Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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

To: The Federal Communications Commission

COMMENTS OF RESEARCH IN MOTION CORPORATION

Clint Robinson
Vice President, Government Relations

Research In Motion Corporation
1050 K Street N.W.
10th Floor, Suite 1000
Washington, D.C. 20001
202.942.0310

January 25, 2013

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EXECUTIVE SUMMARY

Mobile broadband networks have emerged as one of the primary economic engines of our time, and Congress and the Administration have recognized that more spectrum means better, more innovative wireless services for consumers, more jobs, and a stronger economy. The Commission's groundbreaking spectrum policy, which uses market forces to repurpose valuable spectrum, will see the launch of the world's first incentive auctions – an important component of the Commission's unprecedented efforts to make additional spectrum available for broadband. RIM thanks the Commission for this opportunity to play a constructive role as the Commission paves the way in conducting this historic auction and applauds the Commission for meeting the growing demand for wireless services in an innovative way that will be a win for all.

U.S. mobile data traffic grew at almost 300% last year and is projected to grow an additional 16-fold by 2016 – driven by 4G LTE smartphones and tablets.[1] This skyrocketing use of our wireless networks presents one of our greatest challenges as demands on spectrum increase dramatically. As a result, the Federal Government is engaged in efforts to repurpose federal spectrum, revise existing FCC rules to improve allocations, and relocate some commercial blocks. However, more spectrum is needed to further enable innovation, fuel growth of new networks, and continue to foster wireless as a significant driver for economic growth.

In its 2010 National Broadband Plan, the Commission highlighted the importance of wireless spectrum and proposed these incentive auctions as one means of facilitating the economically beneficial reallocation of spectrum.[2] Congress agreed and in passing the Middle Class Tax Relief and Job Creation Act of 2012, authorized the Commission to conduct the incentive auctions.[3] The Commission's bold and innovative approach will see spectrum shifted to its highest use. RIM is proud to continue its support for this revolutionary approach to freeing up additional spectrum to meet the demands of the wireless industry and consumers.

RIM is pleased to see that the Commission plans to keep a firm focus on engineering and economics as it moves forward in implementing Congress's directives through a fact-based, data-driven proceeding.[4] We believe that the Commission's efforts to draw on both public and private expertise by engaging all stakeholders and addressing concerns in a timely manner will facilitate access to and innovative uses of the new 600 MHz band without delay.

In its response, RIM has focused on those matters in which we have long had expertise and that impact handset design, operation, and availability. Accordingly, our comments concentrate on advocating for larger blocks and global harmonization while seeking solutions that would obviate an interoperability mandate. RIM supports an auction design that would facilitate larger contiguous blocks, as in our view bandwidth in excess of 5 MHz uplink and 5 MHz downlink is essential in providing the expected levels of service for mobile broadband today. RIM believes that FDD is the most appropriate way to use this band and we support the 5 MHz building blocks for the Commission's band plan. Furthermore, RIM believes that appropriate interoperability can be achieved by developing a band plan which addresses the

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[1] Statement of FCC Chairman Julius Genachowski, September 28, 2012, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-12-118A3.pdf.

[2] Federal Communications Commission, CONNECTING AMERICA: THE NATIONAL BROADBAND PLAN, released Mar. 16, 2010, *available at* http://www.broadband.gov/plan/.

[3] Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, §§6401-6414, 125 Stat. 156 (2012).

[4] Statement of FCC Chairman Julius Genachowski.

technical handset challenges raised in this proceeding, and by anticipating a design that will foster global harmonization. There are countless benefits to global harmonization, including reduced cost and increased availability of handsets for the consumer. In our submission, we support designating specific uplink and downlink channels to particular frequencies to improve the operation of the mobile device. While we support starting at 698 MHz for the uplink, we highlight that starting the downlink below channel 37 could impact the potential for global harmonization in the future.

RIM is happy to serve as a resource as the Commission and the Incentive Auction Task Force move forward with this important effort.

I. INTRODUCTION

Research In Motion Corporation ("RIM") respectfully submits these initial comments in response to the Notice of Proposed Rulemaking ("NPRM") issued by the Federal Communications Commission ("Commission") seeking comments on expanding the economic and innovation opportunities of spectrum through incentive auctions.

RIM, a global leader in wireless innovation, introduced the BlackBerry® solution in 1999. The BlackBerry product line includes the BlackBerry® PlayBook™ tablet, the award-winning BlackBerry smartphone, software for businesses and consumers, and accessories. Through the development of integrated hardware, software, and services that support multiple wireless network standards, RIM provides platforms and solutions for seamless access to time-sensitive information including email, phone, SMS messaging, Internet and intranet-based applications. BlackBerry products and services are used by millions of customers around the world to stay connected to the people and information that matter most throughout their day. As a manufacturer designing products that operate on multiple frequency bands for hundreds of wireless networks across the globe, RIM has technical expertise to share from a user device perspective regarding the issues raised in this proceeding.

RIM strongly believes that making additional spectrum available for mobile broadband is critical to meeting the needs, demands, and expectations of today's mobile society. The Commission's visionary policy, which will harness market forces to repurpose valuable spectrum, will ensure the future growth of the wireless ecosystem and foster innovative offerings and services for consumers. RIM supports the Commission's unprecedented efforts in this space and appreciates the opportunity to serve as a resource.

The following is our response to certain questions raised by the Commission in this NPRM that impact handset design, operation, and availability.

II. 600 MHZ BAND PLAN AND SPECTRUM BLOCK SIZE

A. THE USE OF 5 MHZ BLOCKS WILL MAXIMIZE UTILITY AND ALLOW FOR EFFICIENT USE OF THE 600 MHZ BAND

RIM agrees with the Commission's establishment of a 600 MHz band plan approach using 5 MHz blocks.[5] A uniform plan with 5 MHz as the basic building block fits well with commercial standards such as LTE. The choice of 5 MHz blocks also fits well with the LTE operations in the adjacent 700 MHz channels. The standards support the aggregation of 5 MHz blocks into larger groupings if so chosen by the network operator. Thus, the use of 5 MHz blocks provides the best configuration for using the spectrum in the most efficient manner in accordance with the Commission's objectives[6] while permitting migration to foster future broadband services through aggregation.

B. LICENSING THE SPECTRUM IN 5 MHZ BLOCKS WILL ALLOW FOR THE GREATEST FLEXIBILITY AND EFFICIENCY

While RIM recognizes that licensing the 600 MHz spectrum in 6 MHz blocks could present some advantages as noted by the Commission,[7] this approach could also lead to inefficiency. Commercial mobile systems, such as LTE, are designed for 5 MHz blocks; thus, using 6 MHz blocks may lead to inefficient use of the spectrum as each 6 MHz block would typically only accommodate one active 5 MHz LTE channel. The incorporation of the leftovers of the 6 MHz channels into additional mobile channels and the guard bands after arrangement into 5 MHz blocks seems the most efficient method to resolve the problem created by the spacing between the 5 and 6 MHz plan raster. The use of 5 MHz blocks that can be aggregated into larger blocks will ensure the most efficient use of the spectrum as proposed by the Commission[8] and provide for effective guard bands and protection of broadcasting and other services.

C. THE AUCTION DESIGN SHOULD FACILITATE AGGREGATION OF CONTIGUOUS 5 MHZ BUILDING BLOCKS

[5] NPRM ¶ 126.
[6] NPRM ¶ 127.
[7] NPRM ¶ 129.
[8] NPRM ¶ 128.

RIM supports the Commission's efforts to look at options for an auction design that facilitates the aggregation of larger contiguous blocks composed of multiple 5 MHz building blocks.[9] In our view, bandwidth in excess of a 5 MHz uplink and a 5 MHz downlink will be essential, in many circumstances, to provide the expected levels of service in today's increasingly mobile society. Contiguous aggregation of blocks is also necessary to ensure compatibility with present and future service developments requiring wider bandwidth channels. Furthermore, wider blocks handle traffic more efficiently than the minimum bandwidths and new spectrum should be designed to meet growing demand in the most efficient way possible. Although commercial standards specifications include options for aggregation of separated assignments, such aggregation is very difficult to achieve technically and the preference is for a contiguous spectrum assignment for aggregation. Aggregated usage of discontinuous channels is particularly difficult if the band plan families contain powerful television transmissions or other services in the intervening blocks. Thus, an option that facilitates contiguous aggregation is best for today's dynamic mobile society.

D. BEGINNING THE DOWNLINK BAND AT 608 MHZ WILL IMPACT HARMONIZATION AND HANDSET DESIGN

RIM supports the Commission's plan to have the uplink band begin at channel 51 and expand downward.[10] This will provide for the best compatibility with the existing 700 MHz band. Starting at channel 51 will also resolve one of the interference challenges – removing the high power television transmitters from the channel – in the lower 700 MHz band.[11] Beginning the downlink band at 608 MHz will have two important impacts. First, starting at 608 MHz and moving downward could have the unintended consequence of preventing much of the rest of the world from using the resulting band plan. In evaluating the impact this will have, there is a need to consider the timing and the likelihood that frequencies below 600 MHz would be available outside of the U.S. International harmonization would allow the telecommunications industry to leverage the Commission's early leadership in this historic

[9] NPRM ¶ 130.
[10] NPRM ¶ 126.
[11] *See* Comments of Research In Motion Corporation, WT Docket No. 12-69 (filed June 1, 2012) at 14.

initiative. Harmonization would also provide enormous benefits to consumers in terms of reducing costs and increasing the availability of services. Second, beginning the downlink at 608 MHz will create a very large duplex separation (90 MHz) that will have an impact on antenna design. This separation is well above the approximately 10% bandwidth capability of the practical electrically small antennas that will fit into handsets for this band. This configuration may be accommodated in the handset by utilizing an antenna that has two feeds to match to the uplink and downlink parts of the band. Since it is unlikely that any band plan will be able to get below a 10% duplex separation we only note this as one factor that will influence the complexity within a handset.

III. BLOCK CONFIGURATION

A. UNIFORM DOWNLINK ASSIGNMENT NATIONALLY

RIM supports the Commission's proposal for a uniform amount of downlink spectrum with no in-band television stations as a way of avoiding interference between television and wireless services.[12] We also support licensing different amounts of wireless spectrum in different areas as long as it does not preclude interoperable handsets.

B. PAIRED SPECTRUM BANDS WOULD ALLOW FOR THE MOST EFFICIENT DEPLOYMENT OF SERVICES

RIM agrees with the Commission that the pairing of spectrum assignments within the 600 MHz band is an important objective for the efficient deployment of services.[13] The existing commercial standards are designed for paired spectrum operation. The pairing need not always require equal uplink and downlink allotments. Established operators have the opportunity to utilize asymmetric downlink channels with some of their spectrum assignments outside the 600 MHz band. Although the commercial standards include TDD options, the long range (wide area) coverage of the 600 MHz band is most suited to FDD operation due to the excessive propagation delays for channel turnaround encountered in TDD systems at these ranges. Since FDD operation is the most suitable and is generally operated on paired spectrum bands, paired spectrum assignments would allow for the most efficient deployment of services.

[12] NPRM ¶ 131.
[13] NPRM ¶ 132.

C. UPLINK AND DOWNLINK BLOCKS SHOULD NOT BE AUCTIONED SEPARATELY

RIM has no objection to offering additional blocks for FDD expansion as proposed by the Commission.[14] However, RIM does not recommend the auction and license of uplink and downlink blocks separately. The separation could lead to spectrum assignments for which it would be very difficult to provide handsets that could accommodate all combinations. It would also be operationally difficult for mobile devices to determine which separate combination of uplinks and downlinks is in operation at each location.

D. THERE IS AN ASYMMETRY IN THE RATIO OF DOWNLINK TO UPLINK THAT IS EXPECTED TO CONTINUE

RIM's analysis of traffic flows in its North American smartphone network in response to the Commission's request[15] indicates an asymmetry in the ratio of downlink to uplink. This asymmetry is expected to continue with a majority of downlink traffic. Thus, it seems appropriate to enable the provision of excess downlink blocks. While the increasing penetration of smartphones, tablets, and machine-to-machine systems is expected to increase the proportion of user created traffic, and hence maintain a healthy amount of uplink traffic, the overall asymmetry will continue.

E. DESIGNATING SPECIFIC FREQUENCIES FOR DOWNLINK AND UPLINK WILL PROVIDE SIGNIFICANT BENEFITS

RIM agrees with the Commission's proposal to designate specific frequencies for downlink and uplink.[16] Nationally designated downlink frequencies will be of significant benefit to mobile device design and operations. Designating specific downlink and uplink to particular frequencies is necessary to enable practical mobile devices to quickly locate network signals and operate throughout the band assignments. Without specific downlink assignments, mobile devices must search through a wide range of frequencies to find services. This is a significant drain on battery life. Moreover, specific frequency designation is also especially important for compatibility with adjacent channel services such as Broadcast, Medical Telemetry, and Radio Astronomy Services. These other services need to have a

[14] NPRM ¶ 133.
[15] NPRM ¶ 134.
[16] NPRM ¶ 135.

designated and stable environment of adjacent channel usage to permit their equipment design and manage interference issues. RIM agrees with starting the uplink blocks at 698 MHz; however, the proposed downlink frequencies could prove difficult for global harmonization in the future.[17]

IV. BAND PLAN FAMILIES

A. THE IMPLEMENTATION OF DIFFERENTIAL RECEIVE FILTERING IS MORE PRACTICAL IN THE BASE STATION THAN IN THE MOBILE DEVICE

RIM agrees with the Commission's premise that implementation of specific channel filtering is more practical in the base station than in the mobile device.[18] An individual deployed base station only operates in a specific fixed environment with a subset of channels. The base station's receive filters may be implemented for each base station frequency configuration. Furthermore the base station's receive antenna patterns may be configured to minimize interference from nearby television transmissions. Mobile devices however, because of their mobility and usage, must accommodate any channel in the band and may be physically located near powerful television stations. There is significant benefit to the size and cost of mobile devices if the downlink signals are confined to a specific channel set segregated from television transmissions and thus can be accommodated with a single filter configuration for all channel families.

B. EXTENDED FAMILIES COULD REQUIRE SEVERAL DIFFERENT FILTERS TO ENSURE INTEROPERABILITY WITH THE FULL FAMILY

RIM concurs with the Commission's interoperability concerns about extended families.[19] Our experience building mobile devices indicates that practical filter bandwidths should be less than approximately 4% of the center frequency. Families of band plans that exceed this guideline will require multiple filter sets (and associated switches) to accommodate the whole family. It is thus to be expected that different amounts of cleared spectrum, and consequently different members of the family which exceed the 4% guideline, will require two or three overlapping filters for implementation in mobile devices to assure their interoperability with the full family of band plans. Furthermore, due to the

[17] *See* Comments of Research In Motion Corporation, WT Docket No. 12-268 (filed Jan. 25, 2013) at 7.
[18] NPRM ¶ 138.
[19] NPRM ¶ 143.

approximately 10% bandwidth limit of the electrically small antennas that are practical for mobile devices, additional antenna feeds and structures may be required to cover the extended family of band plans, which in turn has significant effects on handset design and, effectively, consumer choice.

V. TECHNICAL CONSIDERATIONS

A. GUARD BANDS SHOULD CORRESPOND TO THE POWER OF TELEVISION BROADCAST SIGNALS TO PREVENT HARMFUL INTERFERENCE

The Commission has recognized that the protection of mobile downlink channels from television broadcast signals is a difficult technical challenge due to the very high power of television broadcast transmitters[20] and the likelihood that mobile devices may operate close to the television transmitter site. As a consequence of their mobility, these devices are likely to be operated in close proximity to a television transmitter. In such cases the mobile receiver must reject the strong television signals operating on a nearby channel in order to receive a weaker signal from the network base station.

RIM recommends that mobile services be separated from television broadcast stations operating below 100 KW by at least 6 MHz and that stations operating above 100 KW be separated by at least 12 MHz. In its analysis, RIM notes that a 100 KW transmitter will have a signal strength of about -40 dBm at a 3 mi distance from the transmitter (Hata/COST231 L50 urban propagation model for nominal 5 MHz bandwidth and 985 ft television antenna height, 6.5 ft mobile height). A 1 MW transmitter would have a signal strength that is correspondingly 10 dB higher. Current mobile equipment have an adjacent channel blocking specification at a level of -44 dBm separated from the desired receive signal by 5 MHz and -30 dBm separated by 10 MHz (see 3GPP reference[21]). Practical equipment performs somewhat better than the specification numbers. This indicates that a 6 MHz separation from television transmitters under 100 KW and 12 MHz separation for those over 100 KW should be sufficient to protect mobile services in urban areas that are separated from the television transmitter location by 3 mi or more. However, a 3 mi exclusion zone for the television transmitter may represent a significant loss of coverage if the

[20] NPRM ¶ 158.

[21] *See Adjacent Channel Blocking*, 3GPP, TS36.101, v11.2.0, tbl.7.6.1.1-2, September 2012 (Case 2 "second adjacent channel" -44 dBm and Case 3 "third adjacent channel" -30 dBm for 5 MHz LTE channels).

transmitters are located in sizable urban or suburban concentrations and additional separation or other mitigation measures may be required.

B. MULTIPLE BANDS DECREASE THE POTENTIAL FOR INTEROPERABILITY AND HARMONIZATION

RIM agrees with the Commission's analysis regarding the relationship between separate bands and handset complexity.[22] Each band plan in the family may require an appropriate set of filters and switches in the mobile device. This additional complexity impacts both handset interoperability and performance. The band plan family within the 600 MHz band that can be incorporated into a mobile device is heavily dependent on what other bands and features are required for that device by the market.[23] Each additional 600 MHz band plan included in the device therefore decreases the possibility of operation across the full suite of bands. Furthermore, each filter and associated switch consumes space and power and also degrades the receiver or transmitter performance and associated battery life of the mobile devices due to increased insertion losses. RIM strongly urges the Commission to develop a homogeneous 600 MHz band plan that minimizes these possible outcomes.

RIM has further concerns that a complex band may not allow for harmonization with other countries that could eventually decide to open up the 600 MHz band. This will create a new interoperability problem and limit the industry's and consumers' ability to benefit from harmonization.

C. THE COMMISSION SHOULD NOT ADOPT A SPECIFIC INTEROPERABILITY RULE

RIM agrees with the goal of enabling interoperability wherever possible for the reasons highlighted by the Commission. RIM does not, however, support promoting interoperability by adopting rules for interoperability. As we noted in our comments to the Commission in its earlier proceeding on interoperability,[24] mandating interoperability is not the right solution. We noted that mandating

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[22] NPRM ¶ 161.

[23] For example, typical handsets in today's market already include operation in bands at 700, 800, 850, 900, 1800, 1900 MHz as well as NFC (13.56 MHz), Bluetooth (2.4 GHz), WiFi (2.4 GHz and 5 GHz) and GPS. While the bill of materials (BOM) cost for the handset components for each band is not large individually, the cost for space/volume and compatibility/certification testing for each new band plan and its associated antennas is significant.

[24] *See* Comments of Research In Motion Corporation, WT Docket No. 12-69, at 7-13 (filed June 1, 2012).

interoperability would significantly increase the technical challenges of handset design, could lead to higher consumer prices, limit handset functionality and interoperability with other bands, and would not be sustainable. The Commission should use its authority to reduce the technical regulatory barriers, such as a fragmented 600 MHz band plan, that would make it difficult to produce interoperable mobile devices. Creating a complex band plan that by its design requires interoperability mandate rules would not be the most efficient path forward. Instead, it might be helpful to reevaluate the circumstances that are driving multiple band plans and consider how to formulate a less complex band plan.

For example one requirement for multiple band plans is the expected geographic disparity in cleared spectrum. Developing complicated band plans that take into account spectrum that may only be available in places where the spectrum demand is much lower (for both television and mobile broadband) will be at odds with developing an interoperable plan. RIM recommends that there be a balance between making small gains in additional spectrum and creating a sustainable band plan(s).

D. A COMMON DOWNLINK SPECTRUM NATIONWIDE WILL MINIMIZE COST AND PROMOTE INTEROPERABILITY

RIM agrees with the Commission that ensuring a common downlink spectrum nationwide across all of the family members will minimize the space and power requirement for downlink filters in mobile devices and help ensure interoperability across the band.[25] A common pairing of downlink and uplink channels is also required, although there may be an excess of bandwidth in the downlink. As noted earlier herein, the downlink filters for this band in the mobile devices are generally limited to about 4% bandwidth and multiple overlapping filters may be required if a wider downlink band is cleared. In the uplink the mobile device's transmitter emissions are generally set by industry standards.[26] These standards also include a network signaling capability for locations where additional suppression of transmitter emissions is required. Such a common band for the downlink will also enable mobile devices to better recognize the availability of services in the band.

E. THE DUPLEX GAP SHOULD BE GREATER THAN 2%

[25] NPRM ¶ 163.

[26] *See Output RF Spectrum Emissions*, 3GPP, TS36.101, v11.2.0, § 6.6, September 2012.

The Commission recognizes the range in duplex gaps for different bands[27]; in some deployments of mobile systems the duplex gap is as low as 1%. While operation with a 1% gap is possible, RIM's experience is that a wider gap is preferable as it minimizes the losses in the associated duplex filters used in mobile devices. For the 600 MHz band the sharp cut off filters needed to achieve the 1% gap incur excessive pass band loss and may be temperature sensitive. Such pass band losses reduce the receiver sensitivity and waste the transmitter power. Practical operation is to be preferred with a duplex gap greater than 2% in the 600 MHz frequency band.

F. 4% OF THE PASS BAND FREQUENCY IS A PRACTICAL LIMIT THOUGH THERE ARE ADDITIONAL CONSTRAINTS THAT SHOULD BE CONSIDERED

As the Commission has recognized there are technical limits on pass bands[28] and RIM's experience is that approximately 4% of bandwidth is a practical limit for pass band filters in mobile devices in this frequency range. In addition to pass band filters, there are important additional constraints due to the practicalities of antennas. In the 600 MHz band the wavelength is about 440 mm. Current mobile devices have a major dimension of about 110 mm, thus the best antenna that can be included inside a device is less than ¼ of the wavelength. Such electrically small antennas have very low efficiency (<30%) and a limited bandwidth (10%). RIM notes that with the objective of making possible a total in excess of 60 MHz available in the 600 MHz band means that any band plan will exceed the 10% bandwidth limit of simple electrically small antennas. The proposed 600 MHz configuration with downlink below channel 37 and the uplink below channel 51 with a 90 MHz duplex separation can be supported with antenna configurations in the mobile devices with separate tuning and matching for the uplink and downlink. For mobile devices, the practicalities of antennas are an equally important constraint as filter pass band limitations.

VI. CONCLUSION

The incentive auctions are a groundbreaking process for making more spectrum available for wireless mobile broadband and the Commission's laudable efforts to draw on both public and private

[27] NPRM ¶ 167.
[28] NPRM ¶ 170.

expertise by engaging all stakeholders and addressing concerns in a timely manner will facilitate access to and innovative uses of the new 600 MHz band without delay.

Respectfully submitted,

Clint Robinson
Vice President, Government Relations

Research In Motion Corporation
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10th Floor, Suite 1000
Washington, D.C. 20001
202.942.0310

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