of deployment, affecting an operator's competitiveness. These differences can be seen in comparisons between low- and mid-band spectrum and between mid- and high-band spectrum, since propagation loss increases exponentially.[18]

Ofcom, the UK regulator, addressed the relationship between coverage and frequency in several studies in preparation for the UK auction in 2013 of 800 MHz and 2.6 GHz spectrum.[19] Ofcom modeled the performance of three LTE networks using in each case the same bandwidth of spectrum, but at different frequencies: 800 MHz (Low-band), 1800 MHz (Mid-band) and

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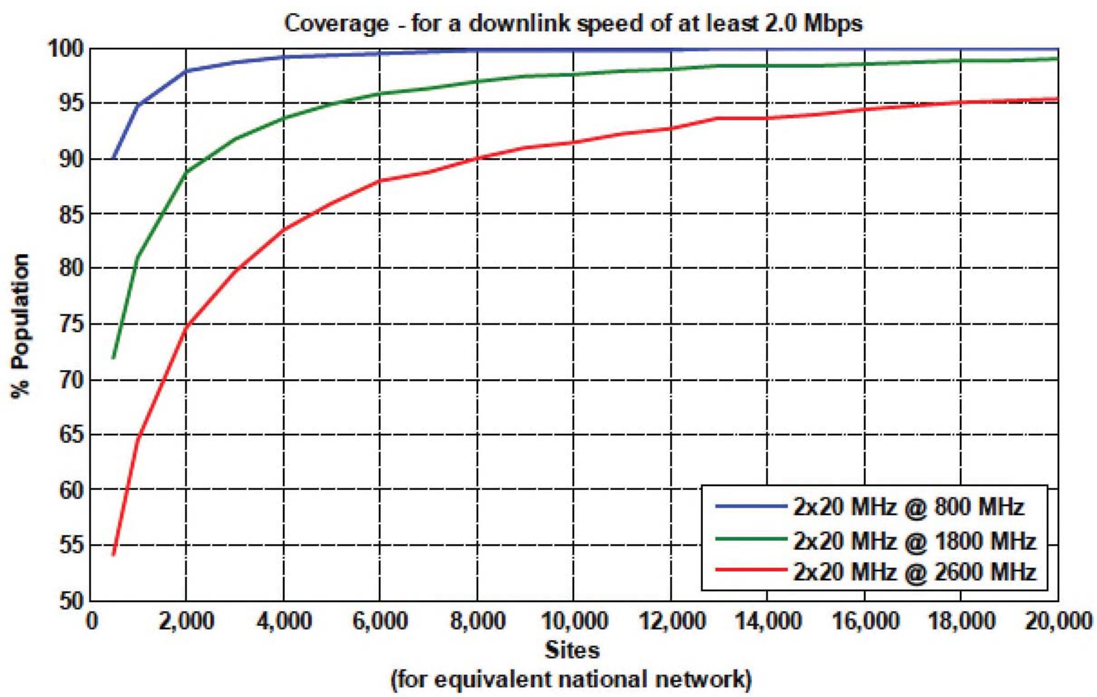
[17] The annual costs of operating a wireless network include amortized capital expenses (CAPEX) (including interest), operational expenses (OPEX) and selling, general and administrative expenses (SG&A). SG&A and OPEX are typically the largest costs.

[18] Moreover, the denser network required at higher frequencies also presents a variety of siting, backhaul and regulatory challenges affecting the utility and thus competitive impact of using this spectrum relative to mid and low band spectrum.

[19] *See* Ofcom, *Assessment of Future Mobile Competition and Award of 800 MHz and 2.6 GHz*, Statement, Annex 7 (2012), *available at* http://bit.ly/1eVuY6X ("*Ofcom 800 MHz & 2.6 GHz Statement Annex 7*").

2.6 GHz (High-band). Ofcom found that for any given number of sites and guaranteed downlink data-rate, a network operating at 800 MHz will be able to reach a consistently higher proportion of the population than networks operating at 1800 MHz or 2.6 GHz.[20] Further, the gap in coverage between networks using different frequencies widens as the downlink data-rate increases.

The Ofcom data provides useful insight into the relative number of cell sites required to cover an equivalent proportion of the population. The following figure from the Ofcom report shows, for each frequency, coverage as a percentage of the population as a function of the number of cell sites.



As the figure above illustrates, complete coverage of the population studied using 2.6 GHz alone would require an extraordinarily large number of cell sites, which would prove uneconomical. Coverage of 95 percent of the studied population could be achieved with approximately 1,000 cell sites at 800 MHz, approximately 5,500 cell sites at 1800 MHz or approximately 18,000 cell sites at 2600 MHz. In other words, *eighteen times* as many cell sites are required at 2.6 GHz to achieve the same degree of coverage as at 800 MHz and about 5.5 times as many as at 1800 MHz.[21]

[20] *Id*. at 3-5.

[21] The ratio of the number of cell sites gives the relative weights of the different frequency bands. For example, using the Ofcom derived data, the relative weight of 2600 MHz to 800 MHz would be 1,000/18,000 or about 0.055. These ratios compare with a relative weight of 0.20 under Sprint's original proposal for a weighted spectrum screen. *See Sprint Spectrum Screen Proposal* at 21-26.

Similarly, T-Mobile has evaluated extensive data collected in drive tests in urban, suburban, and rural environments to measure the propagation advantage of 700 MHz spectrum relative to the AWS-1 spectrum on its current network.[22] T-Mobile concluded that the real-world measured propagation advantage of 700 MHz spectrum relative to AWS-1 spectrum was greater than predicted by theory, with suburban areas experiencing the greatest increase.[23] T-Mobile found that designing a network using lower-band spectrum allowed it to achieve better coverage "using approximately half the number of base stations required by the mid-band baseline model, making it much more cost effective to overlay [its] existing coverage footprint as well as allowing [it] to expand coverage into areas with low population density."

Sprint has provided similar evidence demonstrating that these cost differentials occur not only between networks with low- and mid-band spectrum, but also between networks with mid- and high-band spectrum. For example, Sprint conducted a comprehensive review of its network data to identify the total cost disparity between deploying 20 megahertz of spectrum for a 4G LTE broadband data channel in different frequency bands in a rural scenario, where coverage is most important, and in a suburban scenario, where coverage and capacity are both network considerations. Because of propagation differences, *total* costs, (i.e., CAPEX, OPEX and spectrum costs), for deploying a network in rural areas not currently covered using high-band spectrum were found to be *up to 13 times the costs of deploying and operating a network using low-band spectrum* and, for a suburban network expansion, *up to 1.9 times higher*.[24]

An independent study by CostQuest supports these findings. T-Mobile commissioned CostQuest Associates in 2012 to examine the total cost to provide 4G wireless service in areas in fifteen states where 4G service is not available.[25] CostQuest developed a forward looking economic cost model that estimates the *total costs* of providing users with broadband service using either the 700 MHz band or the 1.9 GHz band.[26] The study found that the total costs to provide wireless broadband service are significantly higher using mid-band PCS spectrum compared to low-band 700 MHz spectrum: on average, across the fifteen states studied, the total cost to serve these areas using 1900 MHz spectrum requires 279% (i.e., 3.79 times) more total investment than deploying 700 MHz spectrum. The difference in these costs is due primarily to the difference in CAPEX and OPEX at the two frequencies, which is determined by the number of cell sites deployed at each frequency.

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[22] Declaration of Mark McDiarmid, Vice President for Radio Network Engineering and Development, T-Mobile USA, Inc., Docket Nos. 12-268 & 12-269 ¶ 27 (Apr. 11, 2014) ("*McDiarmid Declaration*").

[23] The data quoted by T-Mobile concluded that the measured propagation advantage of 700 MHz spectrum relative to AWS-1 was 2 dB to 4.5 dB greater that that predicted by free space loss, which varies with the square of the frequency and distance. *Id*.

[24] *See Sprint White Paper* at 8-10.

[25] *See* CostQuest Associates, *T-Mobile USF Mobility Model Report* (Oct. 1, 2012), *available at* http://apps.fcc.gov/ecfs/document/view?id=7521069118.

[26] The costs include, in addition to the traditional CAPEX and OPEX to deploy and operate networks at these frequencies: selling, general and administrative expenses (SG&A); usage expenses such as long distance, roaming and termination fees; and profit.

The greater path loss of high-band as compared to mid-band spectrum is no small matter for network operators, because the majority of mobile network grids were designed to support mid-band spectrum. This existing design leaves carriers relying upon 2.5 GHz spectrum for broadband deployment with the dilemma of either leaving satisfaction-sapping dead-zones in coverage, or spending cost-prohibitive amounts building new infrastructure to fill in these holes.

C. The Proposed Screen Ignores the Challenges Associated With Providing Indoor Coverage Using High-Band Spectrum.

In the same way that the proposed screen appears to ignore the disparities related to providing wide-area coverage, it also appears to ignore the weight of technical evidence concerning the in-building performance of high-frequency spectrum relative to low-frequency and mid-frequency spectrum. In its current form, the scope of the proposed spectrum screen cannot be reconciled with the evidence that high-band spectrum provides less support for indoor coverage than low- or mid-band spectrum.

The record of this proceeding demonstrates that as frequency increases, so in general do building penetration losses.[27] Lower-frequency signals are less affected by obstructions that cause signals entering a building to be attenuated and reflected. Higher frequency networks are more likely to need a denser network of smaller cells to try to maintain an equivalent indoor coverage.[28] As a result, lower-band spectrum offers higher-quality and more reliable indoor coverage capabilities, a fact that has been verified by numerous studies.[29] Ofcom, in studies and consultations dating back to 2007, has incorporated assumptions regarding increasing building

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[27] *See, e.g.*, McDiarmid Declaration ¶ 13; *Sprint White Paper* at 13, 22-24.

[28] In a recent filing, T-Mobile documented the myriad obstacles that a carrier encounters when trying to resolve coverage inadequacies of a macro network using small cells. *See* McDiarmid Declaration ¶¶ 18-23. Sprint's experience with small cell deployment confirms T-Mobile's observations: relying on small cell technology to rectify the coverage shortcomings of a higher-frequency network presents a plethora of design and deployment challenges that can be cost prohibitive, delay service, or (at times) are outright insurmountable.

[29] For example, in 2012, Ofcom commissioned an independent expert to conduct a meta-analysis of the technical literature on building penetration losses across a range of frequencies and types of buildings. *See Real Wireless*, Propagation Losses into and within Buildings in the 800, 900, 1800, 2100 and 2600 MHz Bands, Survey for Ofcom (2012), *available at* http://bit.ly/Qd4cfm (Annex A) ("*Real Wireless Study*"). Most of the references in that study confirm that building penetration loss increases with frequency, although some authors reported a decrease for certain types of buildings. *See Sprint White Paper* at 23 (explaining that high-frequency spectrum does *not* have an advantage in penetrating steel and reinforced concrete construction but that propagation losses may be affected due to Fresnel zone blockage at certain frequencies). Researchers at Virginia Tech, NIST and Qualcomm have all come to similar conclusions. Va. Tech: *Real Wireless Study* at 21; A. Safaai-Jazi; S.M. Riad; A. Muqaibel and A. Bayram, *Through-the-wall propagation and material characterization, UWB Propagation Measurements and Channel Modeling*, DARPA NETEX Program, Report. Virginia Polytechnic Institute and State University, November 2002("the attenuation constant . . . increase[s] substantially as the frequency increases."); NIST: W.C. Stone, *Electromagnetic signal attenuation in construction materials*, NIST Construction Automation Program, Report No. 3 (Oct. 1997); Qualcomm: *Real Wireless Study* at 21 (finding observed increased loss due to increased frequency in 11 of 12 buildings tested).

penetration losses with increasing frequency.[30] The potential capacity advantages of high-band spectrum (more intensive reuse enabled by faster signal decay) cannot be traded off to meet customer's expectations of reliable and high-quality indoor service. These differences impact the ability of carriers to retain and attract new customers, who expect their mobile broadband service to work wherever they are, including at home or at the office. These differences, in other words, materially affect downstream competition, which is the ostensible focus of the spectrum screen. As currently proposed, however, the revised spectrum screen unreasonably fails to account for this substantial evidence.

The relative limitations of propagation and building penetration on indoor coverage were evaluated by Ofcom researchers. They assessed the indoor coverage levels achievable in England, Wales, and Scotland with 12,000 cell sites using 800 MHz, 1.8 GHz, and 2.6 GHz spectrum. As detailed below, investigators examined building penetration in areas with varying levels of population density by examining downlink single-user throughput as a function of population (percentile) for networks with 2x10 MHz and 12,000 sites and 85% loading.[31] In each case, 800 MHz spectrum performed the best at reaching customers deep inside buildings, and 1800 MHz offered stronger indoor coverage capabilities than 2.6 GHz, as demonstrated in this summary chart reproduced from the study:[32]

[Space Intentionally Left Blank]

[30] Ofcom assumptions were that building penetration loss was 10 dB, 12 dB and 13 dB at 900 MHz, 1800 MHz and 2100 MHz. *See* Ofcom, *Application of spectrum liberalization and trading to the mobile sector* (Sept. 2007), *available at* http://stakeholders.ofcom.org.uk/consultations/liberalisation/.

[31] *See Ofcom 800 MHz & 2.6 GHz Statement Annex 7* at Figures A7.11-A7.16.

[32] *Id.* ¶ A7.87.

Study Area[33]	% Pop Living in Study Area	Shallow Building Penetration			Deep Building Penetration		
		800	1800	2600	800	1800	2600
0-50%	50%	98%	93%	89%	96%	86%	78%
50-80%	30%	96%	83%	76%	91%	73%	62%
80-90%	10%	94%	80%	71%	87%	67%	58%

The chart shows the percentage of the United Kingdom population that can receive basic connectivity (i.e., the lowest possible throughput) for low-, mid-, and high-band spectrum when the user is located indoors in a 'shallow' room and in a 'deep' room.[34] As can be seen from the decreasing percentages in the chart from left to right, high-band suffers a disadvantage as compared to mid- and low-band spectrum, and it performs even worse in the "deep" room scenario. As the study concludes, "[s]ingle user throughput performance and coverage is better at lower frequencies and both degrade when going from shallow to deep indoor locations and from more dense to less densely populated areas."[35]

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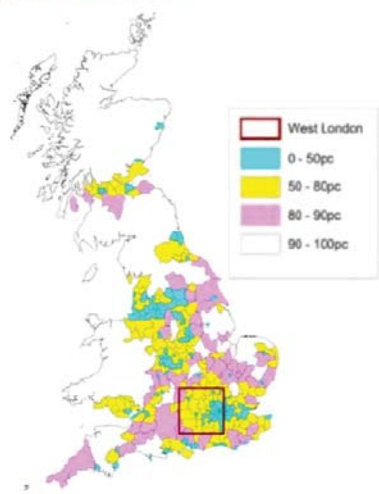
[33] *Id.* ¶ A7.19. These categories (0-50%, 50-80%, and 80-90% areas) represent three different simulation area types based on population density, with the 0-50% study area being the densest. The least dense area type (the 90-100% area) was not modeled. Figure A7.1, reproduced here, shows the locations of the study areas.

Figure A7.1: Simulation areas



[34] *Id.* ¶ A7.46 ("We interpret 'shallow' as typical of a location in a room with at least one external wall and window within a residential property. We interpret 'deep' as typical of a location without an external wall or window within a residential property."); *see also id.* at 59 n.29 ("Local Authority data for Northern Ireland was not available for the purposes of this exercise. Thus Northern Ireland is not included in the modeling, with the total population adjusted accordingly. It is reasonable to assume that Northern Ireland follows a similar population distribution to other areas in the UK and therefore would not significantly alter the results.").

[35] *Id.* ¶ A7.86.

D. *High-Band Spectrum Suffers a Signal-to-Interference-and-Noise Ratio Disadvantage.*

Measurements of the signal-to-interference-and-noise ratio (SINR) reinforce the pronounced differences among low-, mid-, and high-band spectrum. SINR measurements are especially important for operators because these values are directly associated with how much throughput can be provided with a given amount of spectrum.[36] In other words, the SINR that is often mistakenly assumed to be constant across frequencies is not: high-band spectrum has lower SINR than lower frequencies. As Ofcom explained, the SINR of higher frequency spectrum compares particularly unfavorably to lower frequencies where the networks are noise limited (*i.e.*, the noise power is significantly greater than the interference).[37] In particular, because high-frequency deployments suffer more path loss and greater building penetration losses, their signals are more likely to be noise-limited, resulting in poor SINR deep inside buildings and in areas where the cellular grid is more sparse, as is the case in suburban and rural deployments.[38] Moreover, high-band spectrum can suffer a greater SINR disadvantage as compared to mid-band spectrum than the already significant disadvantage mid-band suffers as compared to low-band spectrum.

As part of its consultation prior to the auctions of 800 MHz and 2.6 GHz spectrum, Ofcom analyzed the respective SINRs for 800 MHz, 1.8 GHz, and 2.6 GHz spectrum.[39] Reviewing Ofcom's analysis shows just how large the SINR variation among low-, mid-, and high-band spectrum can be. Examining a similar coverage scenario to that of Sprint in the U.S.,[40] and based on a moderate network load of 30%, Ofcom found the following disparities in SINR between low-, mid-, and high-band spectrum:[41]

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[36] According to Shannon's law, the theoretical maximum capacity (C) of a given communications channel is directly related to the bandwidth (B) and the ratio of the average signal power (S) to the average noise power (N) of additive white Gaussian noise according to the equation: $C = B\log_2\left(1+\frac{S}{N}\right)$. *See, e.g.*, Princeton University, *Shannon-Hartley Theorem* (last accessed Apr. 19, 2014), http://bit.ly/1r0dVCR.

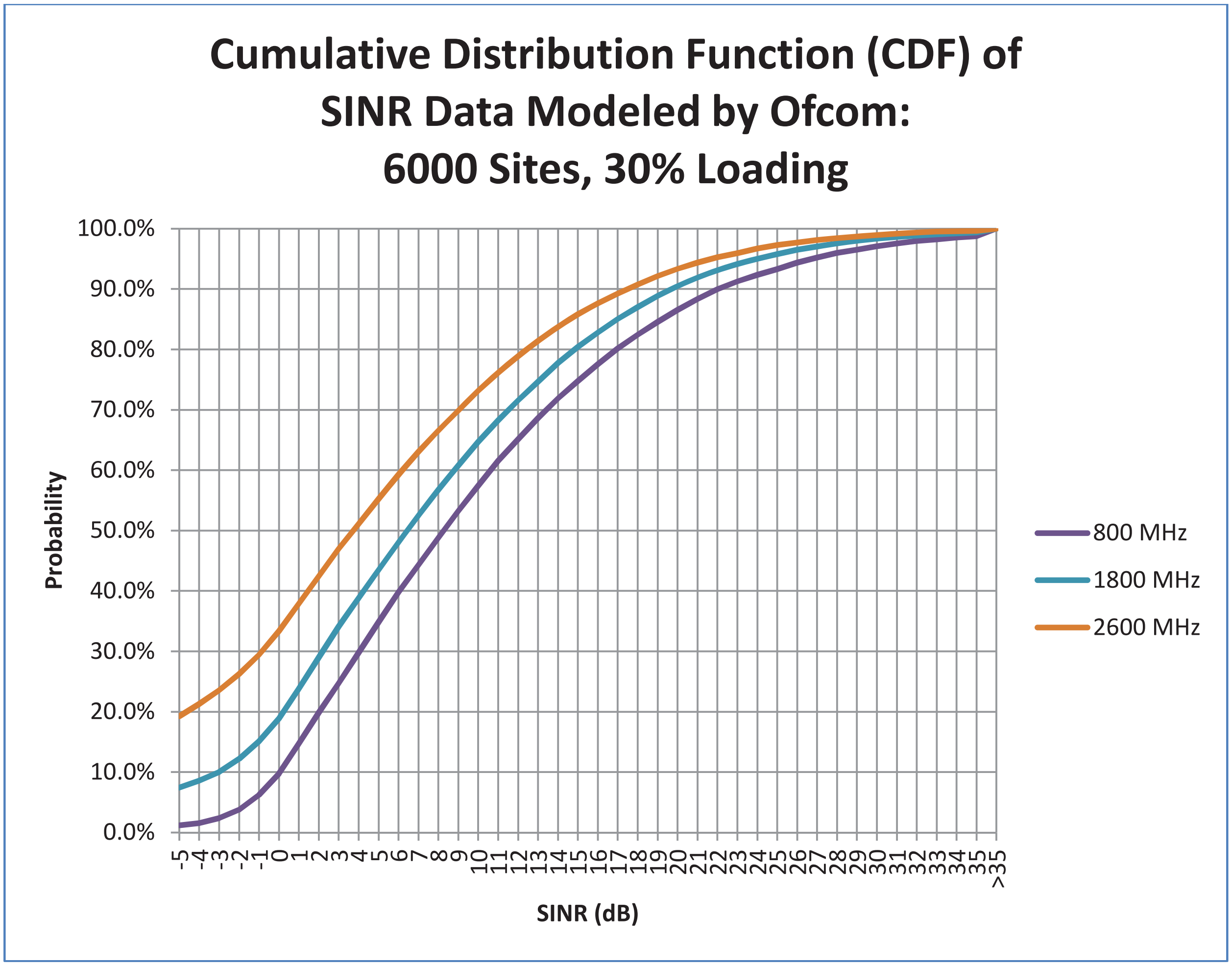
[37] *Ofcom 800 MHz & 2.6 GHz Statement Annex 7* ¶¶ A7.12-A7.16.

[38] *See id.*

[39] Ofcom, *Consultation on Assessment of Future Mobile Competition and Proposals for the Award of 800 MHz and 2.6 GHz Spectrum and Related Issues* (2011), *available at* http://bit.ly/1r7E4O5 ("*Ofcom 800 MHz & 2.6 GHz Consultation*").

[40] Ofcom's 6,000-site scenario, which analyzes how 6,000 sites provides coverage to the landmass of the United Kingdom (approximately 94,058 sq. mi.), represents an average of 15-16 square miles per site. This average is roughly equivalent to Sprint's average density in the U.S. of 16 square miles per site, with approximately 55,000 sites covering roughly 900,000 square miles.

[41] Ofcom describes its SINR methodology in Annex 8 to its consultation. *See Ofcom 800 MHz & 2.6 GHz Consultation*, Annex 8 (2011), *available at* http://bit.ly/1izPt8B. The SINR data is provided separately in several excel spreadsheets. *See* Ofcom, *SINR Distributions* (last accessed Apr. 19, 2014), http://bit.ly/1mng4Gs. Ofcom subsequently altered its modeling methodology but did not make the data available. *See Ofcom 800 MHz & 2.6 GHz Statement Annex 7* ¶ A7.25. Where the high-band spectrum is interference-limited, the revised methodology should have little effect on the results of the analysis.



In this cumulative distribution function, each line represents the probability that the SINR ratio in a given location is below a certain value on the X-Axis. As is immediately apparent, the high-band spectrum suffers significantly poorer SINR performance than mid- and low-band spectrum; the differences are illustrated by the great distance between the high-band and the low- and mid-band lines, especially where the SINR is lowest in the left-most portion of the graph. This model illustrates the following significant SINR disadvantages associated with high-band spectrum:

1. ***Greater Likelihood of Inoperable Connection in Poor Performing Network Areas.*** The probability of a user experiencing an SINR that is below -5 dB, which is generally considered to be roughly the lowest useful SINR for LTE,[42] is about 20% in a high-band network. Meanwhile, the probability of experiencing the same minimal threshold for LTE service is only about 8% in the mid-band network and about 1% in the low-band network.

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[42] *See, e.g.*, Matthew Baker, *Uplink Transmission Procedures*, *in* LTE – The UMTS Long Term Evolution: From Theory to Practice 414 (Stefania Sesia et al. eds., 2d ed., 2011) (explaining that -5dB is "around the lowest useful SINR").

2. ***Worse Signal-to-Interference-and-Noise in Average Performing Network Areas.*** The median SINR in a high-band network, where the probability of a lower SINR is 50% and the probability of a higher SINR is also 50%, is 4 dB, whereas the median in a mid-band network is 6.5 dB, and the median in a low-band network is 8.2 dB. The median of the high-band network is 2.5 dB less than the mid-band network and 4.2 dB less than the low-band network.

3. ***Worse Signal-to-Interference-and-Noise in the Best Performing Network Areas.*** When the probability of achieving a lower SINR is 80% (i.e., the probability of achieving a higher SINR is only 20%) the SINR is about 12.2 dB for a high-band network, 15 dB for a mid-band network, and 17 dB for a low-band network. Again, a high-band network suffers as compared to mid- and low-band, with a SINR 2.8 dB less than mid-band and 4.8 dB less than low-band (2 dB).

These disparities in SINR translate into meaningful disparities in throughput, which are even more pronounced at the poorest SINRs more often experienced in high-band deployments. Based on research mapping various SINR levels to the LTE Channel Quality Indication (CQI) Index,[43] Sprint derived estimates to show the decline in throughputs associated with lower SINRs. Because the degree of change in throughput potential varies based on SINR, Sprint looked at three deployment scenarios to approximate the relationship: poor SINR (<2 dB), adequate SINR (between 2 dB and 10 dB), and good SINR (greater than 10 dB). Sprint found the following percentage improvements in throughput for each additional decibel in SINR:[44]

Estimated Effect of SINR on Throughput	
SINR	**Percentage Improvement in Throughput per dB**
Poor (<2 dB)	25-28%
Adequate (between 2 and 10 dB)	15-19%
Good (>10 dB)	8-10%

Thus, when SINR is good (>10 dB), each 1 dB improvement in SINR results in a roughly 8% to 10% improvement in throughput. Using the third example above in which the probability of achieving a lower SINR is 80% for any particular deployment, low-band spectrum can accommodate approximately 20% more throughput (10% * 2 dB) than mid-band spectrum,

[43] *See* Mohammad T. Kawser et al., *Downlink SNR to CQI Mapping for Different Multiple Antenna Techniques in LTE*, 2 Int'l J. of Elec. Eng. 757 (Sept. 2012), *available at* http://bit.ly/1fbyVEN. These calculations are based on a 2x2 MIMO configuration and are relatively easy to derive based on the efficiency and required SINR of each modulation and coding rate.

[44] Because the LTE adaptive modulation and coding (AMC) scheme increases in discrete steps – for example, a marginal increase in SINR, may step up the modulation and coding more significantly – specific comparisons of the effect of individual SINRs on throughput may somewhat vary. However, these estimates illustrate the effective magnitude of improvement.

which itself can accommodate an even greater 28% more throughput than high-band spectrum (10% * 2.8 dB). For adequate and poor SINRs, the differences in throughput are even greater. When SINR is adequate (between 2 dB and 10 dB), each 1 dB improvement in SINR results in a roughly 15% to 19% improvement in throughput, or almost twice as much as the good SINR scenario. Taking the median SINR example above – point 2 under the SINR CDF – low-band spectrum achieves approximately 32.3 % (1.7 * 19%) greater throughput than mid-band spectrum, which in turn achieves 47.5% (2.5*19%) greater throughput than high-band spectrum. Again, the throughput penalty for high- as compared to mid- and low-band spectrum is great.

When SINR is poor, the percentage improvement per decibel is almost three times that for good SINR, roughly 25-28%. High-band spectrum suffers even more of a disadvantage here – not only does it generally suffer worse SINRs, but at these lower SINRs, each dB of improvement has a greater effect. To illustrate, when the probability of achieving a lower SINR is only 20% in the above CDF example (i.e., the probability of achieving a higher SINR is 80%), low-band spectrum has a SINR (2 dB) two decibels greater than mid-band (0 dB), which in turn has a SINR five dB greater than high-band (-5 dB). At this 20% probability, low-band can accommodate roughly 56% greater throughput than mid-band (28%*2), and mid-band can accommodate roughly 140% greater throughput than high-band.

These material differences in SINR, which significantly affect throughput, directly impact the quality of service experienced by users. The throughput that any given band can support directly influences the output of a network operator (quantitatively from the network perspective, which translates qualitatively for the user attempting to utilize a mobile broadband service) – with resultant differences that directly relate to the ability of operators to attract and retain customers. In other words, the disparity between high-band as compared to low- and mid-band is great, and these differences should be reflected in the Commission's competition policy.

As this explanation illustrates, high-band deployments are at a throughput disadvantage as compared to mid- and low-band deployments, assuming similar deployment scenarios (e.g., the same number of sites, same bandwidth, same MIMO configuration, and the same other network features). Indeed, as this example derived from Ofcom's data shows, high-band spectrum suffers a greater disadvantage compared to mid-band spectrum than mid-band suffers relative to low-band spectrum. Moreover, as SINR decreases, which represents an especially likely problem in high-band relative to mid-band networks, the effects on throughput become more and more pronounced. If the relative disparity in low- and mid- band spectrum justifies unique consideration of low-band spectrum under the Commission's competition framework, so does the disparity between high-band spectrum and mid-and low-band spectrum.

E. Announced Goals for Peak Speeds Do Not Mean that Such Speeds will be Available Everywhere.

Sprint's new Spark service is a tri-band offering, relying on Sprint's 800 MHz and 1900 MHz spectrum, in addition to its 2.5 GHz holdings.[45] Spark will opportunistically connect

[45] *See, e.g.*, Sprint, *Introducing: Sprint Spark* (Oct. 29, 2013), *available at* http://bit.ly/1qZmbTD.

a user device to the optimal band (800 MHz, 1900 MHz, or 2.5 GHz), with the highest peak speeds requiring the availability of a significant aggregation of 2.5 GHz spectrum. The realization of Sprint's forward-looking statements regarding the high-bandwidth potential of its 2.5 GHz spectrum[46] is only achievable where three or four adjacent EBS or BRS channel groups can be aggregated[47] and where the aggregated 2.5 GHz spectrum can actually provide coverage. As a result, areas where peak performance is possible will not be ubiquitous.

Sprint is investing substantial resources to bring the broadband performance that Spark promises to wireless broadband users. Doing so improves Sprint's competitive positioning relative to the other national wireless carriers and thereby benefits consumers. When fully implemented, it holds the promise of stimulating further competition among national providers to offer faster speeds and additional broadband applications supporting other industries and communities.

Having said that, however, Sprint Spark relies in significant part on a difficult-to-aggregate amalgam of BRS licenses and "grandfathered" E and F group EBS licenses,[48] primarily in the Upper Band Segment (UBS) of the 2.5 GHz band (2618 MHz - 2690 MHz) and an even more challenging collection of EBS leases, primarily in the Lower Band Segment (LBS)

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[46] *See, e.g.*, Mike Dano, *Sprint's Saw: Spark to Hit 120 Mbps Peaks at End of 2014, 180 Mbps at end of 2015*, FierceWireless (Mar. 24, 2014), *available at* http://bit.ly/1ruh92E.

[47] In the Lower and Upper Band Segments, an EBS channel group includes three 5.5 MHz channels, for a total of 16.5 MHz. EBS channel groups (e.g., EBS A Channels, B Channels, etc.) often have different ownership and different geographic service areas (GSAs) with different center points and different shapes. Since the GSAs of different channel groups do not coincide geographically, aggregating three or four adjacent channel groups, as required to achieve peak speeds, usually results in a reduction of the service area from that of the underlying three or four GSAs (while correspondingly resulting in the necessity of *holding* spectrum licenses covering geographic areas in which service simply can't be provided).

[48] The limitations and uncertainty of EBS spectrum leasing extend into the "core" BRS spectrum in the UBS because there are many "grandfathered" EBS licenses that hold spectrum in the BRS E and F group spectrum. In 1983, the Commission redesignated the E and F Group ITFS (now EBS) channels from the EBS to MDS (now BRS). *See Amendment of Parts 2, 21, 74 and 94 of the Commission's Rules and Regulations in regard to frequency allocation to the Instructional Television Fixed Service, the Multipoint Distribution Service, and the Private Operational Fixed Microwave Service*, Report and Order, 94 FCC 2d 1203 (1983). At the same time, however, numerous EBS licensees holding E and F channels were "grandfathered" and their licenses remain allocated to EBS. *See Amendment of Parts 2, 21, 74 and 94 of the Commission's Rules and Regulations in regard to frequency allocation to the Instructional Television Fixed Service, the Multipoint Distribution Service, and the Private Operational Fixed Microwave Service*, Memorandum Opinion and Order on Reconsideration, 98 FCC 2d 129, 132-33 ¶ 12 (1983). Until 2006, the Grandfathered E and F group EBS licenses were protected only to the extent of service as it existed 1983. After 2006, however, the FCC relaxed the limitations associated with grandfathered E and F Group licenses and awarded those licensees geographic licenses, though the exact scope of those license rights varied depending on the degree of overlap with co-channel BRS licensees. *See, e.g.*, *In the Matter of Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands*, Order on Reconsideration and Fifth Memorandum Opinion and Order and Third Memorandum Opinion and Order and Second Report and Order, 21 FCC Rcd 5606 ¶¶ 333-354 (2006) (explaining that in "rebanding" the 2.5 GHz band, the Commission would grandfather certain legacy site-based facilities, taking away from the service areas of larger BRS licenses); *see also, e.g.*, 47 C.F.R. § 27.1216.

of the 2.5 GHz Band (2496 MHz - 2568 MHz). Ultimately, the high-bandwidth potential of 2.5 GHz depends on a significant depth and breadth of spectrum coverage that is difficult to achieve due to the EBS licensing limitations and the technical limitations of the frequencies in the 2.5 GHz range. For example, irregular patches of EBS white spaces, which do not allow base station operations at that particular frequency and which vary geographically and on a channel-by-channel basis,[49] present an obstacle not present in geographically-licensed spectrum bands. This affects 2.5 GHz utility, cost and time to deploy with *competitive implications that the staff-proposed revised spectrum screen ignores.* Similarly, the utility of 2.5 GHz EBS spectrum is diminished where leases for the chain of contiguous channels necessary to support high-bandwidth applications are unavailable, expired, held by other entities, or otherwise unsuitable for aggregation – *another reality described and documented in the record but ignored in the proposed revisions.* The proposed revised spectrum screen fails to recognize these realities and thus proposes additional unwarranted regulatory obstacles to this already challenging initiative. The Commission has attempted many times over the past few decades to adjust the 2.5 GHz regulatory framework to enable more efficient and effective use of this spectrum.[50] It is ironic indeed that the staff's proposed spectrum screen would impose obstacles that could thwart that goal just when a carrier is making the investments necessary to ultimately achieve it.

IV. As the Commission Has Recognized Time and Again, Mobile Operators Using EBS Spectrum Face Unique and Significant Challenges.

The EBS band is the only mobile band where a wireless operator must negotiate with a multitude of lessors in order to deploy a network using the spectrum. The fragmented patchwork of non-overlapping and noncontiguous EBS license areas and the difficulties associated with navigating hundreds of lessors to assemble the contiguous spectrum necessary to deploy should be reflected in the Commission's competition framework. As the Commission has recognized time and again, EBS lessees face these unique challenges, and the spectrum should be discounted under the screen accordingly.

A. The EBS Band is the Only Band Where an Operator Must Lease the Vast Majority of Spectrum.

The EBS band is the *only* band where an operator leases the vast majority of spectrum from multiple licensees. This unique character of the EBS band has significant competitive consequences; for a variety of reasons, operators greatly prefer owning spectrum to leasing it.

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[49] EBS channels frequently have varying white spaces and are not neatly confined to remote or rural areas. Instead, EBS white spaces are often located in critical service areas, including: in between channel groups; in the center of urban areas; in critical spaces between metropolitan areas such as highways or transit centers; or at stadiums and other places where people congregate and where mobile broadband is in high demand.

[50] *The Evolution of the 2.5 GHz Band and its Success for Mobile Broadband Demand a Spectrum Screen Refresh*, *attached to* Letter from Kathleen Grillo, Senior Vice President, Verizon, to Marlene H. Dortch, Secretary, FCC, Docket No. 12-269, at 3-8 (Mar. 5, 2014).

First, acquiring leases is costly and uncertain. In addition to the financial cost of the lease, there are the issues of negotiating and implementing the arrangement over a long period of time.[51] While Sprint currently has entered into hundreds of leases covering well over 1,000 EBS licenses, Sprint will still need to renew many of these leases and obtain new leases for several hundred additional EBS licenses just so it can aggregate a single contiguous 60 MHz TDD channel covering approximately two-thirds of the U.S. population.[52] The number of lease renewals, lease renegotiations, and transactions required to assemble even this level of coverage is daunting, and the Commission's competition policy should reflect this reality. In addition, the Commission's rules and policies require close cooperation between lessor and lessee for the benefit of educational institutions.[53]

Second, the EBS band is licensed exclusively to educational entities,[54] with availability for commercial services only on an excess-capacity, leased basis requiring eligible educational entities to retain at least five percent of the system's capacity for their educational mission. The educational reserve requirement reduces the amount of leased EBS bandwidth available in any market area. Moreover, many EBS lease agreements allow the educational licensee to renegotiate to increase the amount of the educational reserve, adding further uncertainty to the lease and further detracting from its value.[55] The modest five percent discount included in the proposed rules does not adequately reflect the obstacles to deployment associated with EBS spectrum.

Third, assembling geographic and spectrally contiguous frequencies from EBS license leases is exceptionally complex and subject to serious practical limitations. The Dallas-Ft. Worth region serves as an illustration of just one of the many challenges EBS operators face. As

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[51] While a portion of Sprint's EBS leases has terms that exceed fifteen years, even these leases may entail regular negotiation, administrative costs, and uncertainty. As explained in note 555, *infra*, the FCC's rules allow license holders to revisit the terms of long-term EBS leases entered into after July 19, 2006 every five years.

[52] Even then, the 60 MHz TDD channel will exist on different frequencies in different locations because of the patchwork of EBS license areas, which results in significant EBS white space that varies on a channel-by-channel basis, and the difficulty of obtaining leases for contiguous spectrum blocks.

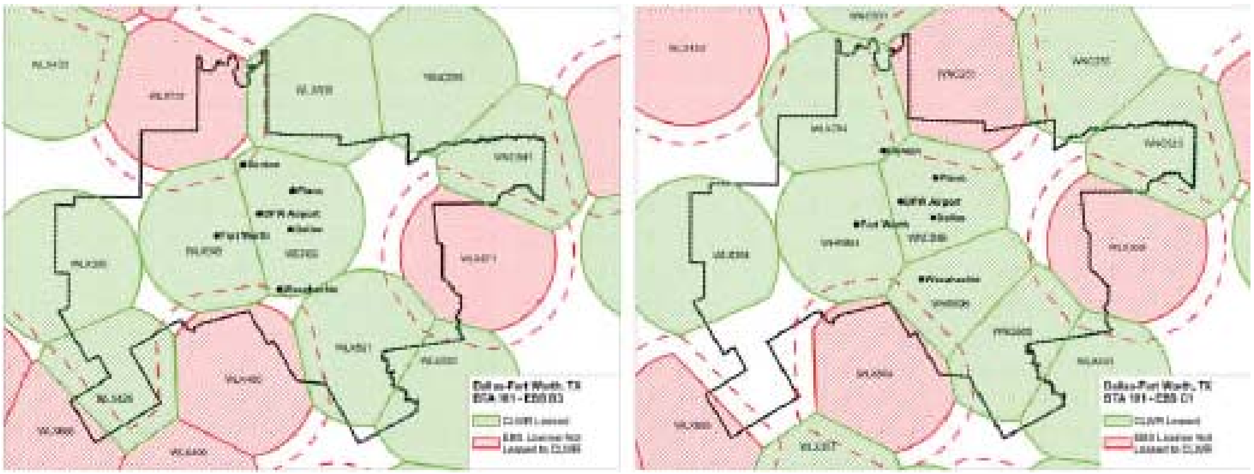
[53] *See, e.g.*, 47 C.F.R. § 27.1214.

[54] Eligibility for EBS spectrum licenses is limited to: (1) accredited educational institutions, such as such as public and private schools (including Catholic school systems in a number of large metropolitan areas), colleges and universities, (2) governmental organizations engaged in the formal education of enrolled students, and (3) nonprofit organizations whose purposes are organizational and include providing educational and educational television materials to accredited institutions and governmental organizations. *See Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands*, Report and Order and Further Notice of Proposed Rulemaking, 19 FCC Rcd 14165 ¶¶ 10, 149 (2004).

[55] Different FCC rules and regulations apply depending upon when the lease was established. For example, leases entered into before January 10, 2005 may remain in effect for up to 15 years. The initial term of EBS leases entered into after January 10, 2005 is required to be coterminous with the term of the license. However, EBS leases entered into after July 19, 2006, with a term that exceeds 15 years, must give the licensee the right to reassess its educational use requirements every five years starting in year 15. This gives the license holder the capability to increase the previously negotiated cost of the lease. *See* Clearwire Corp. Annual Report (Form 10-K) at 14 (Feb. 16, 2012).

shown below, the GSAs of EBS channel leases often exclude large portions of the core urban area requiring wireless broadband coverage.

EBS Leases for Adjacent EBS Channels B-3 and C-1 in the Dallas-Ft. Worth Area, Illustrate the Disjointed and Non-Overlapping Nature of EBS Leases[56]



Worse than the disjointed hodgepodge of leases is the even smaller overlap area – the area actually useful for broadband offerings where adjacent channels overlap and the aggregated spectrum is contiguous and can support larger channel bandwidths necessary for broadband offerings.

Contiguous Channel Availability for EBS Leases B-3 and C-1 in the Dallas-Ft. Worth Area

The blue outlines shown above illustrate the limited areas of overlap of the B3 and C1 channels inside the Dallas BTA. The overlap areas are not contiguous and demonstrate the

[56] The black line shows the BTA licensing area that applies for BRS licenses in the area. The green areas represent the service areas covered by EBS leases held by Sprint (formerly Clearwire). Some EBS licenses (shown in red) are simply not available to Sprint under a lease and cannot be used. Other areas (shown in white) have no EBS license at all; this "white space" cannot be used. Under EBS rules, site placement is restricted near non-leased licenses in order to avoid interference (shown by dashed red lines).

limitations of this spectrum for broadband use because the adjacent channel is not available in many areas. Moreover, this analysis represents only *two* channels of at least *eleven* channels that need to be available to deploy three contiguous 20 MHz LTE carriers (5.5 MHz per channel * 11 = 60.5 MHz). The area where 10 MHz – much less 60 MHz – of contiguous EBS spectrum will be available is relatively small – often much smaller than shown here. The reality of the legacy EBS licensing restrictions not only diminishes the utility of the EBS spectrum, but also requires a 2.5 GHz operator to lease a great deal of "extra" spectrum that is not used or useful for broadband, but is nonetheless required simply to have sufficient spectrum depth to support a broadband offering in the discrete portions of the geographic area where sufficient contiguous spectrum can be assembled. Inclusion of this "extra" spectrum – which is not useful for deployment but is necessary to acquire in order to successfully deploy *other* portions of the 2.5 GHz band – is an especially anomalous and perverse aspect of the proposed revised spectrum screen.[57]

V. The Commission Should Include Lightly-Licensed Bands and Unlicensed Bands As Part of the Screen If the Commission Includes 2.5 GHz Spectrum on an Unweighted Basis.

The Commission has acknowledged that "[s]ince the Commission's last comprehensive review of these issues, the number of spectrum bands used for mobile wireless services has expanded; new, innovative service offerings have been rolled out . . . ."[58] Those new services include "lightly-licensed"[59] and unlicensed operations that compete with and expand traditional wireless networks. The ability to provide mobile broadband service using these bands has a competitive impact and should be included in the screen's diagnostic assessment of market power, particularly now that they provide the "predominant internet connection across portable devices in the U.S."[60] The proposed inclusion of virtually all 2.5 GHz spectrum, without fully accounting for the important utility and competition-affecting features distinguishing it from other CMRS bands, invites inquiry as to why other bands used for mobile broadband have been excluded. Failing to include these bands – which are now used for similar purposes to the bands already under the screen – is inconsistent.

For example, the Commission currently licenses the 3650-3700 MHz band on a "licensed light" basis, which was crafted to "encourage multiple entrants and promote rapid deployment of

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[57] In some sense, this spectrum exhibits similar characteristics to the excluded portions of the WCS Band (which AT&T still owns but which does not get counted within the spectrum screen): to make the greater portion of the WCS band useable for mobile services, the, extra spectrum (the C and D Blocks), which are restricted to fixed services, act essentially as guard bands.). *See, e.g.*, Kostas Liopiros, *Value and Utility of the 2.5 GHz Spectrum Band*, at 23 n.38 (Feb. 27, 2013), http://bit.ly/1hTeZFW.

[58] *Policies Regarding Mobile Spectrum Holdings*, Notice of Proposed Rulemaking, 27 FCC Rcd 11710 ¶ 2 (Sept. 28, 2012) ("*Mobile Spectrum Holdings NPRM*").

[59] The 3650-3700 MHz band is currently licensed on a "licensed light" basis whereby prospective operators may register for ten-year, non-exclusive, nationwide licenses to operate facilities in the band. *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Notice of Proposed Rulemaking, 27 FCC Rcd 15594 ¶ 77 (2012) ("*3.5 GHz NPRM*").

[60] Deloitte, *Global Mobile Consumer Survey*, at 4 (Oct. 2013), *available at* http://bit.ly/1i8IzZg.

wireless broadband services to rural and underserved areas of the country."[61] These rules have been successful – towards the end of 2012, there were 2,117 licensees with more than 25,000 registered sites throughout the United States.[62] As the Commission has explained, these "licensees are providing a variety of important services to utility companies, public safety entities, businesses, and consumers."[63] In particular, Wireless Internet Service Providers (WISPs) rely on the "licensed light" spectrum, in addition to unlicensed bands, to serve approximately three million customers, primarily in rural areas.[64] Based on these and other services, commentators have noted that "[t]he 3650-3700 MHz segment is widely used for delivery of commercial broadband service."[65] To the extent the staff recommends including EBS spectrum in the spectrum screen without fully accounting for all of its propagation and licensing challenges, the Commission should also include this similar "licensed light" spectrum used for the delivery of commercial broadband.

Similarly, unlicensed spectrum should be considered in any competitive analysis that, on an unweighted basis, includes the vast majority EBS spectrum. Today, Wi-Fi technology using the 2.4 and 5 GHz bands carries a significant amount of mobile broadband traffic, just as other high-band spectrum proposed for inclusion under the screen.[66] According to Cisco, in 2013, more than 45% of global mobile data traffic was offloaded through Wi-Fi or femotocells, and that proportion is expected to increase to over half by 2018.[67]

Indeed, the ability to deploy mobile broadband services over Wi-Fi and unlicensed bands has attracted new competitors. Jointly, the country's largest cable operators, including BrightHouse Networks, Cox, Optimum, Time Warner Cable, and Comcast allow each other's high-speed Internet customers to access more than 200,000 Wi-Fi hotspots.[68] Making its own competitive play, Comcast has deployed more than 1 million Wi-Fi hotspots as "an important part of [its] strategy to be the place where customers connect all devices, anywhere and at any time," both in and outside the home.[69] Comcast is monetizing this strategy beyond its existing

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[61] *3.5 GHz NPRM* ¶ 77.

[62] *Id.*

[63] *Id.*

[64] *See* Paul Kirby, *Wireless Internet Service Providers Stress Need for More Spectrum*, TRDaily (Mar. 18, 2012), *available at* http://bit.ly/1fQBjM1.

[65] Mitchell Lazarus, *FCC Proposes New Approach to Spectrum Management*, CommLawBlog (Apr. 27, 2014), http://bit.ly/1ku4atS.

[66] S*ee* Mark A. Israel and Michael L. Katz, *Economic Analysis of Public Policy Regarding Mobile Spectrum Holdings*, at 47 n.67 (Nov. 28, 2012), *attached to* Comments of AT&T, Docket No. 12-269 (Nov. 28, 2012) (arguing that the one-third screen threshold should be relaxed because of factors including WiFi offloading).

[67] *See* Cisco, *Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2013-2018* (2014), *available at* http://bit.ly/1hMVos0.

[68] *See, e.g.*, Cable WiFi, *Homepage* (last accessed Apr. 21, 2014), http://www.cablewifi.com/.

[69] Comcast, *Comcast Unveils Plans For Millions Of Xfinity Wifi Hotspots* (June 10, 2013), http://corporate.comcast.com/news-information/news-feed/comcast-unveils-plans-for-millions-of-xfinity-wifi-hotspots-through-its-home-based-neighborhood-hotspot-initiative-2.

fixed-location subscriber base; non-subscribers can access the network on a per-use basis and travel from hotspot to hotspot.[70] More and more, these competitive offerings are viewed by consumers as more traditional wireless offerings. Republic Wireless, for example, sells wireless phone voice and data plans that compete with nationwide carrier offerings, but uses Wi-Fi networks as their default service. Republic phones use "hybrid calling" technology to hand off calls to traditional cell networks as a backup only when Wi-Fi not available.[71] As David Morken, the CEO of Republic Wireless, put it, "[w]hy ignore the biggest network in the world?"[72] As in the case of the 3650-3700 MHz band, unlicensed spectrum seems an appropriate candidate for inclusion in any screen that fails to fully account for the propagation and licensing challenges associated with 2.5 GHz spectrum.

VI. The Commission Has Several Options for Repairing the Broken Proposal

Rather than adopting a one-size-fits-all spectrum screen, the Commission should employ, as Sprint has advocated, spectrum weights that reflect the real-world ability of operators to deploy and use different spectrum bands. A simplified three-tier approach, with a weight of 1.5 for low-band spectrum, 1.0 for mid-band spectrum, and 0.5 for high-band spectrum, would better reflect the competitive impact of the respective spectrum bands. This approach would leave reasonable headroom for all competing national carriers – and smaller regional and rural carriers as well – without unwarrantedly penalizing Sprint for undertaking the investments necessary to effectively deploy what was historically viewed as spectrum unsuitable for mobile wireless services.[73]

This approach has many advantages over the one-size-fits-all spectrum screen. It reflects the utility and challenges of each of the spectrum bands. It comports with the rationale of giving

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[70] *See* Robert Channick, *Comcast turning Chicago homes into public Wi-Fi hot spots*, Chicago Tribune (Mar. 5, 2014) *available at* http://bit.ly/1rkfDwV.

[71] Republic Wireless, *How we do it.*, https://republicwireless.com/meet-republic/how-we-do-it (last accessed Apr. 21, 2014).

[72] Brendan Greeley, *What Wi-Fi's Popularity Means for Cell Phone Carriers*, Business Week (Jan. 2, 2014), *available at* http://buswk.co/1ncJfPh.

[73] Under this approach, the holdings of the four national carriers would be as follows:

< 1 GHz weighted at 1.5 1 GHz - 2.2 GHz weighted at 1.0 > 2.2 GHz weighted at 0.5 (Updated w/ 1Q14 data)	**Sprint**	**AT&T**	**T-Mobile**	**Verizon**
Threshold (MHz)	187.0	187.0	187.0	187.0
Exceeds Screen - Counties	0 (0%)	37 (1.1%)	0 (0%)	2 (0.1%)
Exceeds Screen - Population	0 (0%)	5.5 M (1.8%)	0 (0%)	0.04 M (0.01%)
Avg MHz	126.3	138.7	73.7	125.6
Avg MHz (Top 100 CMA)	134.4	144.1	81.4	128.2
Avg MHz (Top 10 CMA)	136.9	146.2	85.5	131.4
Headroom (Top 100 CMA)	52.6 MHz	42.9 MHz	105.6 MHz	58.8 MHz

*The analysis also reviewed twenty smaller operators; none would exceed the screen in any county.

'enhanced review' to spectrum below 1 GHz by integrating that closer scrutiny within a broader framework that recognizes that carriers seek a mix of low-, mid-, and high-band spectrum inputs precisely because of their differing competitive implications in broadband networks. And it is fully consistent with the Commission's repeated determination that "not all spectrum frequencies are created equal."[74]

Most importantly, the three-tiered screen once again becomes a useful tool for identifying potentially anti-competitive aggregation of spectrum resources. Unlike the error-prone current proposal with its false positives and false negatives, the weighted, three-tiered screen proposed by Sprint protects competition by providing all four nationwide carriers a reasonable amount of headroom in the vast majority of markets, while being triggered in similar cases to those in which the Commission has previously determined harm to competition would result.

Other alternative approaches exist.[75] But if, despite the extensive record evidence supporting Sprint's proposal, the Commission nevertheless does not pursue Sprint's proposal or Sprint's modified alternative weighting mechanism, the Commission should defer action on the screen. The proposal for a revised screen will not apply in the AWS-3 or 600 MHz auctions; therefore, it is not critical that the Commission make a final decision at this time.

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[74] Letter from Tom Wheeler, Chairman, FCC, to the Honorable John Barrow, U.S. House of Representatives (Apr. 17, 2014).

[75] There are some alternatives available to the Commission that are not as broken as the current screen, but that also fail to provide all of the advantages of a weighted three-tier screen. One option is adopting separate low-, mid-, and high-band screens, and discontinuing the overall transactional screen. This would accurately reflect the reality that carriers need a mix of spectrum to provide competitive service, and would encourage carriers to acquire that mix (notably through mutually beneficial transactions, as described in Sprint's Spectrum Screen Proposal.). *Sprint Spectrum Screen Proposal* at 25-26. It would also incorporate into the Commission's competition policy the material differences between high- as compared to mid- and low-band spectrum.

VII. Conclusion

The current proposal for a revised spectrum screen establishes new regulatory barriers to broadband deployment that will harm consumers. While the Commission appears to have recognized that low-band spectrum differs from mid- and high-band spectrum in competitively significant ways, the current proposal fails to acknowledge that high-band spectrum is also distinct from mid- and low-band spectrum. Without further revision to capture these differences, the revised screen will likely both fail to adequately diagnose market power and fail to withstand judicial review.

Respectfully Submitted,

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