Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
	)	
Promoting Interoperability in the 700 MHz Commercial Spectrum	)	WT Docket No. 12-69
	)	
Interoperability of Mobile User Equipment Across Paired Commercial Spectrum Blocks in the 700 MHz Band	)	

REPLY COMMENTS OF CELLULAR SOUTH, INC.

Cellular South, Inc. ("Cellular South") submits these reply comments in response to the Commission's Notice of Proposed Rulemaking in the above-referenced docket to promote interoperability in the 700 MHz commercial spectrum and to promote the interoperability of mobile user equipment in the 700 MHz band.[1]

INTRODUCTION

The record in this proceeding lacks any policy or technical basis to prevent device interoperability in the Lower 700 MHz paired spectrum. Interoperability opponents base their opposition on either a misunderstanding of the relief sought, or a technically-flawed analysis that suggests a complete inability to provide legitimate data in opposition to Lower 700 MHz interoperability.

By contrast, the record in this proceeding (and its nearly 3-year-old predecessor, RM-11592) is replete with examples of the harm caused by the current lack of interoperability in the Lower 700 MHz spectrum band.

Notably, interoperability proponents are the only commenters in this proceeding to offer relevant, real-world data on the question of 700 MHz interoperability – data that disproves every theoretical objection lodged by the interoperability opponents.

The solution to the Lower 700 MHz interoperability problem is to require all devices operating in the Lower 700 MHz spectrum must be capable of operating across

[1] *Promoting Interoperability in the 700 MHz Commercial Spectrum, Interoperability of Mobile User Equipment Across Paired Commercial Spectrum Blocks in the 700 MHz Band,* WT Docket No. 12-69, Notice of Proposed Rulemaking, FCC 12-31 (re. Mar. 21, 2012) ("NPRM").

all paired spectrum in this band. It is the solution that would have been implemented had this problem been foreseen prior to Auction 73, and it should not be disregarded now simply because some actors have successfully fragmented the Lower 700 MHz spectrum and crippled competitors' ability to use Lower 700 MHz spectrum to deliver LTE service in their operating areas.

The Commission should act on this issue immediately to establish interoperability in the Lower 700 MHz paired spectrum through the use of an existing, inclusive LTE Band: Band 12. The transition to Band 12 should begin no later than January 1, 2013 and should be completed no later than January 1, 2014. With this solution, the Commission can begin to restore competition and allow the public to have access to portions of their wireless spectrum that they have been prevented from using.

DISCUSSION

I. Comments reveal an overwhelming industry consensus in favor of device interoperability via the elimination of Band 17.

Commenters who support interoperability offer substantial technical[2], economic, and competitive evidence demonstrating that Commission action to require device interoperability at Lower 700MHz – by eliminating the use of Band 17 for Lower 700MHz operations – is in the public interest.

The competitive wireless industry is unified in its call for interoperability.[3] Competitive wireless operators and potential new entrants spent billions of dollars to acquire spectrum in the Lower 700 MHz band. But, because of the lack of device interoperability across the Lower 700 MHz spectrum, these licensees have been almost uniformly unable to access the devices necessary to a successful 700 MHz A Block deployment. This means that substantial economic activity has been stifled by reduced investment in the development of Lower 700 MHz spectrum.[4] FCC action on device interoperability would "encourage broadband deployment, permit carriers and customers to enjoy the benefits of economies of scale, and enable scarce spectrum resources in the 700 MHz band to be put to their highest and best use."[5]

[2] In addition to quantitative data and analysis previous submitted into the record by a collection of A Block licensees, a new, comprehensive report of additional testing utilizing commercial Band 12 and Band 17 devices is now part of the record in this proceeding. The new testing reaffirms the previous testing and specifically concludes that, with regard to Lower 700 MHz CMRS deployments, "there is no reason, based upon empirical data, to select Band 17 operations over Band 12 operations." *See generally,* V-Comm, LLC, Reply Comments ("V-COMM Study")

[3] *See, generally,* Blooston Rural Carriers Comments; Cavalier Wireless, LLC and Continuum 700 LLC Comments; Cellular South, Inc. Comments; Cricket Communications, Inc. Comments; Horry Telephone Cooperative, Inc. Comments; King Street Wireless, L.P. Comments; MetroPCS Communications, Inc. Comments; NTCH, Inc. Comments; T-Mobile USA, Inc. Comments; United States Cellular Corporation Comments; Vulcan Wireless, LLC Comments.

[4] *See*, MetroPCS Communications, Inc. Comments at 9.

[5] *Id*. at 1.

But the lack of access to devices is not the only operational issue that has stifled Lower 700 MHz A Block deployments.[6] Device interoperability also is critical to achieving the roaming arrangements necessary to assure consumers nationwide coverage. However, AT&T, in concert with others, has acted to impede roaming in the 700 MHz band by advancing the technical bar of a superfluous Band 17.[7]

In short, the overwhelming industry consensus is that interoperability in the Lower 700 MHz band advances the public interest.[8] Device interoperability in the Lower 700 MHz would ensure substantial device availability and selection to the most consumers across more of the country and would enable the nationwide roaming availability that customers have come to expect.

Generally, commenters opposing interoperability appear confused regarding the resolution proposed by proponents of Lower 700 MHz interoperability and ignore the fact that Lower 700 MHz interoperability can be achieved by simply eliminating the use of Band 17 for Lower 700 MHz operations. Only two commenters – AT&T (the only wireless operator opposed to interoperability in the Lower 700 MHz) and Qualcomm – offer any technical reasoning for their opposition. Both, however, are fatally flawed in their analysis.

The Telecommunications Industry Association ("TIA") is one of the commenters that fundamentally misunderstands the issue posed by the NPRM. TIA asserts "[d]evice manufacturers face significant hurdles to create devices that can operate across all 700 MHz bands."[9]

Similarly, Research In Motion Corporation ("RIM"), in apparently opposing interoperability, notes that "each additional band required [in a device] increases the handset complexity exponentially."[10]

These concerns, however, cut in favor of imposing the proposed solution: all deployments on Lower 700 MHz paired spectrum must use Band 12, not Band 17. The foundational hurdle to achieving interoperability at 700 MHz, as TIA and RIM note, is the unnecessary proliferation of bands in the 700 MHz spectrum. In other words, TIA and RIM have identified the precise issue that gives rise to the competitive harms

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[6] AT&T's assertion (s*ee,* AT&T Services, Inc. Comments at 11) that one Band 12 operator's access to one Band 12 smartphone, one Band 12 tablet, and one Band 12 hot spot somehow levels the competitive playing field is, at best, laughable. The fact that such a limited and – from the average consumer's standpoint - undesirable device selection is all that is available to one Band 12 operator underscores the anti-competitive harm AT&T and its vendor partners have inflicted through the creation of an unnecessary Lower 700 MHz band – Band 17.

[7] *See,* United States Cellular Corporation Comments at 17.

[8] *See, e.g.,* Horry Telephone Cooperative, Inc. Comments at 7; Public Knowledge, New America Foundation and Free Press Comments at 2; Rural Telecommunications Group Comments at 6–10; T-Mobile USA, Inc. Comments at 11

[9] *See*, TIA Comments at p. 4 (pages not numbered in original).

[10] *See*, RIM Comments at p. 9.

resulting from a lack of interoperability at 700 MHz – there are too many Bands in that spectrum. That is why proponents of interoperability seek a transition to Band 12 – the Band originally designated for the Lower 700 MHz paired spectrum – and away from the extraneous Band 17.

Even Qualcomm engages in this line of argument. In Section IV of its Comments, Qualcomm describes a litany of allegedly time-consuming steps it claims to be pursuing to increase the number of bands supported in a device, and to increase the Band 12 rejection of nearby signals.[11] Such measures are unnecessary. The Band 12 devices would operate normally in the presence of strong Channel 51 and Lower E Block signals. Interoperability may be achieved by harmonizing all Lower 700 MHz devices to Band 12.

The only reason that there are multiple LTE Bands in the Lower 700 MHz paired spectrum is that AT&T and its surrogates created Band 17 without technological justification. The existence of this superfluous Band has forced device manufacturers to choose between including Band 17 or Band 12 in their devices. Because of the enormous scale of AT&T, the device manufacturers have, to date, chosen Band 17, which leaves operators seeking to deploy on Band 12 with no viable devices for a deployment. Accordingly, billions of dollars of "beachfront" 700 MHz spectrum have remained almost completely undeveloped since they were awarded in 2009. This unnecessary result is not in the public interest and begs for Commission action allowing taxpayers to finally reap the economic growth benefits available from at least 12 MHz of valuable Lower 700 MHz spectrum.

II. Qualcomm's and AT&T's "analyses" are fatally flawed.

a. **<u>AT&T has offered no quantitative basis for its opposition to a transition to Band 12.</u>**

AT&T has offered no quantitative basis for its opposition to a transition to Band 12, and its engineering report in support of its opposition is replete with mischaracterizations, an insufficient grasp of concepts necessary to discussion of these issues and a general lack of precision in its analysis.

In AT&T's comments, Channel 51 and Lower E Block interference claims were presented in Exhibit A, a white paper prepared by Jeffrey Reed and Nishith Tripathi (the "White Paper"). Reed and Tripathi provided no theoretical calculations, no laboratory test data, no field measurements, or any other evidence to support their claims that Band 12 devices would receive interference from Channel 51 and E Block – they simply stated their unsupported, and incorrect, belief that interference would exist. Moreover, Reed and Tripathi's comments specific to Channel 51 and the Lower E Block were consistently wrong. AT&T's technical experts committed numerous errors in their white paper:[12]

[11] *See*, Qualcomm Comments at pp. 58-62.

[12] Beyond the substantive errors detailed below, other misstatements reflect a general carelessness in the non-quantitative approach of AT&T's submission. For example, on page 8 of the White Paper, Reed and

i. Misinterpreted the 3GPP LTE device specifications.

First, Reed and Tripathi misinterpreted the 3GPP specifications by claiming that the desired signal must be 33 dB stronger than the adjacent signal to avoid adjacent channel interference.[13] Instead, the relevant specification - TS 36.101 - states the opposite: the adjacent signal may be 31.5 dB stronger than the desired signal in the first ACS test case. The device is designed to tolerate a stronger nearby signal without reliance on the RF filter for attenuation of nearby channels.[14]

Because of this first error, Reed and Tripathi then go on to incorrectly assume that an LTE signal would require a signal-to-interference ration ("SIR") of 33 dB for normal performance. LTE is designed to use the same frequency in every sector and site of the network. When devices operate near the cell site coverage boundary with other sites, co-channel interference will often reduce the SIR to 0 dB or lower. Error coding and retransmission protect communications in such situations. An SIR of 33 dB is clearly not the "minimum performance specification" as incorrectly claimed by Reed and Tripathi.

ii. Falsely claimed that device interference was anticipated in the 2002 Report and Order related to the Lower 700 MHz Band.

Reed and Tripathi next proceed to incorrectly claim that 700 MHz interference to devices was envisioned by the rules established in the 2002 Report and Order:

> As was widely recognized, the proximity of mobile broadband frequencies to these high-powered television and video broadcast frequencies creates significant potential interference issues [19].[15]

The Report and Order paragraph cited here by Reed and Tripathi to support their claim of "widely recognized" interference makes no mention of 700 MHz device interference. Instead, the cited paragraph merely explained the geographic exclusion zone set up to protect the incumbent Channel 51 full service licensees. This rule is specific to A Block transmitter location and has no bearing on Lower B or C Block device specifications. At no point did the Report and Order suggest that interference may result to Lower 700 MHz devices, as Reed and Tripathi imply. Quite the contrary – the

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Tripathi exhibited unfamiliarity with the history of the 700 MHz spectrum when they state the wrong year for Auction 73, which was closed in 2008: "In 2009, the FCC auctioned frequency blocks in the 700 MHz range…". Also, Reed and Tripathi repeatedly misidentify the engineering firm Wireless Strategy, LLC, as "Wireless Strategies," which is a New York-based firm unrelated to any of the testing conducted by Lower 700 MHz A Block licensees.

[13] *See*, AT&T Services, Inc. Comments, Exhibit A, p. 6.

[14] 3GPP TS 36.101 v8.14..0 2011-06 "Evolved Universal Terrestrial Radio Acces (E-UTRA) User Equipment (UE) radio transmission and reception" § 7.5.1 Table 7.5.1-2 for the adjacent channel selectivity case 1, p. 46.

[15] *See,* AT&T Services, Inc. Comments, Exhibit A, p. 8

Report and Order provides strong language noting that adjacent channel interference will not occur from 50 kW transmissions because the Commission's engineers provided a power flux density limit equivalent to that of the 1 kW ERP base stations:

> 105. This PFD standard will minimize the likelihood of adjacent channel interference to groundbased devices by effectively limiting the energy received by such devices to levels no greater than what they would receive from adjacent channel base stations operating at 1 kW ERP or less. For UHF operations, antenna height tends to be a more important variable than output power in causing/mitigating interference, so the effect of a 50 kW ERP signal on adjacent channel devices operating on the ground will be minimized given the tower heights likely to be used. We have performed calculations that demonstrate, for example, how 50 kW ERP, high antenna broadcast operations can co-exist with lower-power/low antenna height land mobile operations.[16]

The analysis provided by the FCC's engineers in Appendix D of the Report and Order established a power flux density limit[17] for the 50 kW transmissions such that the E Block ground-level power would be no different than the LTE ground-level power, a conclusion validated by the comprehensive Atlanta, Georgia field and Herndon, Virginia, lab testing results presented to the Commission on May 29, 2012, by a coalition of A Block licensees (the "Test Report").[18]

Reed and Tripathi summarized their unsubstantiated interference claims on page 8 of the White Paper.

The first claim was related to Channel 51:

> First, transmissions from mobile devices can interfere with the set top boxes used to receive Channel 51 television broadcasts.[19]

However, they provided no calculations or measurements to suggest that a problem may exist, much less to suggest that Band 12 would not perform normally for Lower B and C Block transmissions. This claim lacks merit.

The second claim was related to base station interference:

> Second, Channel 51 and E block broadcasts cause interference within the frequency ranges used by base stations to receive transmissions from mobile devices.[20]

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[16] *See*, Report and Order, *In the Matter of Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, GN Docket No. 01-74, released Jan. 18, 2002, at 105..
[17] *See*, CFR 47 volume 2, Part 27.55b.
[18] *See,* Test Report (Ex parte presentation of Lower A Block Licensees, WT Docket No. 12-69 (May 29, 1012)) § 4.3, p. 26.
[19] *See*, AT&T Services, Inc., Exhibit A, p. 8.
[20] Id.

Again, Reed and Tripathi's claim lacks merit. In 2008, the 3GPP vendors agreed that Channel 51 and E Block transmissions near the base station receive blocks were not a reason for introducing Band 17.[21] Base station interference has no bearing on device interoperability because base station RF filtering may be specific to an operator's spectrum blocks while still complying with a broader Band Class. Devices, on the other hand, must support the entire band to ensure interoperability and roaming.

Reed and Tripathi's third claim was the only claim related to 700 MHz device performance:

> Third, the high-powered transmissions from Channel 51 and the E block cause interference in the frequency ranges used by mobile devices to receive transmissions from the base station.[22]

This last claim, expanded in generalities in the remainder of the paper, was not supported by analytical or empirical data.

iii. Mischaracterized the 3GPP process behind the formation of Band 17.

At the end of the Overview section of the White Paper, Reed and Tripathi inaccurately characterized the 3GPP discussion behind the formation of Band 17 as a process wherein 3GPP "recognized these significant interference concerns and sought to address them by adopting standards and specifications for two different "Bands" in the lower 700 MHz frequencies."[23]

In actuality, the vendors openly questioned the need for a separate LTE Band. Ericsson, the only vendor to submit system simulations to the deliberations, summed up their view of the Band 17 request in the negative: "Summarizing: it is questionable if a Band [17] duplexer should be introduced based on the coexistence results considered above." [24]

In the meeting notes from the session, Ericsson explained the delta between Ericsson's simulations and the analysis suggested by AT&T as follows:

> Ericsson: they do address the blocking as well. If all the users are very close to the site, is in AT&T the degradation could be much higher. The difference between the assumptions, AT&T is close to the worst case scenario, why here it is more typical scenario that is used for average system analysis. (sic) [25]

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[21] *See*, Report of the 3GPP TSG RAN WG4 meeting #47bis, Munich, Germany, 16-200 June 2008, p. 28: "Nortel: for the eNodeB filtering can be improved." And also: "Qualcomm:…they understand that for the [base station] the problem can be solved without introducing [Band 17]."
[22] *See*, AT&T Services, Inc. Comments, p. 8.
[23] Id.
[24] *See*, 3GPP TSG RAN WG4 Meeting #47bis, Munich, Germany, R4-081356 "On the introduction of Band [17]", Ericsson, 16-20 June 2008.
[25] Id. at p. 28.

In other words, AT&T exaggerated the deployment scenario to an unrealistic situation in an attempt to justify their request for a separate band class.

iv. Misunderstood the duplexer role in reverse PA intermodulation.

Intermodulation is an interference mechanism wherein two ***transmit*** frequencies mix and create interference on a third frequency.[26] If intermodulation exists, then harmful interference would only result if the energy was both of sufficient strength and fell upon the ***receive*** frequency of interest. Therefore, if Channel 51 intermodulation were to impact Lower B and C Block operation, the function of the ***receive*** filter would play no role in defining the performance within the Lower B and C Blocks, as inaccurately claimed by Reed and Tripathi.

In Motorola's initial contribution to 3GPP proposing a separate band class, Motorola suggested that the device ***transmit*** filter of Band 17 would roll off over the A Block device transmit frequencies, providing more attenuation of Channel 51 and lowering the level of any IM products:

> For a UE operating in a Band 12 configuration (A+ B+ C), this would result in a significant in-band power when roaming near a channel 51 broadcast transmitter since limited RF filtering would be available for the adjacent Channel 51 if A block is part of the operating bandwidth. This large in band power would intermod with an existing UE transmission in block A, B and C to generate spurious emission (2F1-F2) in other parts of the 700 MHz spectrum. The key issue for Tx IM is the level of the DTV Channel 51 wideband signal that would be present at the UE antenna port based on a reasonable deployment scenario[27]

This is a different point than the one incorrectly claimed by Reed and Tripathi above: the ***transmit*** filter is the relevant filter, not the ***receive*** filter. The Test Report debunked Motorola's prior claim as well, demonstrating that commercially available power amplifiers were designed with sufficient linearity such that reverse PA IM would not exist in an operational market.[28] In other words, commercially deployed device power amplifiers already suppress any energy landing in a device's receive frequencies to below the device's noise floor.

In the ensuing pages of the White Paper, Reed and Tripathi more fully developed their incorrect supposition regarding the filter's role in reverse PA IM. Reed and Tripathi provided Table A, which calculated the possible combinations of Channel 51 with a device transmission to generate IM.[29] Notably, the table agrees with prior data submitted

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[26] *See*, Test Report, p. 45.
[27] *See*, 3GPP TSG RAN WG4 Meeting #47, Kansas City, USA, R4-081108, "TS36.101: Lower 700 MHz Band [17]," Motorola, 5-9 April 2008.
[28] *See*, Test Report, § 5.4.
[29] *See*, AT&T Services, Inc. Comments, p. 12.

by A Block licensees demonstrating that overlap with a Lower B or C receive block would only occur in the case of a B plus C Block allocation (a 10 MHz LTE channel).[30]

The text below the White Paper's Table A expanded on their view that intermodulation energy within the A Block might somehow impact Lower B and C Block operation:

> The bandpass filters used in Band 12 devices do not filter transmission in the A block, and thus will not be able to filter the energy from the intermodulation product that falls within the A block. By contrast, Band 17 bandpass filters do filter A block frequencies, which means that Band 17 bandpass filters are able to significantly attenuate the energy created by the intermodulation product. Band 12 devices will be subject to greater interference in Case I and III (shown in Table A) as well. The intermodulation product in these cases is still centered within (or immediately adjacent to) Band 12, which means that the Band 12 passband filters will not be able to attenuate as much of the energy from the intermodulation products.[31]

The above misperception is grounded in Reed and Tripathi's erroneous view that an LTE device is incapable of receiving a signal unless the adjacent channel is 33 dB weaker than the desired signal.[32] This error led them to believe that a weak intermodulation signal in the A Block could cause some level of interference to B and C Block device reception, and that the Band 17 device's receive filtering of the A Block was somehow material in avoiding IM interference.

The correct view of the 3GPP device specification is that the device may handle a much stronger signal in the adjacent channel with no impact. As validated in the Test Report, in order to impact B or C Block reception, the A Block IM level would have to be 60 dB greater than the LTE signal level in B Block, a physical impossibility given the regulated ERP levels for the signals involved in the IM generation. That is, as a matter of physics, Channel 51 ground level signals mixed with the maximum device transmit power cannot produce an intermodulation signal strong enough to harm 700 MHz device performance in an adjacent block.

v. Incorrectly described the receiver blocking interference mechanism.

In Section 2.2 of the White Paper, in the upper portion of Figure 2, Reed and Tripathi illustrate the out-of-band emissions (OOBE) from the E Block transmitter spilling into the Lower A, B and C Blocks.[33] The upper portion of the figure correctly illustrates OOBE: a transmitter is an imperfect emitter, and unintentionally places some of the energy outside of the transmission bandwidth of interest. This unwanted energy appears in-channel to neighboring receivers.

[30] *See,* Test Report, Table 5.1, p. 47.
[31] *See,* AT&T Services, Inc. Comments, Exhibit A, p. 12.
[32] Id., Exhibit A, p. 6.
[33] Id., Exhibit A, p. 15.

But, in the lower portion of Figure 2, Reed and Tripathi attempt to show the Band 12 and 17 filters attenuating the E Block OOBE differently.[34] This illustration is wrong; the device receive filter is incapable of reducing OOBE energy.

No device receive filter can possibly aid with limiting OOBE. OOBE, by definition, is energy occurring within the Lower A, B and C Blocks as transmitted by an adjacent Channel 51, Lower 700 MHz E Block, or Upper 700 MHz C Block site. The device receive filter, whether it is Band 12 or Band 17, is unable to attenuate energy falling within the receive channel; this energy is within the filter passband. The OOBE interference mechanism would be identical for both a Band 12 and a Band 17 device. The solution to OOBE interference is the placement of a sufficient transmit filter on the relevant Channel 51, Lower E Block, or Upper C Block site to control the energy falling outside of the transmission bandwidth. Therefore, Reed and Tripathi are wrong in claiming an OOBE benefit from the use of a Band 17 filter. Both Band 12 and Band 17 devices would perform identically in such a situation.

vi. Incorrectly stated the function of the device receive filter in the presence of a nearby strong signal.

In the second half of page 15, Reed and Tripathi described their view of receiver overload:

> Overloading occurs when the total signal strength at the receiver – i.e., the sum of ACI and the desired signal – increases the temperature of the device to such an extent that it causes damage to the devices' electronic circuits. Overloading can significantly impair the device's functionality and may even render it inoperable. The total signal strength that causes overloading varies from device to device, and depends on the ability of various components in the device's receiver (e.g., the low noise amplifier and filter) to withstand signal levels and associated rise in device temperature. It is not at all unlikely that receiver overloading will occur in Band 12 devices operating nearby high powered E block transmissions.[35]

This description of the receiver blocking interference mechanism is wrong. An over-the-air E Block signal is physically incapable of causing heat loading of a device such that damage to the circuitry would occur.

Instead, the correct definition of receiver blocking, or overload, is the case where a nearby signal is of sufficiently greater magnitude such that the device is no longer able to handle the signal differential between the stronger undesired signal and the weaker desired LTE signals, thus obscuring the weaker LTE signal.[36] This is evidenced by a reduction in sensitivity of the receiver. This does not impact SIR within the channel, as

[34] Id.
[35] Id. at 15.
[36] *See, e.g.,* http://www.radio-electronics.com/info/rf-technology-design/receiver-overload/blocking.php

Reed and Tripathi incorrectly claim. Any impairment would occur when the selectivity of the device is exceeded, and no degradation would result for adjacent signal levels which remain within the selectivity of the device. The Test Report validated the receiver selectivity for commercial 700 MHz devices and proved that the devices are capable of handling the worst-case signal differentials measured in Atlanta.[37] No degradation would result with the use of a Band 12 device near the Lower E Block towers.

The physics of radiofrequency propagation suggested by the Commission engineers in 2002 were validated in the Test Report. The field measurements in Atlanta demonstrated that LTE base stations delivered similar ground-level signals as the E Block transmitters.[38] If commercial LTE device components were to perform so poorly as to suffer thermal damage when near an LTE base station, then AT&T's customers have much more to fear from the Verizon Wireless system operating on the upper 700 MHz spectrum than they would from some future, hypothetical E Block system. Verizon's base stations transmit in the adjacent block (Upper 700 MHz C Block) to the Band 17 receive blocks and would present a similar ground-level signal as would the E Block to the Lower B and C Blocks.[39]

Further, the FCC power flux density limit specified in the regulations for 700 MHz transmissions ensures that the ridiculously high signal levels necessary to cause circuitry damage would never exist in an operational market.[40]

The drawing which Reed and Tripathi should have included in Figure 2 was an illustration of receiver blocking, in which a nearby signal may be strong enough to reduce the receiver sensitivity of the LTE device.[41] The potential for receiver blocking was fully tested in the Herndon laboratory tests in November 2011 and documented in the Test Report.[42]

The V-COMM Study tested both Band 12 and Band 17 device selectivity in the presence of a Lower E Block interfering signal. The V-COMM Study's results for Band 12 Lower B Block device selectivity met or exceeded the second-adjacent channel performed noted in the Test Report, confirming the accuracy of the Test Report measurement procedure and results.[43] The laboratory-validated receiver performance of Band 12 devices would not experience interference in an operational market as validated by the Atlanta field measurements detailed by the Test Report.[44]

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[37] Test Report, § 4.2, pp. 23-24.
[38] Id. at § 4.3.
[39] Id. at § 4.4.
[40] *See,* CFR Title 47 volume 2, Part 27.55b.
[41] *See, e.g.,* Ex parte presentation of Coalition for 4G in America, "Lower 700 MHz Interference Management", WT Docket No. 06-150, p. 4 (Sep. 20, 2010).
[42] *See*, Test Report at § 4.
[43] *See*, generally, V-COMM Study, pp. 8, 32-36.
[44] *See,* Test Report, § 4.2.

V-COMM Results for 5 MHz Channel	Device A	Device B	Device C	Device D	Device E	Device F	Device G
	Band 17	Band 17	Band 17	Band 12	Band 12	Band 12	Band 17
Device Sensitivity	-100.8	-98.1	-100.2	-100.1	-100.9	-100.2	-101.4
E Blk 1 dB Desense	-18	-13	-16	-20	-23	-26	-15
Device Selectivity	82.8	85.1	84.2	80.1	77.9	74.2	86.4
Test Report 5 MHz Channel				74			

vii. Incorrectly described the available information regarding broadcast mobile video systems similar to MediaFLO.

Reed and Tripathi claim that the E Block environment was an unknown and could not be determined until a nationwide system was built:

> Further, the impact of E block transmissions on Band 12 and 17 networks would be impossible to measure today in any real world application, because the E Block licensees have not yet deployed such networks. Without knowing the locations of E block base stations, the height of the transmitters, the tilts of the antennae, and myriad other factors, it is not possible to accurately predict the extent to which (or where) E block transmissions will interfere with Band 12 networks and mobile devices.[45]

Reed and Tripathi's comments seem focused on delaying any real analysis of the E Block situation until several years from now. Such a delay is unnecessary. Laboratory tests have been and may still be performed with commercial devices to quantify their blocking characteristics. Field measurements of existing systems fully characterized the E Block RF environment. Analytical calculations of potential differences in deployment would provide an understanding of any deployment deltas not seen in Atlanta.

The above actions were taken and the results captured in the Test Report, providing the complete data set necessary to fully understand commercial device performance and the operational environment of LTE systems in the vicinity of E Block towers.

Moreover, the hundreds of site measurements which Qualcomm performed for their D Block MediaFLO system would also provide a characterization of the RF environment around broadcast towers, should Qualcomm choose to share such data. There is no need to await the construction of an E Block system to understand such an RF environment.

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[45] *See*, AT&T Services, Inc. Comments, Exhibit A, p. 19.

viii. Mischaracterized the post-launch operations activities of a broadcast system such as the one contemplated by Dish Network.

On page 19 of the White Paper, Reed and Tripathi demonstrated their lack of understanding of the broadcast video business model:

> For example, operators of an E block network likely will be constantly adding E block transmitters, optimizing antenna tilts, optimizing power, and making the many other day-to-day changes to the network to maximize its performance.[46]

The broadcast mobile video business model is predicated on covering as broad of a geographic area with as few sites as possible. Once built and optimized, the broadcast system would not require site additions or modifications because the information stream never changes; the same number of channels is broadcast over the same coverage area.

The broadcast system is not capacity-limited as is found with a cellular system. Cellular systems must continually add capacity sites to keep pace with customer growth of two-way services. Such cellular capacity must scale directly with the number of customers and usage, and results in constant change as described in the above paragraph. Although Reed/Tripathi's comments are applicable to a cellular-based network such as LTE, they are inapplicable to a broadcast system such as would be employed in the E Block. Thus, Reed and Tripathi greatly exaggerated the difficulty of the environment which would be posed by a future E Block broadcast system.

In fact, Qualcomm, noted in an "Overview" of the MediaFlo deployment submitted to the IEEE that "Since, the typical transmit power for the TV bands in UHF/VHF are assumed to be high, e.g., 50 kW ERP, it is anticipated that transmitter spacing can be fairly large, e.g., 30-40 km. In this setting, a few transmitters (2-3) may be sufficient to cover a metropolitan market area."[47]

At the top of page 20 of the White Paper, Reed and Tripathi continued their argument that useful data quantifying the interference environment cannot be obtained because any supposed impact from the E Block depends on the LTE network usage:

> The impact of interference also depends on usage patterns that affect network loads. The impact of interference – which reduces network resources – will be greater where there is higher demand for network resources. Moreover, the impact of interference will be greater where customers are using relatively high-throughput applications, such as video streaming, or low-latency applications, such as VoLTE.[48]

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[46] Id.
[47] IEEE Transactions on Broadcasting, Vol. 53, No. 1, March 2007, "Flo Physical Layer: An Overview", by M. Chari, et al, at § E, p. 148.
[48] *See*, AT&T Services, Inc. Comments, Exhibit A, p. 20.

Here, Reed and Tripathi appear to have intentionally over-complicated the interference assessment in an attempt to cover up the fact that they have provided no analysis or data to support their interference claims. The simple truth remains that the Test Report demonstrated that ***no interference*** would result to a Band 12 device under worst-case conditions. Therefore, regardless of the application running on the **Lower B or C Block** LTE system, no interference would result.

ix. Misinterpreted and incorrectly described the tests and results submitted in the Lower A Block Coalition Test Report.

Reed and Tripathi again criticized the Test Report for not testing Band 12 devices:

> Most notably, the Wireless Strategies [sic] analysis confirms that no Band 12 devices were used in the analysis. This is a critical flaw. The central scientific hypothesis here is that Band 12 devices will be subject to greater interference than Band 17 devices. It is impossible to test this hypothesis without using both a Band 12 and Band 17 device.[49]

Given the ecosystem challenges documented in the record, Band 12 devices did not exist at the time of the testing. The Test Report clearly explained the procedures used to quantify device performance of the components such that the performance of the same device with a Band 12 duplexer could be quantified. This is not a flaw in the test procedures, but was thoroughly addressed in a manner which obtained useful results applicable to future Band 12 devices.

The accuracy of the earlier Test Report was affirmed by the Band 12 device tests as documented in the V-COMM report and summarized above. The actual Band 12 devices performed equal to or better than the Band 17 devices in the previously reported testing of second-adjacent channel selectivity.

The next "flaw" alleged by Reed and Tripathi is described on page 20 and is related to Channel 51:

> Instead, to analyze Channel 51 interference, Wireless Strategies [sic] merely purports to test whether a Band 17 device would work if it were subject to interference within its filter's passband ranges, and assumes that if it does, then so too would a Band 12 devices when faced with Channel 51 interference that creates interference within a Band 12 device's passband frequencies.[50]

Reed and Tripathi misunderstand the tests performed related to Channel 51 and drew incorrect conclusions about the results. The tests focused on whether the LTE commercial device components would generate intermodulation interference with amplitude above the device noise floor for the worst case Channel 51 and device transmit power levels in a market. The tests quantified the impact of the Band 17 filter. The

[49] Id., Exhibit A, p. 20.
[50] Id.

analyses demonstrated that a device employing a Band 12 filter would similarly not experience interference.

Comparing the Test Report results to the V-COMM test results shows close agreement. The Test Report analysis indicated that Band 12 devices would produce IM at the noise floor of the device if Channel 51 signals were stronger than -13.5 dBm. The V-COMM report of commercial Band 12 devices noted the same result for Channel 51 signals stronger than -12.5 dBm, 1 dB better than the Test Report analysis.

In fact, Qualcomm's test results of the 1900 MHz power amplifier suggested that signals stronger than -15 dBm may begin degrading performance.[51] The three measurements are relatively close. The main disagreement is in the strength of the Channel 51 ground-level signal which a device may experience when in weak LTE coverage. The Test Report and V-COMM analyses demonstrated a negligible risk of harmful interference to Band 12 devices from Channel 51.

On page 21, Reed and Tripathi incorrectly claimed that the test results are flawed because of the choice of test frequencies:

> The Channel 51 analysis is also flawed because it appears designed to understate the extent to which the intermodulation interference will be greater for Band 12 devices compared to Band 17 devices. As we explained above, using the center frequency for Channel 51 transmissions and the center frequency for block C transmissions, produces the center carrier frequency of the intermodulation products in the block A receive frequency for the device (i.e., 731 MHz), which is filtered well by Band 17 devices but not by Band 12 devices. The Wireless Strategies [sic] analysis, instead focused on an intermodulation product produced by an off-center Channel 51 broadcast that results in the center carrier frequency of the intermodulation products that falls within the B block (i.e., 735 MHz), which is not filtered as well by either Band 12 or by Band 17 devices, thus creating the false impression that this interference generally affects both Band 12 and Band 17 equally.[52]

This passage contains multiple logical errors and must be carefully unpacked to note each flaw.

In the second sentence above, Reed and Tripathi note that a Channel 51 signal mixing with a Lower C Block signal produced low-level intermodulation in the Lower A Block. This is precisely the point made in the Test Report and verified experimentally in the lab testing – an LTE system employing only one 6 MHz spectrum block (Lower C) cannot generate intermodulation which mathematically overlaps with the device receive frequencies. As a result, ***interference is impossible in this situation*** because there is no energy overlap of the interfering signal with the LTE receive signal. Thus, in the first

[51] *See*, Qualcomm Comments, p. 40: "A Band 12 filter, however, provides only 5 dB of attenuation (see Figure 17), and thus will not prevent all interference where the Channel 51 signal is at -15 dBm or stronger."
[52] *See*, AT&T Services, Inc. Comments, Exhibit A, p. 21.

half of this sentence, Reed and Tripathi are in agreement with the conclusions of the Test Report.

In the second half of this sentence, however, Reed and Tripathi falsely claim that a Band 17 duplexer can somehow filter energy in the A Block that a Band 12 duplexer cannot. Based on their own statement, filters require "rolloff" and Band 17 would not provide meaningful attenuation within the A Block. But, this has no bearing on any IM interference.[53]

Reverse PA IM interference, if it were to exist at all in this context, would be of very low signal amplitude. This low level of energy in the A Block - more than 6 MHz away from an LTE channel in the C Block - would have no bearing on C Block performance. In short, Band 12 and Band 17 devices would perform identically in this situation of non-overlapping IM products.

In the third sentence above, Reed and Tripathi misunderstand the selection of test frequencies and falsely claim that the test was somehow rigged to show interference to both Band 12 and Band 17 devices.

On the contrary, the analyses in the Test Report showed no interference to either Band 12 or Band 17 devices. In the analysis section, the Test Report noted that the LTE center frequency used by AT&T in Atlanta was such that the mathematical reverse PA IM products overlapping with the LTE receive frequencies would be minimized.

Nevertheless, the laboratory tests placed the LTE channel in the middle of the frequency blocks to represent ***the worst case*** frequency overlap. A number of LTE device transmit frequencies were tested in an attempt to produce a measureable level of intermodulation. The only LTE device transmission which produced a measurable IM response was the Lower C Block transmission at the upper end of the block. The resulting intermodulation product overlapped with the lowest edge of the Lower B Block, requiring a 10 MHz LTE channel for the device to experience any IM overlap with the receive frequencies.

Furthermore, all parties agree that Channel 51 signals must be stronger than -12.5 to -15 dBm to create IM products which would begin to affect the device noise floor. The Test Report field measurements noted that the strongest Channel 51 signal level was -36 dBm for the full service DTV station north of Atlanta. The V-COMM Study report summarized drive test data within 2 km of full service DTV stations and noted a mere handful of locations with signal strength greater than -13 dBm. The Channel 51 signal levels which may be encountered in an operational LTE environment are low enough such that commercial Band 12 devices would not experience harmful interference.

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[53] Id., Exhibit A, p. 5: "All filters experience 'roll off,' which means that a filter designed to block transmissions below a particular frequency (the edge of the passband) will actually achieve a gradually decreasing attenuation for frequencies closer to the passband. In other words, the filter cannot fully attenuate the transmissions directly adjacent to the passband and those transmissions will enter the device at a relatively high level."

The faulty logic employed by Reed and Tripathi regarding reverse PA IM is continued in the next paragraph:

> As we explained in Sections 1 and 2, Band 12 will be more susceptible to interference from reverse intermodulation everywhere that AT&T devices transmit using the C block (or combined B & C blocks). It is the interaction between C block transmissions and Channel 51 that causes centers of the intermodulation products to fall within or very near the RF passband frequency ranges used by Band 12 devices, but outside the RF passband frequency ranges used by Band 17 devices, resulting in greater interference for Band 12 devices relative to band 17 devices. As we explained in Sections 1 and 2, Band 12 devices use RF filters that are substantially less able to attenuate third order intermodulation products produced from interactions between Channel 51 transmissions and C block transmissions, whereas Band 17 devices can significantly attenuate such transmissions. Accordingly, Band 12 devices are more susceptible to interference than a Band 17 device.[54]

As discussed above, Reed and Tripathi fail to perceive that ***a device receiver filter plays no role in protecting a device from reverse PA IM***. By definition, IM would impact a receiver by increasing the interference level within the channel being received. An RF filter is incapable of removing noise or interference from the same channel the receiver is tuned to receive.

The Test Report data and conclusions accurately described this relationship and provided evidence that Channel 51 would not cause interference to Band 12 LTE devices.

In the next paragraph on page 21, Reed and Tripathi attempted to dispute the Report conclusions regarding the impact of reverse PA IM:

> Similarly, Wireless Strategies [sic] asserts that a Band 12 device using C block to transmit and receive would not be subject to IMD, because the IMD product would fall only in the A and B block receive frequencies. Although it is true that the bandwidth of the intermodulation product intersects with the A and B receive frequencies and not with the C receive frequencies, it is not true that this IMD product will not cause interference for a Band 12 device receiving in the C block. The signals do not suddenly drop like a pulse function to minimal power outside the bandwidth; their power levels gradually decrease. Hence, strong IMD will have a high power level when it hits the baseband filter of the C block, causing significant interference. By contrast, a Band 17 device would be less subject to such IMD because the Band 17 device would be able to attenuate the IMD to a larger extent compared to a Band 12 device due to the increased amount of RF filtering and would experience less interference.[55]

Reed and Tripathi made the above claim with **no theoretical analysis or test data to substantiate their position**. Their claim does not withstand technical scrutiny in

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[54] *See*, AT&T Services, Inc., Exhibit A, p. 21.
[55] Id., Exhibit A, p. 21

light of the 3GPP in-band blocking specifications, which permit adjacent channel signals of -56 dBm or more. The Test Report provided laboratory test data of reverse PA IM demonstrating that the signal levels involved are of very low amplitude and do indeed fall off rapidly in frequency, such that the situation described by Reed and Tripathi would never exist.

On page 22, Reed and Tripathi continued their inaccurate criticism of the Report:

> The Channel 51 field testing presented by Wireless Strategies [sic] is also flawed. These field tests purport to measure Channel 51 and base station signal levels in different areas near one Channel 51 receiver. Obviously, even assuming these measurements are accurate, a sample size of one is not sufficient to draw conclusions about the environments nearby the numerous other Channel 51 receivers. Furthermore, the distances where the measurements were made were relatively far from the Channel 51 transmitters. More locations closer to the Channel 51 transmitters should have been selected for measurements. Moreover, it is important to note that Wireless Strategies' [sic] field measurements failed to include in-building measurements where the difference between cellular base station and Channel 51 transmissions may be significantly higher, especially on higher floors.[56]

Reed and Tripathi fail to understand the test methodology employed by the Atlanta data collection. Indeed, they make reference to measurements near a Channel 51 receiver; this term does not even appear in the Test Report. Instead, the Test Report documents the test setup as employing a scanning receiver to continuously measure the Channel 51 signal throughout Atlanta. Accordingly, there is not a "sample size of one", but thousands of locations were measured to quantify the signal level throughout the Atlanta market.

The distance to the Channel 51 tower, as described in the Test Report, was limited by the poor condition of the access road to the tower. The test vehicle was incapable of gaining closer access to the tower than 2 km, which vividly illustrates the unlikely probability of an LTE device closely approaching a Channel 51 broadcast tower at similar facilities around the country.

Finally, the in-building measurements called for by Reed and Tripathi are unnecessary. The ground-level signals from Channel 51 were insignificant (<-36 dBm). While measuring signals in tall buildings would increase the signal level for both Channel 51 and the LTE downlink signals, the building loss would once again reduce the amplitudes relative to the outdoor level. There is no reasonable scenario suggesting that Channel 51 could cause interference to LTE devices within Atlanta. Therefore, contrary to Reed and Tripathi's unsupported assertions, the Test Report measurements accurately portrayed the Channel 51 RF environment.

In the next paragraph, Reed and Tripathi alleged flaws in the E Block results, finding fault once again with the lack of existence of Band 12 devices:

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[56] Id., Exhibit A, p. 22

> The analysis of E block is also fundamentally flawed. Here, again, Wireless Strategies [sic] does not analyze the relative performance of Band 12 and 17 devices in the presence of E block transmissions.[57]

Reed and Tripathi then proceed to misinterpret the test approach and results:

> Instead, Wireless Strategies [sic] purports to have used lab tests to show that a Band 17 device will continue to operate above 3GPP minimum specifications in the presence of high powered transmissions from the immediately adjacent frequency bands (the A block). From this they conclude that a Band 12 device would also operate above minimum 3GPP specification in the presence of high powered transmission from immediately adjacent frequency bands (the E block).[58]

Reed and Tripathi state that they believe the real question at issue is whether Band 12 would be more susceptible to interference than Band 17, and then incorrectly claim that the test results bore out such a conclusion. When in fact, the Test Report clearly states that the laboratory tests determined the receiver selectivity level at which an interference impact would begin to occur – not at which minimum 3GPP performance was maintained, as Reed and Tripathi alleged.[59]

The Test Report's subsequent comparison with the field measurements demonstrated that both Band 12 and Band 17 devices would perform equally well in Atlanta, i.e., perform normally with no impact from the Lower E Block transmissions.[60]

x. Inaccurately claim that more Lower E Block broadcast towers would result in more interference.

Finally, on page 23, Reed and Tripathi erroneously claim that the Test Report showed some impact from Lower E and then stated that a greater density of E Block towers would increase the probability of interference within a market.[61]

The correct, data-driven view is that an E Block tower would not cause interference to Band 12 devices.[62] Therefore, a greater density of towers would also not cause interference, as mathematically proven in the Test Report.[63]

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[57] Id., Exhibit A, p. 22.
[58] Id.
[59] *See*, Test Report, § 3.2.1, p. 16.
[60] Id., § 4.5.
[61] *See*, AT&T Services, Inc. Comments, Exhibit A, p. 23.
[62] *See*, Test Report, § 4.5, p.36.
[63] Id., § 4.7, p. 42.

b. Like AT&T, Qualcomm provided no test data of 700 MHz components or devices to support its interference claims.

Qualcomm's interference claims are based on speculative assumptions with no grounding in actual device performance but rather a limited deployment of a now-defunct broadcasting system.

Qualcomm made two interference claims related to the Lower E Block: device receiver blocking from the nearby strong signal, and intermodulation interference from the combination of the device transmission signal and the Lower E Block signal in the receiver low-noise amplifier (LNA).[64]

i. Lower E Device Receiver Blocking

In terms of receiver blocking, the following technical flaws were evident in Qualcomm's comments: (1) Qualcomm did not perform tests of 700 MHz components or devices; actual device performance related to the Lower E Block was never quantified, and (2) Qualcomm assumed the minimum 3GPP receiver selectivity as the performance metric for Band 12 devices without providing any proof that commercial 700 MHz devices would perform so poorly.[65]

In contrast, the Test Report demonstrated through laboratory tests that commercial 700 MHz devices exceed the minimum 3GPP receiver selectivity by 39 dB.[66]

In Table 2 of its Comments, Qualcomm calculated the blocking margin remaining between the 3GPP minimum specification of -56 dBm and the hypothetical E Block signal assumed by Qualcomm, with levels up to -10 dBm.[67] However, Qualcomm's D Block plots did not show signal levels stronger than -29 dBm, and Qualcomm did not provide evidence that commercial devices would block in the presence of an interfering signal of -56 dBm as claimed.[68] Table 2 is a hypothetical exercise with no basis in reality. The Test Report lab measurements noted that a -17 dBm E Block level would be required to begin impacting a Lower B Block device, 12 dB stronger than the strongest D Block signal in Qualcomm's plots.

In Table 3 of its Comments, Qualcomm assumed that commercial device blocking performance is only 43 dB[69] (8 dB above the 3GPP minimum but 31 dB worse than the

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[64] *See*, Qualcomm Comments, p. 4.
[65] Id., p. 7: "3GPP TS 25.101 contains the requirements for 3G networks and 3GPP TS 36.101 contains the requirements for 4G networks. Suppliers of cellular devices around the world adhere to these levels, and the capabilities of consumer devices match these requirements closely." Qualcomm proceeded to use the minimum 3GPP performance specification in its analysis. However, laboratory testing demonstrates that commercial devices do not, in fact, follow the minimum specifications closely, but instead, well exceed the minimum as documented in the Test Report.
[66] *See*, Test Report, p. 24.
[67] *See*, Qualcomm Comments, p. 10.
[68] Id., p. 25.
[69] Id, p. 11.

corresponding Test Report results for the second-adjacent channel).[70] Again, Qualcomm provided no evidence to support their unrealistically poor assumption. Furthermore, Qualcomm claimed, without evidence, that the E Block signals could reach -10 to -20 dBm. However, Qualcomm's coverage plots of the MediaFLO system did not note signals stronger than -29 dBm. Table 3 is again a hypothetical exercise with no grounding in fact.

Qualcomm's claims of Band 12 device interference were based on their artificially poor device performance assumptions.[71] If, however, Qualcomm's faulty assumptions were replaced with realistic commercial device performance as validated in the Test Report laboratory testing, no interference would result to Band 12 device operation.[72]

ii. Lower E Intermodulation

Qualcomm's second claim of Lower E Block interference was from intermodulation of the Lower E Block signal with the device transmission, mixing within the receiver Low Noise Amplifier ("LNA") to produce intermodulation products which might land on the device receive frequencies.[73] The following technical flaws were evident in Qualcomm's analysis:

(1) Once again, Qualcomm did not measure actual components or devices to determine their performance.

(2) Qualcomm performed simulations using an internally-developed Qualcomm tool to estimate intermodulation in the device low-noise amplifier.[74] Qualcomm did not provide the simulation inputs or methodology such that a third party could independently validate the simulation results.

(3) Qualcomm did not list the linearity assumed for the LNA. A properly designed 700 MHz device would use an LNA with sufficient linearity to avoid any such intermodulation interference, as evidenced by the Test Report results.

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[70] *See*, Test Report, Figure 4.2.
[71] *See*, Qualcomm Comments, pp. 11-18.
[72] *See*, Test Report, Figure 4.2. Substituting the actual device receiver selectivity into the Qualcomm Tables 2 and 3 would show no interference to Band 12 devices.
[73] *See*, Qualcomm Comments, p. 19: "In some cases intermodulation interference can be the result of an intermodulation product created by one out-of-band signal and a consumer device's own transmit signal. In these cases the two signals form intermodulation products in a device's processing or receiver components (e.g. transistors or mixers) that are non-linear (meaning that the output of these components is not linearly proportional to their input). These two signals produce an intermodulation product due to the receiver's nonlinearities. This intermodulation product is spread in frequency and can fall into the device's designated receive channel. This in-channel intermodulation product reduces the sensitivity of the consumer device, potentially causing dropped calls, degraded service, and lost capacity."
[74] Id., p. 22.

(4) Qualcomm failed to provide evidence to support their interference claims. The limited analysis in Qualcomm's comments was based on hypothetical device assumptions which lacked justification or rational linkage to actual device performance. Qualcomm provided no data-driven evidence that the Lower E Block would cause interference to Band 12 devices.

iii. Qualcomm failed to test 700 MHz equipment and relied on a PCS power amplifier.

The interference mechanism for Channel 51 is reverse PA intermodulation. Qualcomm, a company clearly capable of acquiring proper components for testing, provided measurements purported to be Channel 51 reverse PA IM interference, but noted that the power amplifier tested was **a 1900 MHz power amplifier, not a 700 MHz one.**[75]

The level of IM interference generated within a PA depends on the linearity of the PA. Since 700 MHz power amplifiers are readily available in the marketplace, Qualcomm's decision to test a component from a different spectrum band (1900 MHz) is illogical. Such a component may have significantly worse intermodulation performance than commercially available 700 MHz power amplifiers.

Qualcomm then used theoretical propagation models to suggest that DTV signals at ground level may be greater than -20 dBm over large geographic areas. This signal level was the point at which the 1900 MHz power amplifier began to generate intermodulation levels above the noise floor of a typical device receiver.

Together this leads to numerous, significant technical flaws in Qualcomm's Channel 51 interference claims:

(1) Qualcomm did not perform testing of 700 MHz components or devices.

(2) Qualcomm tested a 1900 MHz power amplifier with unspecified third-order intermodulation response characteristics, potentially much worse than commercial 700 MHz components.

(3) Qualcomm did not document the test procedures or the test configuration used in measuring the 1900 MHz intermodulation interference such that a third party could validate the accuracy of their claims. For instance, the interference impact Qualcomm noted may have been caused by a testing artifact such as out-of-band emissions from the DTV test signal, instead of

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[75] Id., p. 37: "Qualcomm performed its measurements on equipment available to it at the time of the tests, using a Band 1 power amplifier with three gain modes, operating within 24 MHz of a DTV transmission. For the TV signal, Qualcomm used DTV waveform at 1954 MHz. For the user equipment transmission, Qualcomm used UMTS waveform at 1930 MHz. Qualcomm [sic] a Triquint TQM776011 UE power amplifier with 3 gain modes."

intermodulation interference. Such a test setup error would invalidate their results.

(4) Qualcomm appears to have tested the power amplifier in isolation rather than as part of an integrated device, calling into question the validity of the results. Other components in a 700 MHz device may improve receiver protection beyond what is provided by the power amplifier response.

(5) Qualcomm does not appear to have considered the 700 MHz antenna gain which would tend to further reduce the Channel 51 signal strength at the power amplifier (gain is typically less than 0 dBi, with a potential further derate from a polarization mismatch).

(6) Qualcomm did not perform field measurements of commercial Channel 51 broadcast transmissions to substantiate their claims of wide-reaching intermodulation interference.

(7) Qualcomm relied upon theoretical propagation models to suggest that Channel 51 signals may be strong over a wide area, but the information provided suggests that the Qualcomm coverage prediction used a mobile antenna height of 10 meters, significantly higher than a typical device at street level.[76] Such a prediction would greatly over-state Channel 51 coverage.

(8) Qualcomm failed to consider that the locations where Channel 51 might be strong would typically enjoy line-of-sight visibility to an LTE base station, increasing the LTE signal level and negating any hypothetical impacts from Channel 51 intermodulation interference.

c. Commenters have provided substantial quantitative evidence supporting the technical feasibility of transitioning all Lower 700 MHz paired-spectrum operations from Band 17 to Band 12.

In stark contrast to the unsubstantiated and fundamentally flawed technical analyses put forward by AT&T and Qualcomm, A Block licensees, including C Spire Wireless have placed substantial quantitative data into the record of this proceeding – all of which supports the technological feasibility of transitioning Lower 700 MHz paired-spectrum operations from the extraneous Band 17 to the inclusive Band 12.[77]

CONCLUSION

As shown above, the record in this proceeding lacks any policy or technical reason that would prevent interoperability. Interoperability opponents base their

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[76] Id., p. 45.

[77] *See generally,* Test Report and V-COMM Study.

opposition on either a misunderstanding of the relief sought in the cases of TIA and RIM, or a technically-flawed analysis that evidences a complete inability to provide legitimate data in opposition to Lower 700 MHz interoperability in the cases of AT&T and Qualcomm.

By contrast, the record in this proceeding (and its predecessor) is replete with examples of the damage caused by the current lack of interoperability in the Lower 700 MHz spectrum band. Furthermore, interoperability proponents are the only commenters in this proceeding to offer relevant, real-world data on the question of 700 MHz interoperability – data that disproves every theoretical objection lodged by the interoperability opponents.

The solution to the Lower 700 MHz interoperability problem is to require that all devices operating in the Lower 700 MHz spectrum must be capable of operating across all paired spectrum in this band. It is the solution that would have been implemented had this problem been foreseen prior to Auction 73, and it should not be disregarded now simply because some actors have successfully fragmented the Lower 700 MHz spectrum and crippled competitors' ability to use Lower 700 MHz spectrum to deliver LTE service in their operating areas.

It is time for the Commission to act on this issue and require interoperability in the Lower 700 MHz paired spectrum through the use of an existing, inclusive LTE Band: Band 12. The transition to Band 12 should begin no later than January 1, 2013 and should be completed no later than January 1, 2014. With this solution, the Commission can begin to restore competition and allow the public to have access to portions of their wireless spectrum that they have been prevented from using.

Respectfully submitted,

/s/ Eric Graham___________
Eric B. Graham
Senior Vice President, Strategic Relations
Cellular South, Inc.
1018 Highland Colony Parkway
Suite 300
Ridgeland, MS 39157

/s/ Ben Moncrief__________
Benjamin M. Moncrief
Director, Government Relations
Cellular South, Inc.
1018 Highland Colony Parkway
Suite 300
Ridgeland, MS 39157

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