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Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
Fostering Innovation and Investment in the) GN Docket No. 09-157
Wireless Communications Market)
A National Broadband Plan For Our Future) GN Docket No. 09-51

NOTICE OF INQUIRY

Adopted: August 27, 2009

Released: August 27, 2009

Comment Date: September 28, 2009

Reply Comment Date: October 12, 2009

By the Commission: Chairman Genachowski and Commissioners Copps, McDowell, Clyburn and Baker issuing separate statements.

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I. INTRODUCTION

1. Wireless communications is one of the most important sectors of our economy and one that touches the lives of nearly all Americans. In this Notice of Inquiry (*NOI*), we seek to understand better the factors that encourage innovation and investment in wireless and to identify concrete steps the Commission can take to support and encourage further innovation and investment in this area.

2. Innovation – the pragmatic application of new ideas to productive ends – has been at the heart of the extraordinary economic growth of the 20th Century. Since 1929, average, inflation adjusted per capita personal income in the United States has grown more than five-fold.¹ In particular, the last century was marked by great innovation in communications that were embraced by a wide range of actors including technologists, businesses, government, and, of course, American consumers. This innovation encompassed not only invention of new *things*, but discovery of new *ways of doing things*.

3. In the wireless marketplace, the pace of change over the past decades has been extraordinarily rapid and has delivered new and empowering technologies to American consumers. During this period, Commission policies in the wireless sector – such as spectrum auctions, secondary markets, unlicensed access to spectrum, and flexible technical and service rules – have helped to encourage and enable waves of innovation by making available spectrum that is the lifeblood for wireless services and products. Policies that foster continued innovation have helped to encourage capital investment in wireless and to deliver new and empowering technologies and applications to American consumers. In particular, under these policies, the wireless ecosystem has generated new standards for wireless connectivity, such as Wi-Fi and Bluetooth, as well as “smart” handheld devices that power applications and content. We intend to build on the success of these policies as we forge new policies for a 21st century.

4. Toward this goal, we seek to further our understanding of where and how key innovations are happening across the full “value chain” of the wireless market, including spectrum utilization, technologies, business models, and services.² We are interested in learning how the public has used wireless services and technology to find innovative solutions to real-world problems in areas such as health care, energy, education, and public safety. Moreover, we seek to develop a framework for analyzing wireless innovation, including metrics or data sources that we should consider, the role of research and development as the generator of innovation, and the relationship between innovation and investment.

5. To the extent innovation is facilitated by Commission policies, we seek comment on how best we can expand the scope of our successful policies. We also seek comment on whether there are policies and processes that the Commission does not have in place that could promote wireless innovation. In addition, while we recognize the success of certain regulatory policies in promoting innovation, we are aware that Commission policies and processes can also hinder the progress of innovation and investment. At times, we have seen innovators subjected to lengthy regulatory processes – such as debates over what constitutes harmful interference or how to fit a new spectrum use within our framework of rules – that can be an obstacle to progress in the wireless arena. A goal of this inquiry is to initiate a dialogue with stakeholders on how to remove any unnecessary impediments caused by the

¹ P. Gomme and P. Rupert, “Per Capita Income Growth and Disparity in the United States, 1929-2003,” Economic Commentary, Federal Reserve Bank of Cleveland, Aug. 15, 2004, available at: <http://www.clevelandfed.org/Research/commentary/2004/0815.pdf>.

² “Value chain” means the chain of individual, value-creating activities. This chain includes not only those activities performed by wireless communications service providers themselves, but also those performed by all other entities, including providers of inputs and complements to wireless communications services.

Commission's policies and rules.

6. To explore these issues, the *NOI* is structured in groups of questions relating to innovation in various specific areas or aspects of the wireless sector. We emphasize that these specific questions in the *NOI* are not exclusive, and we seek comment broadly on any and all ideas that will foster wireless innovation. To the extent that commenters include recommendations that would require an expansion or reinterpretation of the Commission's statutory authority, we request that they also include a discussion of how best to effectuate those recommendations.

7. We note that this *NOI* may include some areas of inquiry that relate to specific issues currently pending before the Commission in other proceedings. The release of this *NOI* is not intended to preclude us from taking action on such pending issues prior to consideration of the record in this *NOI*. In addition, we encourage parties not to repeat arguments already made on specific issues in other proceedings, but rather to focus their discussions here on broader issues of innovation.³

8. Because the issues raised in this *NOI* may be relevant to the Commission's consideration of the National Broadband Plan in GN Docket No. 09-51,⁴ we issue this *NOI* in the National Broadband Plan docket as well as in a new GN Docket No. 09-157. Accordingly, submissions in response to this *NOI* should be filed in both dockets,⁵ and we intend to consider comments on this *NOI*, as appropriate, in developing the National Broadband Plan.

9. We also note that the release today of an *NOI* seeking comment on mobile wireless competition serves as a counterpart to this *NOI* on innovation and investment.⁶ Because competition itself has been a driver of innovation in wireless service, determinations of the most effective comprehensive strategy to encouraging wireless innovation and deployment will necessarily look in part to the state of competition in the wireless market.

II. DISCUSSION

A. Understanding Wireless Innovation and Investment

10. Before seeking comment on innovation in a number of specific areas of wireless communications, we seek comment on certain questions to help us understand the state of both innovation and investment in wireless communications and the Commission's role in promoting them more generally. First, we seek comment on what metrics are most appropriate to evaluate innovation and investment in the wireless sector. Are there existing data sources or publications we should consult? Are there conferences or industry meetings that the Commission should participate in? Which theoretical and empirical models and studies should inform our understanding of innovation and investment in wireless? How should we consider whether the wireless market in the U.S. is more or less innovative than in other countries?

³ We request that, to the extent commenters wish to submit arguments that are substantially similar to materials filed elsewhere, they provide us with a reference to the specific arguments in their pleadings in the relevant docket, rather than re-filing those comments in this proceeding.

⁴ The American Recovery and Reinvestment Act of 2009 (Recovery Act) was signed into law on February 17, 2009. The Recovery Act authorizes the Commission to develop a National Broadband Plan to ensure that all people of the United States have access to broadband capability. See A National Broadband Plan for Our Future, GN Docket No. 09-51, *Notice of Inquiry*, FCC 09-31 (rel Apr. 8, 2009).

⁵ See, *supra*, Section IV.C, "Comment Filing Procedures" ("All filings related to this Notice of Inquiry should refer to GN Docket No. 09-157 and GN Docket No. 09-51.").

⁶ See Annual Report on Competition in the Mobile Wireless Markets, WT Docket No. 09-66, *Notice of Inquiry* (rel. Aug. 27, 2009).

11. We further seek comment broadly on the Commission's role in supporting and encouraging innovation and investment. For example, we seek comment on the most significant obstacles and deterrents to wireless innovation and investment, and what the Commission can do to reduce or eliminate them. We are particularly interested in how our rules or policies may have lagged behind important developments in the wireless industry and might be amended to better accommodate such developments without impairing the Commission's purposes. Similarly, we are interested in what elements of our rules and policies have been successful in stimulating and promoting innovation and investment. Moreover, we seek comment on the impact of regulatory certainty and regulatory flexibility on innovation and investment, and how the Commission should consider those impacts in crafting regulations.

12. We also seek comment on the most important high-level trends driving innovation and investment throughout the wireless ecosystem. In particular, how has the development of Fourth Generation (4G) technology shaped the nature and rate of wireless innovation and investment? Are there innovations in chipsets, antennas, batteries, or other physical components of the wireless ecosystem that promise to drive wireless innovation more generally? To what extent is spectrum use by unlicensed devices playing a role in encouraging or facilitating innovations in wireless devices or networks?⁷ Are there any important trends regarding spectrum use of which we should be aware?

13. We further seek comment on how we should think about or measure the relationship between innovation in wireless and investment, economic growth, and job creation. Are there important trends in considering this relationship? Are there any data that demonstrate measurable correlations?

14. In addition, we seek comment on research and development (R&D) as a generator of investment. Does spending on R&D provide a predictable response in terms of new ideas? What benefits are likely to result from basic R&D and from research targeted to specific product development? Are there particularly successful models of wireless R&D in other countries, and if so, what contributes to their success? We seek comment on these concepts and any others that will further our understanding of wireless innovation.

B. Innovative Uses of Wireless Services

15. We seek comment on how wireless services are being used in innovative ways to solve problems and provide consumer benefit in both the private and public sectors. These innovations are the product of creative efforts by consumers, businesses, and public entities to use the growing range and capability of communications tools available to them to solve important real-world problems. We seek to understand this aspect of wireless innovation, to learn more regarding how wireless communications are being used to provide practical benefits, particularly in instances of broad public benefit, to identify any barriers or deterrents to innovation in the use of wireless services and to take steps where appropriate and necessary to facilitate or accommodate such innovation.

16. For example, we seek comment on innovative uses of wireless to improve the effectiveness, cost, or availability of health care in the nation. We have discussed in other items the dramatic benefits that advanced telecommunications has provided to the health care industry, including improving the capacity for telemedicine, and facilitating the exchange of medical data and opinions through broadband.⁸ We seek comment now on what wireless devices or services are having impact and what we could do to encourage additional growth in this area.

⁷ We seek further comment below regarding the use of unlicensed spectrum. *See, e.g., infra*, Section II.C. 4.

⁸ *See, e.g., Rural Health Care Support Mechanism*, WC Docket No. 02-60, *Report and Order, Order on Reconsideration, and Further Notice of Proposed Rulemaking*, 18 FCC Rcd 24546, 24550 ¶ 6 (2003).

17. We further seek comment on how wireless is being employed in innovative ways to address the challenges of energy conservation, development, production, and management. How are wireless services being used to enable so-called “smart grids” or otherwise help to improve the efficiency or reliability of the nation’s energy grid?

18. We also ask how wireless is being used to improve education. For example, what innovative devices and services have been deployed to students to facilitate their access to information or educational materials, or to enable learning to occur beyond the classroom? Are there steps the Commission could take to foster further innovation in this area?

19. How have new innovative uses of wireless communications improved public safety and homeland security communications? We seek comment, for example, on wireless innovations that have developed in the 800 MHz Band or other spectrum to improve border security. Is there anything the Commission can do to encourage greater innovation?

C. Spectrum Use and Availability

20. The provision of innovative wireless services is critically dependent on having access to spectrum. Further, as wireless is increasingly used as a platform for broadband communications services, the demand for spectrum bandwidth will likely continue to increase significantly, and spectrum availability may become critical to ensuring further innovation and deployment in the wireless sector. Accordingly, in this section, we seek comment on developments that are promoting greater access to spectrum and more efficient and valuable use of spectrum, on the barriers to such developments, and on what role the Commission can play to encourage or promote such developments. In short, what are the most innovative ideas relating to spectrum that the Commission should consider?

1. Current Spectrum Management Practices

21. Current spectrum management practices are the result of an evolutionary process that began even before the establishment of the Commission in 1934. The radio spectrum is divided into separate frequency bands that are each allocated internationally and domestically to various radio services such as TV broadcasting, fixed service, mobile service, satellite, etc. These allocations are shown in the Table of Frequency Allocations, which is, in effect, the master zoning map for how different parts of the spectrum may be used.⁹ Moreover, in the United States the allocations are divided between Federal use and non-Federal use. Each frequency band may be used by multiple services, with each service afforded either primary or secondary interference rights.¹⁰ One way that the Commission has increasingly sought to encourage innovation is by allocating the spectrum flexibly so that it can be used in ways that best meet the needs of the market and the public. For example, rather than allocating a frequency band for either fixed or mobile service, the band may be allocated for both.

22. Within the framework of the Table of Frequency Allocations, the Commission has established rules governing non-Federal access to and use of the spectrum. The rules provide details as to

⁹ The Table of Frequency Allocations (Table) is sub-divided into the United States Table of Frequency Allocations (U.S. Table), which itself consists of Non-Federal Table of Frequency Allocations (non-Federal Table), listing radio frequencies administered by the Commission, and the Federal Table of Frequency Allocations (Federal Table), listing radio frequencies administered by NITA. See 47 C.F.R. § 2.106 (2008).

¹⁰ Stations of a secondary service shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date. Stations of a secondary service also cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or to which frequencies may be assigned at a later date, but may claim protection from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date. See 47 C.F.R. § 2.105(c)(2)(2008).

how the spectrum may be used, how it will be licensed, who is eligible, technical standards, etc. The license provides the right to access and use the spectrum, usually over specific frequencies or frequency bands and at a particular location or geographic area. The Commission has developed a variety of licensing methods consistent with the relevant provisions of the Communications Act. Licensing practices have also evolved in ways to encourage innovation. For example, licenses originally often were granted on a first-come first-served basis and were granted for specific and narrow uses. Today a variety of licensing approaches are used that are often intended to encourage competition among service providers and allow flexibility in the kinds of services that are offered. Notably, many licenses are granted through competitive bidding at auctions,¹¹ in part to enhance the likelihood that the spectrum will be put to its highest-value use. The Commission also shifted away from mandating technical standards other than those designed to control interference or to meet specified public interest objectives (e.g., ensuring the development of hearing aid compatible wireless phones). For example, analog cell phones were originally required to meet a detailed technical protocol. The Commission subsequently adopted more flexible technical rules, which in turn have enabled the introduction of second, third, and fourth generation digital wireless phones, all without the need for further Commission action.

23. Unlicensed devices generally share the spectrum with allocated radio services on a non-interference basis.¹² That is, unlicensed devices may not cause harmful interference to allocated radio services and must accept any interference they receive. The devices must meet technical standards that are designed to minimize the risk of causing harmful interference, such as limitations on the power levels that may be used. Unlicensed devices were originally restricted to very specific applications. For example, rules allowing garage door opener controls restricted the same device from being used to control other sorts of devices, such as light switches. Over the years, the Commission modified the rules for unlicensed devices, including allowing users the flexibility to introduce devices for virtually any type of application. This approach has enabled the introduction and explosive growth of technologies such as Wi-Fi, Bluetooth, security alarm systems, anti-pilferage systems, RFID, keyless entry systems, and the like.

24. The Commission's various spectrum management approaches, as illustrated above, have enabled the introduction of the wide array of products and services consumers and businesses enjoy and rely upon today. For instance, flexible rules and policies have removed previous regulatory impediments that may have hindered the introduction of various innovative products and services in the market, thus stimulating investment in their development. It is our objective to build upon the Commission's policies that have facilitated innovation that has benefited the public, drawing on what has worked well and extending or expanding these policies where appropriate. This will permit us to explore new ideas that may further stimulate investment and innovation that can improve our lives, and to review our current processes that may create unnecessary impediments to such investment and innovation.

2. Making Spectrum Available for New Uses

25. One of the most complex challenges for promoting innovation in the wireless sector is making sufficient spectrum available—both in terms of frequency bands and amount of bandwidth—to support new services and new applications. Thus, we seek, as a general matter, comments regarding the spectrum requirements that are needed to foster innovation in wireless networks and systems. Innovators have to consider the physical properties of different frequency bands (e.g., propagation characteristics) which differ over the range of the radio spectrum. Innovators also need to be cognizant of incumbent technologies and the interference potential that exists with respect to different operations in various bands, as well as the implications of the International Radio Regulations and other international treaty

¹¹ See 47 U.S.C. § 309.

¹² See 47 C.F.R. Part 15 (2008).

obligations.¹³

26. Gaining access to a desirable frequency band is often difficult because in the United States, most of the radio spectrum resource has already been allocated for a wide variety of services for use by both Federal and non-Federal users and put into use by a wide range of users. Thus, we are especially interested in identifying approaches that have been most effective in allowing innovators to gain access to spectrum for new uses. The Commission can, for example, provide flexible spectrum allocations, with flexible rules regarding use of the spectrum, that give incumbents considerable discretion to continue operating existing services or to introduce new services to address changing needs.¹⁴ In other cases, opportunities exist for band sharing among licensees offering different services.¹⁵ Similarly, many frequency bands have allocations for both primary and secondary uses that generally can permit different services to operate in the same bands without causing harmful interference to each other.¹⁶ Finally, spectrum access can be gained by the recognition of “underlays” (permitting certain low-power, low-impact applications to co-exist with existing licensed operations in a given band) and “overlays” (expanded use rights by new users that are subject to the requirement that such use be on a non-interference basis to the operations of existing users). By promoting the use of devices that operate below an acceptable interference level (that is, they operate on a non-interference basis with existing licensees), the Commission has been able to provide new opportunities for shared band use.¹⁷

27. The Commission has taken additional steps to make spectrum with incumbent licensees available for new uses. For example, the Commission has repurposed spectrum by modifying technical and service rules to allow incumbents to provide new services or to free up spectrum for additional licensees or users.¹⁸ The Commission also has reallocated spectrum from one service to another and

¹³ See *International Telecommunication Union Radio Regulations*, Edition of 2008. We note that the United States has many treaties that involve coordination of radio frequency use with other countries, particularly with Canada and Mexico.

¹⁴ Under a flexible allocation model and licensing model, in which the Commission allocates frequency bands for multiple services on a co-primary basis, licensees decide which service to offer on which frequency in their service areas without the Commission having to modify the allocation for the band or re-authorize the licensee. For example, the PCS band is allocated for fixed and mobile services and licensees may deploy mobile systems for providing service to subscribers and fixed systems for backhaul under the same license.

¹⁵ For example, some frequency bands supporting satellite operations also support point-to-point microwave links that can operate at the same time with little potential for interference. As a specific example, the 3700-4200 MHz band is allocated to the fixed and fixed-satellite (space-to-Earth) services on co-primary basis. Sharing on a coordinated basis is possible because the receive earth station antenna is pointing toward the geostationary satellite orbit arc and the large transmit antennas employed by fixed point-to-point microwave stations are directed away from the earth station receive antennas.

¹⁶ In addition, the Commission’s service rules generally establish procedures for determining interference protection rights among stations of co-equal status.

¹⁷ Examples of such use include the deployment of new spectrally efficient technologies, such as ultra wideband, as well as the use of devices that are designed to allow spectrum to be used for more than one user or type of application without causing harmful interference – such as cognitive radios, which are radios that identify and transmit on frequencies not being used by incumbent services at a given location and time.

¹⁸ An example of this approach is the restructuring of service rules for Broadband Radio Service (BRS)/Educational Broadband Service (EBS) at 2500 MHz (*see* Amendment of Parts 1, 21, 73, 74 and 101 of the Commission’s Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands, et al.; WT Docket Nos. 03-66, et al., *Report and Order and Further Notice of Proposed Rulemaking*, 19 FCC Rcd 14165 (2004)).

required incumbent licensees to relocate any continuing operations as necessary to a reduced or modified frequency band.¹⁹ In other cases, the Commission reallocated spectrum from one service to another and relocated incumbents to other bands or media²⁰ Has the Commission's past repurposing of spectrum spurred or resulted in innovation? Which of the Commission's methods for repurposing spectrum have proven most beneficial to fostering innovation? What lessons have we learned from such efforts? We are also interested in exploring which frequency bands present the best opportunities for repurposing spectrum, as well as how repurposing spectrum can best be accomplished. Can innovative uses develop in coordination with the incumbents in relevant bands or is clearing existing uses a prerequisite to innovative developments?

28. Repurposing spectrum is done at some cost, particularly where there are incumbents with investments and infrastructure reflecting the former use of the spectrum. What are these costs and which parties should be responsible for them? Are there auction approaches for affording "new" access to previously licensed spectrum that would also address the cost issues? For example, should incumbents be allowed to offer their spectrum rights at an auction in which the Commission also offers new licenses in the same spectrum band (sometimes referred to as a two-sided auction)? What other approaches to cost-bearing should the Commission adopt when repurposing spectrum for new uses, or otherwise facilitating the entrance of new licensees into spectrum with incumbents, as part of an effort to encourage innovative uses of spectrum? Should incumbents be compensated when their spectrum is repurposed and if so, how would this be accomplished (*e.g.*, who would be responsible for providing compensation, under what terms or conditions, and what form would it take)? Should the Commission provide a transition period during which it would restrict the new licensees to operate only on a secondary, non-interfering basis?

3. Access to Spectrum

29. *Access Models.* In addition to making spectrum available for new services through suitable spectrum allocations and service rules, innovators must have the ability to gain access to that spectrum. We seek comment on whether new developments are changing the way innovators access spectrum either on a licensed or unlicensed basis, and whether new models of spectrum access would further support and encourage innovation in wireless services. Technology is rapidly transforming communications networks and devices so that they perform multiple functions and access multiple frequencies as available. As a result, the traditional association of particular services and applications with specific spectrum bands may become less relevant. Do these technological changes suggest a new spectrum access model that would permit increases in the efficiency of spectrum use? Under any of the Commission's applied access models, are there impediments to innovation or new ways of providing

¹⁹ Examples include the introduction of more spectrally efficient digital technology for television broadcasting (*see, generally*, MB Docket No. 87-268) and broadcasting auxiliary service (BAS) (*see, generally*, ET Docket No. 95-18). A similar approach has been used in the 800 MHz rebanding proceeding, which consolidating public safety operations and "Enhanced Specialized Mobile Radio" (EMSR) services into separate portions of the 800 MHz band to eliminate interference and promote efficient spectrum use. *See Improving Public Safety Communications in the 800 MHz Band*, WT Docket No. 02-55, et al., *Report and Order, Fifth Report and Order, Fourth Memorandum Opinion and Order, and Order*, 19 FCC Rcd 14969 (2004) (adopting an in-band restructuring).

²⁰ For example, Broadband Personal Communications Service (PCS), Mobile Satellite Service, and other Emerging Technologies, displaced fixed service (FS) operations (*see, generally* ET Docket No. 92-9), and Advanced Wireless Service displaced BRS, FS, and Federal Government operations (*see, generally*, ET Docket No. 00-258). In each of these cases, provision was made for the relocation of the displaced services to new spectrum, funded either by the new licensees or, in the case of Federal Government operations, out of proceeds from the auction of the new licenses pursuant to the Commercial Spectrum Enhancement Act (CSEA). *See Implementation of the Commercial Spectrum Enhancement Act and Modernization of the Commission's Competitive Bidding Rules and Procedures*, WT Docket 05-211, *Report and Order*, 21 FCC Rcd 891 (2006).

services that would enhance the efficiency of spectrum use? Are there alternative models that the Commission should consider and over what frequencies should they be applied?

30. Are there particular bands, services, or licensing approaches that serve as good examples of how entities have gained access to spectrum for innovative new uses? For example, the physical characteristics of transmissions in the “70-80-90 GHz” band permitted the use of a streamlined licensing process in the allocation and adopting of service rules for that spectrum,²¹ the recent TV White Spaces proceeding established a means to access locally vacant television broadcast frequencies,²² and our rules for unlicensed operations under Part 15 of the Commission’s Rules afford considerable flexibility to provide service on a non-interference basis. Additionally, are there ways of providing specialized spectrum access – such as grants of Special Temporary Authority (STA) or the development of a spectrum sharing innovation “Test-Bed”²³ – that can serve as useful models for promoting innovation?

31. *Alternative Spectrum Auction Mechanisms.* What auction mechanisms for providing access to spectrum will best support and encourage innovation? Are there innovative developments in methods of acquiring resources for new products or services that might further innovation in wireless services if they are applied to spectrum access? Could, for instance, the lessons of on-line trading mechanisms (e.g., eBay) be instructive with regard to improvements in the Commission’s license auction process? Would innovators be better served if they were able to initiate the auction and licensing process on their own timetable, by filing an application to open a window for competing applications, and would the ability to trigger the process make it easier for the innovator to seek investment financing for any potential auction of mutually exclusive applications? Would regularly scheduled opportunities to seek spectrum licenses help further innovation? For example, the Commission could frequently (i.e., several times per year) announce an inventory of available spectrum licenses (e.g., licenses previously auctioned but unsold), and then proceed to conduct an auction of mutually exclusive applications. Would innovation and investment be promoted if such an inventory were updated in real-time? Are there other changes to the Commission’s traditional auction process or design that would better meet the needs of innovators?

32. *Secondary Markets – Spectrum Leasing and License Transfers/Assignments.* To facilitate access to spectrum through the secondary market, the Commission has developed policies and rules to enable licensees to enter into spectrum leasing arrangements with third parties in need of access to spectrum,²⁴ as well as rules to permit streamlined processing and, where appropriate, immediate approval

²¹ See Allocations and Service Rules for the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands, WT Docket No. 02-146, Report and Order, 18 FCC Rcd 23318 (2003); *Memorandum Opinion and Order*, 20 FCC Rcd 4889 (2005) (permitting licensing without prior coordination due to the “pencil beam” nature of transmissions in the band).

²² See Unlicensed Operation in the TV Broadcast Bands, ET Docket No. 04-186, Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, ET Docket No. 02-380; *Second Report and Order and Memorandum Opinion and Order*, 23 FCC Rcd 16807 (2008) (*TV White Spaces Order*).

²³ In 2006, the Commission and NTIA sought comment on creation of a spectrum “Test-Bed,” which is intended to provide a venue for demonstrating techniques to provide for better sharing between Federal Government (federal) and non-federal radio users. See generally ET Docket No. 06-89 and NTIA Docket No. 060602142-6142-01, 71 FR 33282 (June 8, 2006). On February 5, 2008, each agency designated spectrum and provided guidance for participation in the Test-Bed. See, respectively, “Federal Communications Commission Designates Spectrum and Provides Guidance for Participation in a Spectrum Sharing Innovation Test-Bed,” Public Notice, ET Docket No. 06-89, 23 FCC Rcd 2354 (2008); and NTIA Notice of Solicitation of Participation, Docket No. 080129095-8096-01, 73 FR 6710 (February 5, 2008).

²⁴ Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets, WT Docket No. 00-230, Report and Order and Further Notice of Proposed Rulemaking, 18 FCC Rcd 20604 (2003) (*Secondary Markets First Report and Order*).

procedures for license assignments and transfer of control applications.²⁵ We seek comment on how well the secondary market for spectrum access currently is working. We note that, in other proceedings, parties have asserted that the Commission's secondary market policies do not adequately enable entities that need spectrum to gain access to it.²⁶ Should the Commission take additional steps to facilitate the development of a more robust and efficient secondary market that would increase the availability of unused or unneeded spectrum capacity for prospective users and new wireless technologies?

33. Have innovators been able to launch new deployments and services by using the secondary market for spectrum, either by leasing or license transfer/assignment, and what barriers or impediments exist to such developments or to the efficient operation of secondary markets more generally? Are marketplaces developing that are responsive to the needs of innovators and new entrants that could put more spectrum to use? Are there developments in the secondary markets that need to be encouraged or facilitated, to create additional opportunities?²⁷ For instance, are there additional steps that the Commission should take to remove outdated services rules, or better harmonize services rules in different spectrum bands, in order to promote flexibility and substitutability in the use of spectrum, which in turn could enhance the operation of secondary markets in spectrum usage rights and facilitate the use of spectrum across different bands?²⁸ In particular, we solicit comment on the extent to which secondary market transactions result in the introduction of new and innovative services. We also seek comment on whether there are sufficient incentives for wireless radio service licensees to efficiently use, sell, or lease their spectrum usage rights. If not, what are the factors that may be leading to this result, and what measures, if any, should the Commission take to provide incentives for licensees to voluntarily engage in efficient secondary market transactions? Are there circumstances under which licensees should be required to make spectrum rights available on the secondary market? For example, should spectrum licensees that will not be able to meet applicable construction benchmarks be required to make such unused spectrum available on the secondary market and if so, how would this requirement be implemented? Alternatively, would imposing "use-or-lose" construction requirements similar to those imposed on certain 700 MHz Band commercial licensees help to foster a more robust secondary market?²⁹

²⁵ Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets, WT Docket No. 00-230, Second Report and Order, Order on Reconsideration, and Second Further Notice of Proposed Rulemaking, 19 FCC Rcd 17503 (2004) (*Secondary Markets Second Report and Order*).

²⁶ See, e.g., U.S. Cellular Comments, WT Docket 02-353, filed Feb. 7, 2003, at 8 (asserting that it is "[u]nlikely [regional or rural carriers] will [o]btain [t]imely and [a]dequate [a]ccess to [s]pectrum via [p]artitioning, [d]isaggregation, or [s]econdary [m]arket [r]elationships.").

²⁷ The general goal of our secondary markets policy has been to significantly expand and enhance secondary markets to permit spectrum to flow more freely among users and uses in response to economic demand, to the extent consistent with our public interest objectives. *Secondary Markets Second Report and Order*, 19 FCC Rcd at 17505 ¶ 1. However, Commission policies in this area have also considered other goals, including allowing more flexible use of spectrum by licensees and other spectrum users, better defining licensees' and spectrum users' rights and responsibilities, enabling use of spectrum across various dimensions (frequency, space, and time), promoting the efficient use of spectrum, and providing for continued technological advances. *Id.* at 17505-06 ¶ 1. See also *Principles for Promoting the Efficient Use of Spectrum by Encouraging the Development of Secondary Markets, Policy Statement*, 15 FCC Rcd 24178 (2000).

²⁸ See *Secondary Markets First Report and Order*, 18 FCC Rcd at 20648-49 ¶ 92 (recognizing that "Commission adoption of more flexible use or technical rules for various Wireless Radio Services could well enhance the secondary market for spectrum usage rights").

²⁹ See, e.g., 47 C.F.R. § 27.14(g).

4. Interference Protection

34. Spectrum allocations and access often hinge on controlling interference between new services and incumbent services, as do licensing and service rules to some extent. The resolution of disputes about potential or actual interference in rulemakings can pose a major impediment to the introduction of new services, devices and technologies, either as a result of long delays in the establishment of service rules or the imposition of onerous and perhaps unachievable technical standards. What are the best ways to balance the interference protection rights of incumbents against the opportunities for access to spectrum, and how do interference protection considerations affect innovation? Radio services are generally afforded protection from “harmful interference” on either a primary or secondary basis depending upon their status in the Table of Frequency Allocations.³⁰ Under the present rules, “harmful interference” is defined as interference “which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service.”³¹ The trend of more radio services and devices seeking to use extremely weak signals and mobility bringing products in closer proximity to each other is making the risk of interference a more acute problem. A challenge for the Commission is that application of these criteria often devolves to a case-by-case interpretation of conflicting data.³² What criteria should be specified and how would they be quantified?

35. The viability of spectrum access for new radio services often centers on whether the new service may cause harmful interference to incumbent services. This can lead to delays through protracted rule making proceedings that can create uncertainty and discourage investment. Are there ways the Commission can improve upon this process? For example, alternative dispute resolution (ADR) techniques have achieved increased recognition and acceptance because they can provide a more efficient and less burdensome way to resolve disputes. Are there ADR techniques that could be useful for settling disagreements about harmful interference that arise during the rule making process, and if so, in what instances should they be used and how should the efforts be structured? We can envision a number of different approaches, including the use of mediation or arbitration techniques, and perhaps even contracting for these types of services. Should the Commission designate a panel of technical experts to advise it on spectrum sharing issues and disagreements about harmful interference and, if so, could the Technical Advisory Council (TAC) be used for this process?³³ Alternatively, should we seek to use the negotiated rulemaking process in such cases?³⁴ Can the Test-Bed concept be a useful model for working out interference protection criteria among disparate users and, if so, how could it be used to promote

³⁰ See 47 C.F.R. § 2.106 (2008).

³¹ See 47 C.F.R. § 2.1 (2008) at “*Harmful Interference*.”

³² The definition provides no quantitative guidance on what degree of signal degradation or how many interruptions over what period of time would meet the “harmful” threshold. Moreover, there are other factors that have a strong bearing on this determination, such as the nature and purpose of the communications (*e.g.*, voice, video, data, entertainment, public safety, etc.) that must be taken into account.

³³ The TAC was established in April 1999, and provides technical advice to the Federal Communications Commission in the form of recommendations formulated by a panel of telecommunication experts who periodically meet to discuss the issues and questions presented to it by the Commission. See http://www.fcc.gov/Bureaus/Engineering_Technology/Public_Notices/1999/pnet9007.html.

³⁴ See, *e.g.*, Negotiated Rulemaking Committee Reaches Full Consensus on Proposed FCC Rules for Wireline Telephone Hearing Aid Compatibility and Volume Control, *News Report*, No. DC 95-90, CC Docket No. 87-124 (June 22, 1995) (using the negotiated rulemaking process to reach agreement on new rules to govern wireline telephone hearing aid compatibility and volume control).

wireless innovation?³⁵ Additionally, how should we address interference issues that may arise after a service is deployed if all parties may be operating consistent with the rules?

36. The technical characteristics of incumbent radio systems have a direct impact on the availability of spectrum for other services, both within band and in adjacent bands. Generally, the Commission's rules are designed to control interference by regulating transmitter performance (*e.g.*, power, emissions limits, and field strength) but not receiver performance.³⁶ Should the Commission adopt receiver standards? How should receiver standards be taken into account for purposes of repurposing spectrum, such as the case where protected incumbents are using legacy receivers that could be replaced with newer, state-of-the-art equipment offering superior performance that would facilitate the introduction of new services?³⁷ How should the development and use of "smart antennas" – which employ signal processing algorithms to calculate the direction of incoming signals to locate mobile transmitters – affect any consideration of receiver standards? What technical, economic, and practical tradeoffs would be implicated by specific receiver standards, or any other, alternative approaches?³⁸

37. Finally, are there any innovative ways – including market-based ways -- to manage interference? We note that the UK Office of Communications recently offered licenses incorporating "Spectrum Usage Rights" ("SURs") in its L-Band auction in May 2008, where SURs specify the maximum amount of interference that a licensee may create.³⁹ Under such a system where licenses are subject to interference limits that describe signal strength as experienced by a receiver rather than technical rules on transmitted power, licensees can update or modify their technologies as long as they stay within their interference limit. Could defining licenses in terms of interference rights in this manner provide flexibility for innovations? Could such a system of defining interference rights have the additional benefit of facilitating spectrum sharing by helping to manage the total level of interference? For instance, by allowing users to trade interference rights, similar to the trading of pollution credits in a "Cap and Trade" system,⁴⁰ one user that reduces its interference could sell the interference rights it no longer needs to another operator. Under such an approach, the Commission would set a total interference limit for a given band, and issue (or sell, possibly via auction) a number of "credits", each of which conveys the right to cause a given amount of interference above some set minimum. The total number of credits available would be consistent with the capped total interference level for the band. The credits

³⁵ See *supra* paragraph 30 (discussing the current FCC/NTIA Spectrum Sharing Innovation Test-Bed).

³⁶ For example, a service that uses receivers that respond to RF signals far into adjacent spectrum bands may impede or prevent effective operation of new services in those bands or necessitate that limits be placed on the types of operations provided in the adjacent band(s).

³⁷ Alternatively, if the incumbent continues to use outdated equipment, we could envision providing a reduced level of interference protection to the incumbent. This would allow other services to make more intensive use of the spectrum.

³⁸ We note that there is a record of extensive discussion stretching over many years on the topic of receiver standards and receiver performance requirements. See, *e.g.*, Spectrum Policy Task Force Report, ET Docket No. 02-135 (rel. Nov. 15, 2002), at 31; Interference Immunity Performance Specifications for Radio Receivers, ET Docket No. 03-65, *Notice of Inquiry*, 18 FCC Rcd 6039 (2003) (proceeding terminated without prejudice to its substantive merits by *Order 22 FCC Rcd 8941* (2007)).

³⁹ Ofcom discusses ways of verifying that SUR levels are not being exceeded – namely through measurement or modeling. For more information, see Ofcom, *Spectrum Usage Rights: A Guide Describing SURS* (2008) (available at <http://www.ofcom.org.uk/radiocomms/isu/sursguide/>).

⁴⁰ In the Cap and Trade system involving trading of emission allowances, the total allowance is strictly limited or "capped." Overall air quality goals are set for a geographic area and a "cap" is set on the total amount of pollution that can be emitted from all regulated sources.

would be transferable, so that users that alter their operations to minimize or reduce the potential of their system to cause harmful interference (e.g., operate with reduced power, narrower emissions, etc.) below the level permitted by their credits might sell their unneeded credits to other spectrum users on the open market. Would innovators benefit if they had the opportunity to purchase additional interference rights, while keeping the total level of interference in the band below the maximum?

5. Band Sharing and Efficient Use

38. Some organizations have argued that a substantial portion of licensed spectrum is underutilized, resulting in swaths of fallow spectrum that otherwise could be used to deploy new services to the public.⁴¹ Although a better understanding of spectrum usage and occupancy measurements is necessary before any conclusions regarding spectrum utilization may be drawn, these studies and articles nevertheless suggest that there are instances where licensed spectrum may be available for use on a shared or secondary basis.

39. As we find ways to promote more efficient use of the spectrum resource, we recognize that innovation has always served a crucial role. Innovative approaches to spectrum use – such as the intensive frequency re-use principles that drove the development of widespread commercial cellular radiotelephone networks and the Orthogonal Frequency Division Multiplex modulation – are at the core of the wireless applications and services that we use and rely on as part of our daily lives. Thus, we seek comment on the different ways spectrum efficiency and innovation intersect.

40. As an initial matter, we note that there are several possible definitions of efficiency as applicable to the spectrum resource. In measuring efficient use of spectrum, how should one evaluate “spectrum efficiency” (transmitting the maximum amount of information within the least amount of spectrum), “technical efficiency” (deploying inputs, such as spectrum, equipment, capital, and labor, to generate the most output for the least cost), and “economic efficiency” (using spectrum resources to generate the highest value to the public)? As part of the Commission’s overall efforts to promote efficient spectrum use, we look to constructs such as these to guide our policy decisions. How does the application to the decision making process of these different perspectives on efficiency affect wireless innovation? Could we promote further innovation by taking different views of what constitutes an efficient use of spectrum based on the nature of a particular band of spectrum – *i.e.* whether it is an initial allocation or an established band with many incumbent users? Are there decisions we have made in the name of efficiency that stifled innovation?

41. Have licensees established any new and innovative arrangements (*i.e.*, sharing or secondary use) that make more intensive use of spectrum? What additional future or developing services might operate on a secondary basis or benefit from real-time sharing? Should the Commission require or encourage existing licensees to share their spectrum resources with other users, either on a licensed or

⁴¹ For example, in an article summarizing the results of a series of channel occupancy studies conducted in Washington, D.C., Shared Spectrum and the New America Foundation state that “roughly two-thirds of the spectrum is immediately available for shared, license-exempt use.” See M. McHenry and M. Vilimpoc, *Dupont Circle Spectrum Utilization During Peak Hours*, at 3 (2003) (emphasis removed) (available at http://www.newamerica.net/publications/resources/2003/dupont_circle_spectrum_utilization_during_peak_hours) Shared Spectrum Company and New America Foundation representatives measured spectrum occupancy at a particular location, for the frequencies ranging from 30 MHz to 3 GHz, over a period of several hours. *Id.* at 4 (emphasis removed). While Shared Spectrum Company and the New America Foundation acknowledge that their results may “overestimate the amount of whitespace available, by counting bands in which legitimate users operate below our level of threshold,” they argue that “the fact that wide swaths of spectrum lay empty for significant amounts of time is a compelling reason for a much-needed examination and reconsideration of spectrum allocation policy.” *Id.* at 4 (emphasis removed). See also T. Hazlett, *Optimal Abolition of FCC Spectrum Allocation*, *Journal of Economic Perspectives*, 2008, pp. 103-128.

unlicensed basis? For example, could the Commission enhance innovation by offering underlay or secondary use licenses for certain spectrum? If so, what criteria should be used to evaluate the potential for interference to existing users and the effect on quality-of-service? More specifically, to what extent do these approaches encumber the scope of licenses or require ongoing regulatory oversight? Are there additional steps the Commission should take to promote “dynamic” spectrum leasing arrangements in which licensees and spectrum lessees can share use of the same spectrum, possibly through the use of devices that enable opportunistic use of spectrum?⁴² What would be the most effective combination of spectrum allocation, licensing, and service rules to provide the most flexibility for spectrum sharing?

42. Could spectrum user fees encourage more efficient spectrum use? Would licensees be prompted to sell their licenses to more productive users – or switch themselves to more productive uses – rather than pay a user fee that is high relative to the value generated by the license in its current use? Such fees could be based on bids for auctioned licenses offering comparable spectrum access, to approximate the market value of the licenses. Should such fees be limited to licenses covering spectrum for which the initial license term was not acquired through Commission auction? Should such fees be assessed based on a license's total spectrum capacity or only on the unused portions of that capacity? Or, is the existence of a secondary market sufficient to force spectrum users to face the opportunity cost of holding a license, since the price for which they can sell a license on the secondary market should reflect its value in an alternative use or by an alternative user? We note that certain licenses in the United Kingdom are subject to “Administered Incentive Pricing” (AIP), which are fees intended to encourage spectrum users to more explicitly take into consideration the value of the spectrum resource they hold.⁴³ Has AIP proven effective in encouraging efficient spectrum usage and if so, would similar fees be appropriate in the United States?

43. In order to encourage spectrum sharing, would it be helpful to have a database that provides information regarding licensee contact information, as well as spectrum use and availability by geographic area and frequency band? For example, would it be useful to have information as to whether a transmitter operates continuously or infrequently, or may provide coverage only over a portion of the licensed service area? Commenters should, in particular, discuss how such information might be collected and made transparent to promote effective sharing.⁴⁴ How successful has the private sector been in establishing databases that facilitate information sharing and promote spectrum leasing arrangements (e.g., organizations such as Spectrum Bridge, which provides an online spectrum marketplace)? In the event that the private sector does not succeed in creating a database that effectively promotes widespread information sharing on licensees, spectrum use and spectrum availability, should the Commission assume responsibility for facilitating information sharing? Is there functionality or enhancements we could make to our existing licensing systems to facilitate the ability of the public to extract this type of information? We note, for example, that the Commission has begun a process to consolidate its several licensing systems into a single public licensing database “to reduce costs and make licensing processes speedier and more effective.”⁴⁵ What other improvements to our existing licensing systems should the

⁴² See *Second Markets Second Report and Order*, 19 FCC Rcd at 17547-49 ¶¶ 88-90.

⁴³ See Ofcom, *Policy Evaluation Report: AIP (2009)* (available at http://www.ofcom.gov.uk/research/radiocomms/reports/policy_report/).

⁴⁴ Spectrum use can describe both the amount of spectrum assigned and the extent to which it is employed. For example, a licensee of a cellular radio channel and a licensee of a public safety radio channel may have the same amount of spectrum assigned, but the former will use its channel much more intensively than the latter.

⁴⁵ Fiscal Year 2010 Budget Estimates Submitted to Congress May 2009, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-290641A1.pdf, at 1 (noting funding request for initiative to modernize and consolidate key licensing systems).

Commission consider?

44. We also seek comment on specific technologies that could provide increased access to spectrum. Because not all spectrum is used at any given location and time, technologies that allow for opportunistic access to spectrum can promote more robust use of the limited spectrum resource. For example, software defined radios include transmitters in which the operating parameters (such as frequency range and output power) or circumstances under which the transmitter operates can be modified without making any changes to hardware components that affect the radio frequency emissions. Cognitive radios are incorporated in radio systems whose transmission parameters are based on information on the environment that is external to the radio system. In the recent TV White Spaces proceeding, the Commission enabled access to locally vacant TV spectrum through a combination of geolocation, access to a database of incumbent operations and spectrum sensing.⁴⁶ What can the Commission do to promote the continued development of such technologies?

45. We also note that the Commission has seen numerous innovations in unlicensed spectrum use.⁴⁷ Part 15 of the Commission's rules permits the operation of low power radio frequency (RF) devices without a license from the Commission, but such devices must not cause harmful interference to authorized services and they must accept any interference that they may receive from the operation of an authorized radio station or another Part 15 device. The Commission's equipment authorization program is used to verify that unlicensed devices comply with the Part 15 rules.⁴⁸ We encourage commenters to identify unlicensed technologies that may be under development, and to discuss how we can promote further innovations in the use of unlicensed spectrum under our Part 15 rules.

46. We are also interested in exploring how innovation in spectrum use relates to our technical rules. Are there advances in transmitter or receiver technology or modulation techniques that might improve spectrum sharing?⁴⁹ Are our existing technical rules sufficient to promote such innovations, and when, if ever, should we require the use of specific technologies to improve spectrum use?

47. Are there approaches that can promote the efficient use of spectrum in other ways? For example, what role should certified frequency coordinators play in promoting efficient use? Are there steps we could take to regularly monitor, measure, and report spectrum use? If so, what specifically should we be measuring and how should this information be reported?⁵⁰ We are particularly interested in

⁴⁶ See *TV White Spaces Order*, 23 FCC Rcd 16807.

⁴⁷ For example, spread spectrum technologies are used to send signals over a bandwidth that is much wider than strictly necessary for the information that is to be transmitted. By spreading the energy used to transmit the signal over a wide bandwidth, the energy in any narrow band segment is extremely weak – which can enable many users to share the same spectrum without mutual interference.

⁴⁸ The types of unlicensed devices are numerous and varied, and range from automobile key fobs and garage door openers to Bluetooth headsets and Wi-Fi networking devices.

⁴⁹ For example, automatic power control (APC) or, alternatively, transmitter power control (TPC), continuously adjusts transmitter power to use spectrum more efficiently. Under dynamic frequency selection (DFS), the transmitter uses a sophisticated listen-before-talk protocol to choose vacant channels. This spreads band use more evenly and serves to accommodate more users.

⁵⁰ For example, we envision that the Commission could develop a low-cost standard package of sensors and measurement systems that could be deployed throughout the country. Together, these frequency monitoring sensors would create a real-time spectrum monitoring network, similar to the ubiquitous weather stations atop schools and other buildings that make up local weather networks. The data collected could be useful for the Commission and interested parties for a variety of purposes, such as identifying frequency bands that are underutilized. It could also be used to measure the “noise floor” in an area.

how the noise floor, *i.e.*, the signal created by the sum of all of the noise sources, including unwanted signals, within a specified band, affects the deployment and viability of services. Is the noise floor increasing? If so, should the Commission take steps to reduce the noise floor, or does the evolution of digital technologies that are more tolerant of interference diminish the importance of reducing the noise floor? The Commission could, for example, reduce the general out-of-band and spurious emissions limits for new radio transmitters as well as the emissions limits for unlicensed unintentional radiators by prescribed levels over some period of time. Would this be beneficial or are there other approaches that we should explore that could reduce the noise floor? What levels of reduction in emissions are feasible and what would be the economic impact on the costs of radio transmitters and radio frequency devices? What role does increased access to spectrum through underlays and secondary markets play in our evaluation of the noise floor? Finally, what role does the noise floor play in encouraging or discouraging wireless innovation?

D. Networks, Devices, and Applications

48. In this section, we seek comment on innovation in the various areas of wireless technology, including both the hardware and software used to provide such services. Advances in network infrastructure and systems will create enormous opportunities for innovation. We must also understand the potential impediments to innovation as well as any impact on the networks themselves. Thus, we seek comment on developments and innovations that are promoting investment in and robust use of wireless network infrastructure, end-user devices, and applications and services, on any major barriers or deterrents to such innovation and investment, and how the Commission can best facilitate continued innovation and investment in these areas.

1. Network Infrastructure and Systems

49. The Internet has served as a critical platform for innovation for nearly two decades.⁵¹ As wireless services deploy IP based networks, we anticipate the opening of a new frontier for innovation. Commercial wireless systems have thus far focused on voice communications and access to Internet applications and services. However, IP based networks offer possibilities for use of these networks in many ways. Some of these possibilities have been emerging in the past few years. For example, unlicensed low power sensory networks can be used to monitor the environment in a building and the network can be connected to a remote location for data collection and monitoring by using a commercial wireless network. Similarly, personal medical monitoring devices can send data to a physician or health care facility using a commercial wireless network. Machine-to-machine (M2M) communications is another recent and growing use of commercial wireless networks.⁵² What are the implications of IP-based wireless networks for innovation? Will commercial wireless IP networks provide opportunities for new applications that might otherwise require separate spectrum and networks? What obstacles may exist and how can they be addressed? What are the ramifications of such use for wireless network design and capabilities? As more applications move from specialized networks to IP-based networks, what

⁵¹ For example, the advent of open network architecture and the Transport Control Protocol/Internet Protocol (TCP/IP) suite has had a profound impact on application design and integration. Coupled with the increased use of digital technology and advances in transmission technology, IP-based networks are supplanting the need for many separate specialized networks (*e.g.*, separate voice or video networks that are accessed via dedicated devices) because these applications can now be supported via a common IP based network.

⁵² M2M communications is used in sensor networks to monitor conditions on a wide scale and in a variety of industries including, for example, oil and gas, transportation, healthcare, and manufacturing. Most M2M systems are task specific and private network models have been used to support implementations in the past (*e.g.* meter reading).

challenges must be met if the Internet is to remain the platform of innovation?⁵³ What future business models may facilitate applications on wireless IP-based networks and how can the Commission encourage the development of such models?

50. Fourth generation (4G) wireless networks may represent the most significant advance in wireless communications in a decade, and will be the first converged platform architecture to be deployed, capable of supporting voice, video, and data services.⁵⁴ What policies should the Commission adopt to facilitate deployment of 4G technologies?

51. Wireless network architectures have been changing in many ways. Wireless networks are often combined with wireline networks. Where in the past networks were generally designed to serve either fixed or mobile applications, today a single network can serve both types of services. Wireless devices increasingly have the capability to operate across multiple frequency bands, which creates possibilities for synergies among different radio services. Licensed and unlicensed technologies are also being combined in synergistic ways, such as the inclusion of Wi-Fi, Bluetooth and near-field devices in commercial wireless products. Wireless network architecture is changing in other ways as well.⁵⁵ What new constructs may represent the innovation platforms for the future?⁵⁶ What potential benefits may such architectures offer? Can new service architectures offer benefits and spur innovation?⁵⁷ How should these new network approaches be tracked? What are the potential benefits and associated costs? Do any new network architecture proposals offer opportunities for more efficiently distributing broadband to rural regions? What other innovations are occurring that might provide alternative technologies to meet the transport or backhaul needs of wireless networks? Do these alternatives provide capacity and functionality comparable to traditional backhaul and transport? In an environment of multiple network providers, how can relevant quality of service (QOS), reliability, and performance issues be identified?

⁵³ Past challenges for the Internet have been mainly about scaling in terms of speed and size. As an IP infrastructure replaces the legacy communications environment, will new capabilities be required, such as security, trust models, reliability, quality of service, etc.?

⁵⁴ Performance capabilities may approach nearly a two order of magnitude increase over transmission rates commonly experienced today. Both WiMAX and Long Term Evolution (LTE) are based on global standards and therefore present a global opportunity for application developers. LTE is the 4G technology defined by the Third Generation Partnership Project (3GPP) which manages the evolution of the GSM cellular standard, while WiMAX has been standardized within the IEEE standards organization and was developed largely by chip manufacturers and WiFi vendors. To meet performance objectives, both incorporate many of the same basic advanced technologies such as Orthogonal Frequency Division Multiplex modulation, Multiple Input Multiple Output (MIMO) antenna signal processing, and advanced error correcting codes. Commonality in WiMAX and LTE is therefore high: base stations share about 70% or more common components and the industry now believes a common device chipset is feasible.

⁵⁵ Traditional network architectures are based on a hierarchical service provider model characterized by a backbone structure coupled to a distribution structure, all under the control of a single service provider. Particularly in areas where backhaul and transport infrastructure are available only at very high cost or not at all, such architecture can present significant barriers to wireless deployment.

⁵⁶ Overlay networks, such as commonly found in content delivery networks, have been proposed as a complementary construct to deliver services. "Cloud computing" and "network virtualization" are additional constructs that may enhance the development environment and overcome limitations in legacy networks.

⁵⁷ Mesh networks reuse valuable spectrum in providing their own backhaul and may represent an effective solution for rural areas. Femto cells are wireless facilities owned by the end user which extend a service provider's network into a local premise and use customer provided broadband for backhaul capability. Some new models of networking propose customer ownership of the last mile or alternatively the creation of a broadband commons, both permitting customer choice in selecting service providers.

What are the ramifications for the Internet, recognizing that implementing changes in the Internet poses serious challenges, given the large number of Internet Service Providers (ISPs) and embedded equipment involved.

52. Towers are the backbone of our wireless infrastructure, supporting both commercial and private wireless services, in addition to critical public safety and homeland security wireless communications. We seek comment on what innovative arrangements or technical solutions have been developed to address wireless network siting requirements. We note that the Commission now offers both the Tower Construction Notification System (TCNS) and e-106 systems online,⁵⁸ either or both of which tower builders may utilize for compliance with the Commission's rules regarding historic and cultural sites.⁵⁹ Use of these systems permits faster, more efficient processing of required preconstruction tower review, while making information electronically available to interested parties. Are there any similar, additional measures that the Commission may implement to increase the speed and efficiency of processing tower-related matters? We seek comment on what the Commission can do to promote innovations in tower siting and collocation.⁶⁰ Where are the best collocation opportunities for providing new or expanded wireless services? Are there potential tradeoffs in encouraging such efforts?⁶¹

53. We also seek comment on whether there are ways to alter the role of tower siting in the design and deployment of network resources. For example, a Distributed Antenna System (DAS) is a network of spatially separated antenna nodes connected to a common source via a transport medium that provides wireless service within a discrete geographic area.⁶² DAS antennas may lend themselves to collocation due to their smaller size and weight, and if space on existing towers or other structures suitable for a DAS system can be found, it could be possible to eliminate certain expenses relating to tower construction as well as the related pre-construction environmental, aviation, and other regulatory reviews.⁶³ Other technologies, such as multi-carrier amplifiers, might simplify system implementations

⁵⁸ See http://wireless.fcc.gov/outreach/index.htm?job=tower_notification.

⁵⁹ 47 C.F.R. § 1.1307(a)(4) (governing facilities that may affect districts, sites, buildings, structures or objects, significant in American history, architecture, archeology, engineering or culture, that are listed, or are eligible for listing, in the National Register of Historic Places). See also 47 C.F.R § 1.1307(a)(5) (governing Indian religious sites). The TCNS facilitates communication with, and provides early notification of proposed tower construction to, Indian Tribes, Alaska Native Villages, Native Hawaiian Organizations, and State Historic Preservation Officers, in the context of review required by Section 106 of the National Historic Preservation Act⁵⁹ (NHPA) and the Commission's rules. The e-106 system streamlines the Commission's Section 106 review process for proposed tower construction by enabling real-time referral of information and documented communication among all participating parties.

⁶⁰ For example, new antenna feed mechanisms enabled the collocation of additional services on AM radio towers.

⁶¹ We note that current Commission policy encourages collocation where technically and economically feasible. See, e.g., *Nationwide Programmatic Agreement for the Collocation of Wireless Antennas*, 47 C.F.R. Pt. 1, App. B preamble (2008).

⁶² A DAS splits the transmitted power among several antennas, separated in space so as to provide coverage over the same general area as a single, high-powered antenna, but with reduced total power and improved reliability. The DAS concept has also been used inside buildings as a way to efficiently distribute wireless connections where steel columns and layers of concrete can interfere with wireless signals. For purposes of this inquiry, we are less interested in the implications of in-building DAS deployments.

⁶³ If DAS towers do have to be constructed, they may be smaller than other antenna towers, thus minimizing construction expenses and environmental reviews. However, we also recognize that in some cases, the large number of sites required to host a DAS architecture could actually present greater cost or regulatory burdens than the installation of a single high-power antenna.

and reduce hardware and infrastructure costs by combining functionality currently distributed throughout multiple components. Accordingly, we inquire whether such technologies and approaches are likely to encourage innovation by promoting cost savings and reducing regulatory burdens and uncertainty associated with traditional antenna and equipment placements at tower sites, and whether there are steps we could take to promote their utility.

54. *“Green” Wireless Technologies.* We seek comment on innovations in the use of renewable energy and other green technology to makes wireless networks more energy efficient or address other environmental concerns. For example, the use of renewable energy sources to power wireless telecommunications towers, in addition to being environmentally beneficial, has allowed tower siting in unserved or underserved areas where access to traditional power sources is unavailable.⁶⁴ What are the challenges to using renewable energy sources and other green technology in powering wireless towers and other network elements? What are the cost savings of using renewable energy sources and other energy efficient technologies in new and existing towers compared to potentially higher front-end investments? Are there any wireless industry-led innovations or practices addressing environmental concerns that are providing benefits to the public as a whole?⁶⁵ We seek comment on whether and how the Commission should encourage or facilitate them.

2. Devices

55. The ever-increasing sophistication and complexity of new wireless devices is one of the most striking trends in modern telecommunications today. This particularly includes the development of consumer-oriented devices with multiple embedded transmitters that operate on several frequencies over multiple networks and have multiple capabilities, such as multi-function smart phones.⁶⁶ How have such devices affected development of innovation in wireless applications and services? Another example includes devices that are tailored to perform specialized functions – such as those used for M2M communications.⁶⁷ In order to anticipate future trends in this arena, we seek additional information on what types of applications are developing for specialized wireless devices in general, and those that are designed for M2M functionality in particular. What implications do these types of devices have for technical rules regarding matters such as interference, unlicensed/licensed regulation, and spectrum

⁶⁴ For example, a cell tower that relies primarily on renewable energy was built in a remote area where access to the power grid was economically unfeasible. See, e.g., Cellcom goes green. NSight News, July 28, 2009 at <http://www.nsisight.com/about/news.php?id=195>, and Green Cell Tower – Efficient and Effective. Viodi, July 22, 2009 at <http://www.viodi.tv/2009/01/22/green-cell-tower/>. Another example is the GSM Association’s Green Power for Mobile Program, which seeks to power 118,000 existing and new off-grid base stations in developing countries using renewable energy sources by 2012. See, The GSM Association’s Green Power for Mobile Program, July 22, 2008, at <http://www.gsmworld.com/our-work/development-fund/energy/index.htm>. See also Sangani, Kris, *Base stations to be powered by renewables*, published September 18, 2008. The Institute of Engineering and Technology, Knowledge Network, July 22, 2009, at <http://kn.theiet.org/news/sep08/base-station-renewables.cfm>.

⁶⁵ We note, for example, an agreement reached earlier this year between a number of mobile operators and manufacturers in Europe and the United Kingdom to implementing a cross-industry standard for a universal charger for new mobile phones. See <http://www.gsmworld.com/newsroom/press-releases/2009/2548.htm>; <http://www.guardian.co.uk/business/2009/feb/17/universal-mobile-phone-charger>. Achieving implementation of such a standard will, assertedly, result in an estimated 50 per cent reduction in standby energy consumption and the potential elimination of up to 51,000 tons of duplicate chargers, as well as simplifying the charging of mobile phones.

⁶⁶ These devices often operate on licensed bands while simultaneously utilizing unlicensed bands for technologies such as Wi-Fi, Bluetooth and RFID/near field communications.

⁶⁷ Wireless M2M technology could be readily adaptable for a variety of useful purposes in home, office, and industrial environments alike.

underlay considerations? We note that these new smart phones and other specialized devices increasingly are designed to have the capability to operate in both licensed bands and Part 15 unlicensed bands. Given this development, are there particular challenges for how the Commission should evaluate and regulate such devices?

56. With a goal of minimizing burdens on manufacturers and decreasing the time to market while ensuring that RF equipment complies with our rules, are there any ways in which the existing equipment authorization process could be modified or relaxed in order to simplify the process?⁶⁸ What approaches could be taken to make the process more efficient and to prevent it from becoming a bottleneck to timely innovation?⁶⁹ Are there other categories of devices, such as those used for wireless power transfer,⁷⁰ for which relaxed procedures would be appropriate? In addition, how could the process be adapted to better address concerns of the consumer electronics industry regarding such matters as confidentiality of approvals prior to marketing? On the other hand, relaxed procedures could also open the door to increased enforcement problems. How could these concerns be addressed?⁷¹ Thus, we seek comment on what additional efforts to harmonize technical rules or streamline the equipment authorization process might be considered in order to reduce unnecessary regulatory burdens that could delay development and marketing of innovative devices.

3. Applications and Services

57. We seek comment on innovation occurring in wireless applications and services, particularly within the mobile wireless market. In the previous decade, mobile wireless applications were largely limited to paging, voice service, and text messaging. Now, thanks in part to significant advances in both network infrastructure and mobile device capabilities, the market for mobile wireless applications has dramatically expanded to include, for example, web browsing, location services, music services, instant chat, streaming video and radio services, downloadable ringtones, and many other uses. We inquire into the extent of innovation, where it is occurring, and whether the Commission should take any action to facilitate it.

58. *Applications generally.* What new wireless applications or services are becoming available in the near future that will significantly change the way Americans work or live? To what extent are communications services and applications more broadly (voice, e-mail, Internet access, data, video, etc.) converging on wireless platforms? Does the Commission need to modify its wireless service rules to reflect and/or accommodate such convergence? Further, how is innovation in mobile wireless applications being affected by the increasing trend of convergence of all data services and functions,

⁶⁸ The Commission's RF equipment authorization program is designed to ensure that RF devices comply with Commission technical rules and that those devices which could cause harmful interference do not enter the marketplace. In addition, the equipment authorization process also ensures that RF products comply with other provisions of the Commission's rules, such as the limits on human exposure to RF electromagnetic fields and compatibility with hearing aids. See 47 C.F.R. Part 2, Subpart J (2008).

⁶⁹ For example, could we relax the approval process for certain RF devices that have a good track record and that are unlikely to cause harmful interference - such as inductive devices used for very short-range purposes (e.g. less than 1 inch) - and treat them as unintentional radiators?

⁷⁰ Wireless power transfer is a technique that relies on the establishment of a magnetic field to transfer energy between an antenna connected to an electrical outlet and an antenna located in close proximity; devices located within range of the magnetic field would be charged wirelessly.

⁷¹ Furthermore, the complexity of new convergence devices poses additional challenges because they are likely to be subject to multiple sets of differing regulations for each embedded transmitter.

wireless or not, on a single device?⁷² We seek comment on the impact of innovations occurring in the application layer as a result of the growing consolidation of devices and services.

59. *Openness.* We also seek comment on the current state of the wireless application market, including the market for mobile applications. Who are the market players, what are the economic arrangements for entry into the market, and what is the extent to which entry into the market by new application developers or access to potential customers may be restricted? To what extent are wireless applications being offered to the public through parties other than a network or mobile device provider? To the extent that there are barriers for such third party offerings, are these barriers introduced at the network level, the device level, or by some other aspect of network service? To what extent are wireless networks and devices open, and what is the industry trend with regard to network or device openness? How is the “openness” of wireless networks and devices affecting the pace of innovation? We note that the Commission has imposed open platform obligations on the 700 MHz C Block licensees.⁷³ Has this requirement demonstrably led to expansion or innovation in the mobile wireless application market? Should this requirement (or other obligations related to network management) be applied more broadly?

60. *Technical Standards.* We also seek comment on how standards can affect the innovation processes. We note that the Commission has long supported flexibility in the standards-setting process, and we do not anticipate altering this overall approach. We are particularly interested in how multiple standards and platforms may affect innovation. For example, do the existence of multiple standards and platforms create additional challenges for introducing new devices? Can the marketplace efficiently resolve issues related to the incompatibility of various standards?⁷⁴ Should the Commission play a role in developing, promoting, or seeking to find consensus about standards? We recognize that specific standards do not drive the development of many applications, but that the applications designers instead rely on software application development environments that have simply gained popularity and acceptance in the general marketplace. The open nature of the Internet has fostered the creation and widespread availability of many applications and services under this model. As other approaches, such as cloud computing, evolve, will established standards or *de facto* standards become more important to the applications development process?⁷⁵ For example, can a dominant cloud computing position raise the same competitive issues that are now being discussed in the context of network neutrality? Will it be necessary to modify the existing balance between regulatory and market forces to promote further innovation in the development and deployment of new applications and services?

E. Business Models and Practices

61. We seek comment on what innovative business models and practices are being adopted in

⁷² One example of this broad trend is the increasing availability of devices that include both the capacity to play digital music and a wireless communications capability, as occurs on smart phones.

⁷³ See 47 C.F.R. § 27.16 (2008).

⁷⁴ A popular example of competing standards battling in the marketplace involves the introduction of videocassette recorders (VCRs) and the separate Betamax and VHS formats. Betamax was first to market in November 1975, but the rival VHS standard ultimately became the dominant standard. Once videocassette manufacturers stopped producing recordings in Betamax format, the value of Betamax VCRs dropped and, eventually, Sony Corp. stopped making Betamax equipment. See, e.g., Francie Grace, “Bye Bye Betamax!” CBS News, August 28, 2002 (available at <http://www.cbsnews.com/stories/2002/08/28/tech/main520011.shtml>).

⁷⁵ See, e.g., “Verizon Wireless, Qualcomm join on machine-to-machine venture: *Computerworld*, July 28, 2009 (available at http://www.computerworld.com/s/article/9135978/Verizon_Wireless_Qualcomm_join_on_machine_to_machine_venture, accessed July 29, 2009), on July 28 2009. The venture envisions using cloud computing for the provisioning of M2M devices, and expects to “create strategies to standardize products.” *Id.*

the wireless sector, in this country as well as in foreign markets, and on the Commission's role in fostering such innovations. We also recognize that our policies for innovation in the wireless domestic market both affect and are affected by policies for innovation in the wireless international market. Accordingly, we encourage commenters to consider how policies for innovation in the wireless domestic market might appropriately reflect or support global innovation for international networks generally. By business model, we refer to a framework for converting technology to economic value. For instance, are there business models that may more effectively leverage new technologies and applications? What new business models and solutions are being developed to provide service to previously unserved or underserved populations, or to otherwise overcome challenges of economic viability or limitations in access to spectrum or infrastructure? We note that in some cases, local entrepreneurs in rural areas have partnered with a major carrier to establish a 3G network compatible with that carrier, interconnecting, and entering into a fee arrangement (e.g. splitting roaming fees). We solicit comment on how these partnerships are overcoming local challenges and how well these efforts have promoted the availability of 3G or 4G wireless services.

62. We note as one potential business model the multi-sided platform (MSP), which brings together two or more inter-dependent groups of customers in order to produce economic value for all of them, typically by reducing their search costs and shared transaction costs, e.g. eBay as a platform for buyers and sellers.⁷⁶ We seek comment on the extent to which wireless innovators are creating such platforms, and how they are affecting the wireless landscape. Conversely, are there innovative business models achieving advantage in jointly serving two or more customer groups that traditionally have been served with separate networks such as commercial subscribers and public safety entities?

63. We also invite comment on what significant innovations have occurred in specific business processes that are enabling new wireless experiences and unlocking value for consumers. For example, what important innovations or trends have occurred in customer provisioning, billing, how customers pay to access wireless networks or gain wireless services (e.g. pay-as-you-go), or other key business processes? To what extent have wireless companies adopted innovations in business practices in response to competition or to better accommodate consumer needs or expectations? Has competition and consumer demand driven companies towards industry-wide best practices in certain areas?

64. Finally, while the Commission has traditionally avoided providing preferential support for a particular business model, we seek comment on whether the Commission nevertheless has a role to play in accommodating or fostering innovation in business models. For example, we seek comment on whether our rules are unnecessarily or unintentionally inhibiting such innovation.

F. Supporting Innovation and Experimentation

65. As a final matter, what can be done to affirmatively support experimentation in wireless technology and services? Experimentation is a key element of innovation. What types of experimentation would promote innovation in the wireless sector? Are there ways to encourage more experimentation in pure research as well as practical applications? Experimentation may require access to spectrum to develop new or improved technologies or it may require marketing trials to try out business models or service offerings. One avenue of inquiry is whether the Commission should explore modifying its current rules for the issuance of experimental licenses under Part 5 of its rules. For example, do the restrictions on market trials conducted under an experimental authorization constrain innovation and limit the value of the experimental study in cases in which substantial marketing data is an essential component of determining the success or failure of the experiment?⁷⁷ Does the requirement that the experimenter must

⁷⁶ See <http://hbswk.hbs.edu/item/5237.html>.

⁷⁷ See 47 C.F.R. § 5.93 (2008). These limitations affect the size and scope of the marketing trial, as well as restrict ownership of equipment used in the trial to the licensee.

own all of the transmitting and/or receiving equipment used favor manufacturers over others who seek to conduct market trials? What benefits for wireless innovation might result if the Commission's rules enabled broader market studies in cases in which substantial marketing data is an essential component of determining the success or failure of the experiment?

66. Should research organizations (e.g., universities) be permitted to operate experimental stations without individual coordination of frequencies, conditioned on their not causing harmful interference to authorized stations? Such a program could allow us to work cooperatively with researchers to identify topics and frequency bands for further study and to learn about the new wireless technologies being investigated. We could require real-time (i.e. web-based) disclosure of frequencies being used and semi-annual reports to measure the success of the various research programs. We envision that in some cases various wireless or telecommunications stakeholders might partner with these organizations to provide support for specific projects. Would such an approach promote new ideas that would lead to new or improved services for the public? Are there other novel approaches to authorizing experimental spectrum use that we should explore?

III. CONCLUSION

67. We believe that the information sought in this *Notice of Inquiry* will enable us to better understand the extent of innovation occurring in the wireless sector, how it is impacting consumers, and what the impediments are. With this foundation, the Commission can determine how best to continue fostering such innovation for the benefit of the public. Accordingly, we seek comment on those matters discussed above.

IV. PROCEDURAL MATTERS

A. Paperwork Reduction Act

68. This document does not contain proposed information collection(s) subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. In addition, therefore, it does not contain any new or modified "information collection burden for small business concerns with fewer than 25 employees," pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 47 U.S.C. § 3506(c)(4).

B. Ex Parte Presentations

69. This is an exempt proceeding in which ex parte presentations are permitted (except during the Sunshine Agenda period) and need not be disclosed.⁷⁸

C. Comment Filing Procedures

70. Pursuant to sections 1.415 and 1.419 of the Commission's rules,⁷⁹ interested parties may file comments and reply comments regarding the Notice on or before the dates indicated on the first page of this document. **All filings related to this Notice of Inquiry should refer to GN Docket No. 09-157 and GN Docket No. 09-51.** Comments may be filed using: (1) the Commission's Electronic Comment Filing System (ECFS), (2) the Federal Government's eRulemaking Portal, or (3) by filing paper copies. *See Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998). Commenters desiring confidential treatment of their submissions should request that their submission, or specific parts

⁷⁸ 47 C.F.R. § 1.1204(b)(1) (2008).

⁷⁹ 47 C.F.R. §§ 1.415, 1.419 (2008).

thereof, be withheld from public inspection pursuant to the Commission's rules.⁸⁰

- **Electronic Filers:** Comments may be filed electronically using the Internet by accessing the ECFS: <http://www.fcc.gov/cgb/ecfs/> or the Federal eRulemaking Portal: <http://www.regulations.gov>. Filers should follow the instructions provided on the website for submitting comments.

- ECFS filers must transmit one electronic copy of the comments for both **GN Docket No. 09-157** and **GN Docket No. 09-51**. In completing the transmittal screen, filers should include their full name, U.S. Postal Service mailing address, and the applicable docket number. Parties may also submit an electronic comment by Internet e-mail. To get filing instructions, filers should send an e-mail to ecfs@fcc.gov, and include the following words in the body of the message, "get form." A sample form and directions will be sent in response.

- **Paper Filers:** Parties who choose to file by paper must file an original and four copies of each filing. Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail (although we continue to experience delays in receiving U.S. Postal Service mail). All filings must be addressed to the Commission's Secretary, Marlene H. Dortch, Office of the Secretary, Federal Communications Commission, 445 12th Street, S.W., Washington, D.C. 20554.

- The Commission's contractor will receive hand-delivered or messenger-delivered paper filings for the Commission's Secretary at 236 Massachusetts Avenue, N.E., Suite 110, Washington, D.C. 20002. The filing hours at this location are 8:00 a.m. to 7:00 p.m. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes must be disposed of before entering the building.

- Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9300 East Hampton Drive, Capitol Heights, MD 20743.

- U.S. Postal Service first-class, Express, and Priority mail should be addressed to 445 12th Street, S.W., Washington D.C. 20554.

- Parties should send a copy of their filings to Peter Trachtenberg, Wireless Telecommunications Bureau, Federal Communications Commission, 445 12th Street, S.W., Washington, D.C. 20554, or by e-mail to peter.trachtenberg@fcc.gov; and Jamison Prime, Office of Engineering and Technology, Federal Communications Commission, 445 12th Street, Washington, D.C. 20554, or by e-mail to jamison.prime@fcc.gov. Parties shall also serve one copy with the Commission's copy contractor, Best Copy and Printing, Inc. (BCPI), Portals II, 445 12th Street, S.W., Room CY-B402, Washington, D.C. 20554, (202) 488-5300, or via e-mail to fcc@bcpiweb.com.

- Documents in GN Docket No. 09-157 and GN Docket No. 09-51 will be available for public inspection and copying during business hours at the FCC Reference Information Center, Portals II, 445 12th Street S.W., Room CY-A257, Washington, D.C. 20554. The documents may also be purchased from BCPI, telephone (202) 488-5300, facsimile (202) 488-5563, TTY (202) 488-5562, e-mail fcc@bcpiweb.com.

D. Accessible Formats

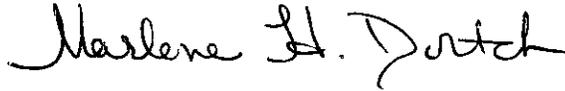
71. To request materials in accessible formats for people with disabilities (Braille, large print, electronic files, audio format), send an e-mail to fcc504@fcc.gov or call the Consumer and Governmental Affairs Bureau at 202-418-0530 (voice) or 202-418-0432 (TTY). Contact the Commission to request reasonable accommodations for filing comments (accessible format documents, sign language interpreters, CART, etc.) by e-mail: FCC504@fcc.gov; phone: 202-418-0530 or TTY: 202-418-0432.

⁸⁰ 47 C.F.R. § 0.459. See also Examination of Current Policy Concerning the Treatment of Confidential Information Submitted to the Commission, *Report and Order*, 13 FCC Rcd 24816 (1998), *Order on Reconsideration*, 14 FCC Rcd 20128 (1999).

V. ORDERING CLAUSE

72. Accordingly, IT IS ORDERED that, pursuant to the authority contained in sections 4(i), 4(j), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 154(j), and 403, this Notice of Inquiry IS ADOPTED.

FEDERAL COMMUNICATIONS COMMISSION



Marlene H. Dortch
Secretary

**STATEMENT OF
CHAIRMAN JULIUS GENACHOWSKI**

Re: Fostering Innovation and Investment in the Wireless Communications Market (GN Docket No. 09-157); A National Broadband Plan For Our Future (GN Docket No. 09-51)

Maximizing and accelerating innovation and investment, along with ensuring competition and empowering consumers, are core components of the FCC's mission. The first inquiry we initiate today focuses on innovation and investment in wireless communications. Specifically, we seek to identify appropriate and concrete steps the Commission can take to support and encourage further innovation and investment in this area, and to understand better the factors that encourage innovation and investment in wireless.

With respect to mobile, it is hard to think of a sector of the communications marketplace that better illustrates the potential of innovation coupled with investment. Over the past decade and a half, cell phones have gone from something accessible to a relatively small segment of the population – just 33.8 million users in 1995 – to an indispensable device carried by over 270 million Americans today.

With the advent of extraordinary and innovative new devices like the iPhone, Pre, and Blackberry, we are on the verge of a second transformation: from mobile voice to mobile broadband, from handheld devices that can do just one thing to smart mobile mini-computers that can do almost anything at all. The remarkable devices we see today, and the consumer enthusiasm surrounding them, are just a start—recent projections indicate that smartphones may outsell personal computers by 2011. It is essential that the U.S. become the leader in this new wireless marketplace.

Of course, no one can really predict with confidence exactly how the revolution in mobile broadband will ultimately affect our society and our economy. But it doesn't take a crystal ball to see that the effects are going to be deep and far-reaching. Mobile broadband will create and support many of the great companies, technologies, and applications of tomorrow. It will play an essential role in supporting the long-term health of our economy and creating new jobs for American workers. It will enable all of us to be more productive and more connected everywhere we go. And, I believe, it will have positive consequences for our nation's ability to solve pressing problems like health care, energy, education, and public safety.

The FCC, as the agency entrusted with managing the public airwaves, will play critical role in this process. The FCC's decisions on how spectrum is allocated, assigned, and licensed (or unlicensed); on how interference is defined, disputes are adjudicated, band-sharing is administered; on how equipment is authorized and experimental licenses are granted or denied; and on a whole host of other questions discussed in today's Notice, will have a profound impact on how the wireless marketplace develops.

The Commission's history in this area holds great examples of success, such as the PCS auctions, the creation of the unlicensed regime that enabled Wi-Fi and Bluetooth, and other powerful innovations. But there are also examples of failures—band plans and services that failed to attract users, lay fallow or near-fallow for years, and needed to be reconsidered after much wasted effort and time.

In short, at times the Commission has gotten it right, and at times it has gotten it wrong. The purpose of initiating today's inquiry is to make sure that we get it right as we move into the brave new world of wireless broadband.

It is important as well to note that the nature of innovation is not constant—indeed it has changed significantly in recent time. Our digital era allows for greater collaboration, rapid iteration, and faster times to market. These trends have affected innovation at large companies, some of which are responsible for truly impressive recent innovations. And these trends have also created a new generation of innovators, working with new tools, on new platforms, and having an extraordinary impact on our economy and society. This is great news for the communications marketplace and for communications consumers. It is essential that the Commission come to grips with this new world, take seriously the new opportunities and the new challenges, and be relentless about developing policies that maximize and accelerate innovation and investment.

**STATEMENT OF
COMMISSIONER MICHAEL J. COPPS**

Re: Fostering Innovation and Investment in the Wireless Communications Market (GN Docket No. 09-157); A National Broadband Plan For Our Future (GN Docket No. 09-51)

Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless including Commercial Mobile Services (WT Docket No. 09-66)

Consumer Information and Disclosure (CG Docket No. 09-158); Truth-in-Billing and Billing Format (CC Docket No. 98-170); IP-Enabled Services (WC Docket No. 04-36)

Today we launch three important Notices of Inquiry—each going to the heart of the Commission's core function: protecting and empowering American consumers. This is a most propitious beginning for the first meeting of our fully reconstituted FCC. These items are welcome news. I want to thank Chairman Genachowski for his vision and leadership in bringing these items forward at the outset of his tenure. It shows a commitment that bodes well for the months and years ahead.

The Notices that we are adopting today lay the groundwork for sound public policy-making. They seek to protect consumers in three ways—by searching out new ways for the Commission to facilitate wireless innovation and investment; by improving our ability to promote wireless competition; and by ensuring that consumers of wireless and other services have the information they need to make intelligent choices.

We begin with innovation. More even than the dramatic technology advances of the Twentieth century, the Twenty-first will be about stunning and transformative innovations in technology. Wireless innovations have already empowered consumers in ways unimagined just a few short years ago. Those first seemingly magical devices that carried our voices hither and yon—when everything was working well—are now evolving into robust mobile computers. The wireless industry deserves recognition and credit for how much it has accomplished. But mark me down as one who believes we have only glimpsed the beginning. Much more is coming. How much more depends in significant measure on our country's success in encouraging wireless innovation. There should be no doubt that facilitating further innovations in wireless technologies and services is absolutely crucial to our nation's prosperity and well-being in the Digital Age. We look to industry for much of that. But visionary public policy should always be the handmaiden of private enterprise. That's how we grew this country. Now, once again, we must learn to harness all our national resources for innovation and growth.

One of the great and costly shortfalls of the last decade was a declining national commitment to basic technology research and development. The tsunami of industry consolidation America endured in recent years short-changed research and development because R&D supposedly didn't nourish the quarterly bottom-line in ways sufficiently appealing to speculators-on-the-make. At the same time, government was for the most part exiting its role as an incubator of research and development. These simultaneous private and public cut-backs constituted a double whammy that cost us—consumers, citizens and country—dearly. The National Research Council reported, a couple of years ago, that without enhanced focus on technology research and development the U.S. role as a global leader in technology innovation can only continue to decline. The report showed how industry and government-funded research have decreased considerably over the past several decades. We need to understand these things. We need to act upon them.

With today's Notice on fostering innovation in the wireless communications market, we begin to act. We launch an inquiry to understand how the Commission can better promote innovation and investment in new technologies and services. We ask wide-ranging questions. We seek to better understand where and how key innovations are occurring across the extensive "value chain" of the wireless market. What has gone wrong? Where are the shortfalls? What are other countries doing to promote innovation? We also inquire about ways to improve spectrum management practices to make more spectrum available for innovative services. For example, do technology innovations create new opportunities for accessing or sharing spectrum? What are they? How can we revise our rules to enable greater access for those with new products and services that Americans want? How can we do a better job as an agency addressing interference protection concerns and the conflicting claims of contending parties so that rulemakings do not continue to languish? What rule changes do we need to make as wireless network infrastructure and technologies bring us a flood of new possibilities and new applications? Improving the Commission's analysis and understanding of these matters will substantially enhance our ability to take the actions needed to promote wireless innovation and investment.

I am also pleased that a number of questions in this Notice focus on innovations in wireless devices and applications. The increasing sophistication and complexity of new devices and applications have opened new worlds to millions of consumers. How exactly does the "openness" of wireless networks and devices affect the pace of innovation? Aren't open platforms and open access the kinds of models that best promote innovation? What can we learn from the Internet model, where openness has provided consumers a fantastic world of choice in applications and services? The freedom to choose devices and applications is, I believe, good for consumers and good for entrepreneurs, too.

Wireless technologies and services are not just ends in themselves. These are things that will be called on to help solve many of the critical challenges facing our country—improvements in health care through telemedicine and patient monitoring devices; energy conservation through "smart grids;" education by bringing classrooms to eager learners wherever they may be; and public safety by enhancing the capabilities of our first responders, just to name a few. As we enable wireless technologies and services, we enable America to meet and master these many challenges. I would also say how pleased I am that we will have the opportunity to consider the comments we receive in this Notice as we develop our Congressionally-mandated National Broadband Plan, wherein promoting innovation will be critical to the achievement of our goals. Of course we already have records on some of these issues so that action does not have to wait until next year.

Today we also pave the way for improving the agency's annual *CMRS Competition Report* to Congress by expanding the scope of the report. For years I have advocated the benefits of a more granular, data-driven understanding of the current mobile wireless marketplace. While we have made some limited progress in this regard in recent years, we have a long way to go. In particular, I have remained concerned that the Commission has not yet developed a clearer, more analytically sound standard for evaluating the state of competition that these annual reports are supposed to address.

This is a crucial time to fully understand the state of competition in wireless. It's no secret to most folks in this room that I have been more than a tad critical of the extensive consolidation that has occurred in wireless. While I again applaud the technology and service strides the wireless industry has made, I remain unconvinced that the road we traveled was ideal. The Commission has a statutory duty to prevent undue concentration in the wireless marketplace. We opened the floodgates to consolidation with the repeal of spectrum caps and, more recently, the Commission has been playing unhelpful games with altering spectrum aggregation screens without first completing the necessary analysis on how the use of different frequency bands may affect competition. The time is now, with a new Commission and with a National Broadband Plan in the making, to decide what path to take in order to ensure a more competitive

wireless marketplace.

Today's Notice signals that the Commission is, at last, moving beyond too heavy a focus on what it has classified as "commercial mobile radio service" so that, going forward, we can cover more completely the broader mobile wireless marketplace. The nature of mobile wireless services has evolved significantly in recent years, transitioning from a reliance chiefly on mobile voice services to the increasing use and reliance on mobile broadband services in a variety of forms that connect Americans in myriad new ways. We need to better understand the various segments that comprise the mobile wireless ecosystem. So in this inquiry we seek to identify the retail service and consumer market segments that we should examine – which could include analysis of the market by type of service (such as mobile voice, text, or data), type of device (such as handsets or modem cards), type of subscription (such as prepaid or postpaid), or type of subscriber using the service (such as individual consumers, small businesses, or enterprises). We seek additional data about "upstream" markets (such as spectrum, towers, and backhaul) and "downstream" or "edge" markets (such as applications and content) that may affect mobile wireless competition. And we seek more data regarding the range of choices that consumers have that affect their purchasing decisions. These are the right questions.

Finally, we will consider today a Notice addressing consumer information and disclosure. It inquires how the Commission can better protect consumers by ensuring that they have the information they need when purchasing their communications services. We have not done much of a job on this important element of consumer protection in recent years. Consumers cannot be expected to make informed choices without information that truly informs. I have spoken in the past about, for example, better cell phone mapping being available to consumers when they go in to sign up with a carrier. The situation is arguably better now than it was, but it could have been better sooner and there is still room for improvement. Wireless bills remain a monthly agony for consumers. Ask my wife who pays our bills about how much she looks forward to *that* envelope arriving in the mail each month!

Consumer protection must always be front-and-center as we discharge our public interest obligations, and in a market that I think is less than maximally competitive, that's not just good public policy—it is essential public policy. If information is power, consumers too often lack power. So as the Digital Revolution transforms our lives, let's make sure that consumers have the information they need to select and maintain the products and services that serve them best.

I am also very pleased that this Notice asks whether the Commission's truth-in-billing rules—which currently apply only to wireline and wireless voice services and then, as I've remarked, not always adequately—should be extended to broadband Internet access service and subscription video services. The Digital Age is a time of communications convergence wherein voice, video and broadband services are more and more intertwined. Double, triple and quadruple play services are now offered by single or partnered service providers. I am pleased that, finally, with this item, the Commission begins to examine what information should be readily available to consumers who seek to protect and empower themselves when selecting, maintaining or switching these new services.

In sum, these Notices are good news. By issuing them, we endeavor to become the more pro-consumer agency that we were originally conceived to be—and must yet become. But let there be no doubt that these Notices represent only the beginning of the process. NOIs begin proceedings; NPRMs breathe direction into them; Commission Orders bring the change. I hope, and I believe, that this Commission will act with a sense of urgency in getting from NOIs to final Orders. That's fundamental to doing our job for the American people.

Again, I appreciate the leadership of the Chairman and the input of all my colleagues, two

of whom didn't have exactly an abundance of time to consider these items. And I thank the staff from all the different bureaus and offices that has collaborated in the preparation of these proceedings. A job well done!

**STATEMENT OF
COMMISSIONER ROBERT M. MCDOWELL**

Re: Fostering Innovation and Investment in the Wireless Communications Market (GN Docket No. 09-157); A National Broadband Plan For Our Future (GN Docket No. 09-51)

I congratulate Ruth Milkman and the Wireless Bureau team, as well as Julie Knapp and the fine folks in the Office of Engineering & Technology, for their work on this thoughtful, comprehensive notice. As our inquiry acknowledges, the Commission's policies in the wireless sector have helped encourage and enable the innovation that defines today's wireless marketplace. Likewise, policies that foster continued innovation have spurred capital investment in wireless and brought advanced services to American consumers.

Furthermore, according to the *Thirteenth Wireless Competition Report*, released by our Wireless Telecommunications Bureau in January, 2009, more than 95 percent of the U.S. population is able to choose among at least three mobile service providers, and more than 60 percent is able to choose among at least five competing providers. At the same time, more competition is coming over the horizon with the build out of the AWS-1, 700 MHz, white spaces, and more. Prices have been decreasing, while functionality, innovation and choice have been increasing. As a result, wireless technology has penetrated broadly and quickly across America.

Even at present, in the midst of the worst economy in decades – an economy that seems only to shrink – the communications sector, which includes wireless technologies and services, intends to plow as much as \$80 billion this year alone into capital expenditures that are making broadband services faster, more available, and more affordable. Few, if any, sectors can make such a claim. In short, the phenomenal success of the wireless sector shows how well a light regulatory touch works.

While today we unanimously support the Commission seeking to develop a framework for analyzing wireless innovation, and the relationship between innovation and investment, where we go from here is not yet clear. But where we have *been* is clear: The Commission's longstanding policy to allow competitive market forces, rather than command-and-control regulations, to foster the development of and investment in wireless networks and services has led to remarkable advances. Thus, I hope that we will proceed with care; mindful that any future action we consider should aim to *attract* more private investment capital, rather than deter it.

Finally, I want to note my preference for a more pragmatic comment period. Thirty days from the release date of the inquiry – presumably thirty days from today – in my view, does not provide parties with adequate time to collect, organize, and submit insightful information. While I appreciate the idea of including the comments filed in this proceeding in the docket associated with the National Broadband Plan, I am concerned that we may shortchange both inquiries by not allowing adequate time for meaningful input on the challenging legal and economic questions raised here.

Again, I thank the Chairman for his leadership and staff for its work. I look forward to working with you, and all interested parties, to learn more about innovation and investment in the wireless marketplace.

**STATEMENT OF
COMMISSIONER MIGNON L. CLYBURN**

Re: Fostering Innovation and Investment in the Wireless Communications Market (GN Docket No. 09-157); A National Broadband Plan For Our Future (GN Docket No. 09-51)

It is very exciting to embark on this quest to expand and inform our understanding of key innovations in the wireless market. At the outset, I want to thank Chairman Genachowski for his leadership in initiating this Notice of Inquiry which is intended to build on already successful policies in this critical sector.

The wireless marketplace continues to evolve. The past decades of technological advancements and innovations in software, content and handsets are remarkable, capturing the attention of consumers across all demographics. The inquiry we start today is designed to canvass specific areas of wireless innovation, understand any regulatory encumbrances, and elicit new information on how to best promote and enable wireless innovations. I think our efforts here, combined with today's inquiry into competitive conditions in the mobile wireless market, are important steps in the right direction. The extent to which our inquiry will lead to greater competition and innovation in the wireless market can only inure to the benefit of the American consumer.

I am particularly pleased that this item seeks comment on the best methods for repurposing spectrum and the cost factors associated with such reallocations. The questions we raise regarding access models and mechanisms are equally important. As this Notice correctly recognizes, spectrum availability for new services and applications is an ongoing challenge and a handicap on wireless innovation. I greatly look forward to hearing from all of you on ways we can spur the innovative and intensive use of spectrum.

Finally, I am well aware of the protracted interference disputes that can arise when new services and devices are sought to be introduced into a particular shared or adjacent spectrum band. So I'm pleased that this item raises questions regarding alternative approaches to managing spectrum interference. I'm eager to hear back from the public on this and all of the other important questions raised in this Notice.

I thank the staff of both the Wireless Bureau and the Office of Engineering and Technology for your hard work on this item which I'm pleased to support.

**STATEMENT OF
COMMISSIONER MEREDITH A. BAKER**

Re: Fostering Innovation and Investment in the Wireless Communications Market (GN Docket No. 09-157); A National Broadband Plan For Our Future (GN Docket No. 09-51)

Today, in this *Notice of Inquiry*, we commence a proceeding which will allow the Commission to obtain comprehensive information about innovation in the wireless industry. I am encouraged to see the Commission undertake a thorough review of its policies and procedures to ensure that we do all we can to continue to foster and encourage competition, innovation, and investment in the wireless sector. I am very pleased that this will be the first vote that I will cast here at the Commission.

I am also pleased that today's *Notice* poses important questions about the critical role spectrum management plays in wireless innovation. Specifically, we hope to acquire a comprehensive understanding of developments that will promote greater access to and more efficient uses of spectrum.

At the outset, I want to note that this *Notice* will likely produce many recommendations for Commission action. We must be wary, however, of implementing policies that could benchmark innovation and unintentionally hinder possible new entrants, technologies, and business models. Rather, any future action that arises as a result of this *Notice* should ensure that capital investment will not be deterred and that innovation continues to flourish to the benefit of the American consumer. Over the past ten years, the nation's wireless industry has witnessed unparalleled innovation and growth. In fact, the wireless industry has grown at well over 16 percent per year outpacing the remainder of the economy which has grown at a rate of a little more than 3 percent per year,⁸¹ and, over the past seven years, wireless providers have invested \$22.8 billion per year, on average, to upgrade networks to provide broadband services.⁸² We stand on the verge of the next generation of wireless broadband products and the government should proceed with great caution so as to ensure the best outcome for consumers.

I thank the Chairman for taking into account my concerns regarding the Commission's statutory authority to regulate some of these areas.

While more detailed information is helpful, I would like to raise the issue of the potential burden on interested parties. We are releasing this *Notice* concurrently with our important inquiry on mobile wireless competition, and I question whether stakeholders will have the ability to submit substantive responses in both proceedings. While we do not know what this inquiry will yield, in determining our next steps, we should be mindful of our past successes and continue to refrain from imposing unnecessary and burdensome regulatory obligations on industry.

Finally, I want to thank the staffs of the Wireless Telecommunications Bureau and Office of Engineering and Technology for this thorough and comprehensive item. I look forward to contributing my views and engaging in this debate with staff, interested parties, the Chairman, and my fellow Commissioners. Ongoing wireless market innovations – whether handset functionality, 4G technologies,

⁸¹ Harold Furchtgott-Roth, *The Wireless Services Sector: A Key to Economic Growth in America*, 2008 Report (January 2009).

⁸² Letter from Christopher Guttman-McCabe, Vice President, CTIA – The Wireless Association, to Chairman Julius Genachowski, Commissioner Michael J. Copps, Commissioner Robert M. McDowell, Federal Communications Commissions, at 1-2 (July 9, 2009) (this figure does not incorporate investments made by wireless providers to acquire certain spectrum at auction or to develop handsets and applications).

smart antennas, or software defined radios, to name a few – are the key behind greater productivity and improved gateways to information that enhance the lives of American consumers and our economy. I hope this Notice will help inform what we at the FCC can do to ensure that America continues to be a world leader in the next generation of wireless innovation.