Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands	)	ET Docket No. 03-237

COMMENTS OF THE WIRELESS COMMUNICATIONS ASSOCIATION INTERNATIONAL, INC.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

As the trade association of the wireless broadband industry, the Wireless Communications Association International, Inc. ("WCA") has a direct and immediate interest in the Commission's *Notice of Inquiry* and *Notice of Proposed Rulemaking* ("*NOI*" and "*NPRM*," respectively) in this proceeding. WCA consistently has supported the agency's efforts to shed obsolete legacy regulation in favor of flexible use and secondary market policies that rely on the marketplace, not regulation, to drive technological innovation and promote greater spectral efficiency. Thus, WCA applauds the Commission's desire in this proceeding "to promote more efficient use of the spectrum." WCA fears, however, that the interference temperature paradigm contemplated by the *NOI/NPRM* (and particularly the proposal to rely on an interference temperature metric to "force feed" low-power underlays into licensed spectrum) is a step in the wrong direction.

Certainly, WCA agrees with the fundamental technical premise that interference will occur at any given receiver at any given point in time when the cumulative level of undesired signals plus noise at the receiver exceeds its tolerance threshold. Similarly, WCA agrees that at any given point in time the same receiver will not suffer interference where the cumulative level of undesired signals plus noise at the receiver falls below its tolerance threshold. These basic principles, however, do not mean it is legal or desirable from a policy perspective for the Commission to rely on an interference temperature metric to force low-power underlays into licensed spectrum. Moreover, there is no evidence that the interference temperature metric is a feasible means of protecting licensees from harmful interference caused by underlay devices. At most, reliance on an interference temperature metric may at some time in the future permit low-power underlays in isolated cases where the "overlaid" licensed service utilizes relatively few receivers installed at fixed, known locations. For the reasons discussed herein, it cannot and should not be applied to spectrum that is allocated for services where receivers are portable or mobile or are at fixed locations that need not be registered with the Commission (including the CMRS services, WCS, MDS and ITFS, DEMS, 28 GHz and 38 GHz services provided by WCA's constituents).

First and foremost, the *NOI/NPRM* is mistakenly premised on the assumption that reliance on the interference temperature metric to force underlays into licensed spectrum will promote, rather than preclude, innovation. The irony here is that the Commission is well aware that technology and consumer demand increasingly are driving licensed wireless services towards low power architectures that permit substantial increases in spectral efficiency, and the *NOI/NPRM* speaks of that trend in glowing terms. Lost in the Commission's enthusiasm for forcing underlays based on an interference temperature metric is the fact that forced underlays will put a stick in the spokes of the wireless industry's movement towards lower power facilities, thereby stalling the industry's efforts to achieve greater spectral efficiency through increased frequency reuse. And, along similar lines, it will deter licensees from deploying higher modulation densities designed to improve spectral efficiency.

The preclusive effect of forced underlays is patent. As discussed in the *NOI*, a Commission-designated interference temperature "cap" will represent an upper bound on the potential RF energy that can be introduced in any given frequency band. Theoretically, once the Commission sets the interference temperature cap at "X" degrees for a particular licensed frequency, underlay services would be permitted to operate so long as their contribution of RF

energy keeps that frequency's interference temperature below that level. Even assuming that the Commission can properly set an interference temperature benchmark that protects licensees' current operations and can effectively police compliance with that benchmark (and those are assumptions WCA cannot, and the Commission should not, make), the problem is that in setting the cap at "X" degrees to protect today's services, the Commission is likely to leave insufficient margin to accommodate future licensee innovations designed to promote spectral efficiency. In other words, a licensee may be effectively precluded from achieving greater spectral efficiency in the future by reducing power or increasing modulation density, since the Commission will have allowed the spectrum to be littered with low-power underlay devices that, while benign relative to the licensee's current technology, cause harmful interference to its future technology. The net result effectively locks licensed service providers, equipment vendors and consumers into a level of spectral efficiency defined by a regulatory construct (the interference temperature cap) rather than the marketplace – in other words, "command and control" *redux*.

Forcing underlays based on an interference temperature metric also raises daunting legal and practical difficulties that render the entire concept unworkable in most, if not all, cases. As a preliminary matter, WCA believes it is impossible to square the concept of forced underlays with the rights wireless licensees have spent billions to acquire at auction. Moreover, and more importantly, the Commission itself concedes it is still not proven that technology can assure the interference temperature cap is not exceeded at licensees' receivers. While the *NOI/NPRM* presents several theoretical scenarios as to how forced underlays could be implemented based on the interference temperature metric, WCA is unable to envision a single practical mechanism by which licensees can operate without risk of interference from forced underlay devices.

Since the fundamental premise here is that interference only occurs when the interference temperature cap is exceeded at a given licensed receiver, the most effective (but hardly fail-safe) approach to implementing forced underlays is to provide all licensed receivers with interference temperature "thermometers" and location identification technology, plus the ability to transmit pertinent location and interference temperature information to all underlay devices close enough to the receiver to pose a threat of exceeding the cap were they to transmit at maximum power. Those forced underlay devices will similarly need to be equipped with location identification technology so that they can calculate their location relative to licensed receivers, as well as the intelligence to calculate their own contribution to the interference temperature cap at each licensed receiver. However, this solution fails to prevent interference when multiple underlay devices commence transmissions at or about the same time, depends on technology that is unproven and, in any event, is not practical given the significant costs, increased spectrum requirements and adverse impact on receiver form factor and power consumption requirements associated with its implementation.

The *NPRM/NOI* presents other approaches that, while more perhaps practical, inevitably become less precise and thus subject receivers in licensed services to a greater risk of harmful interference from underlay operations. For example, the *NOI/NPRM* raises the possibility of a grid of monitoring stations capable of measuring the interference temperature and transmitting pertinent information to underlay devices. Putting aside the question of who will pay for building and operating this network and what spectrum will be used to provide the network-to-underlay device communications, even the Commission appears to recognize in its parallel docket on cognitive radio that no monitoring grid can be sufficiently granular to serve as absolute insurance against violation of the interference temperature cap. Thus, the *NOI/NPRM*

presents an even more simplistic approach – having each underlay device merely measure the interference temperature at its own location and only transmit if its own contribution to the interference temperature would not exceed the cap. While certainly simple, this approach ignores the very real possibility that the interference temperature will be higher at licensed receivers than at the underlay device itself, and that the interference temperature cap at these licensed receivers will be exceeded by the underlay transmissions.

Fortunately, however, the Commission need not go down the road of forced underlays to promote increased access to spectrum. Rather than establish a regulatory mandate for forced underlays via interference temperature, the Commission can and should rely on secondary markets to define when (if at all) underlays on licensed spectrum are appropriate, and permit licensees and spectrum lessees to establish the terms and conditions of those underlays via arms-length negotiations. As recognized by the Commission's Spectrum Policy Task Force, secondary markets correctly assume that licensees have economic incentives to maximize revenues from their spectrum, and are in the best position to know how their spectrum can be deployed in the most efficient manner. Secondary markets thus give each licensee the opportunity to determine on an individual, case-by-case basis – in its discretion and under terms of its own choosing – whether to make capacity on its spectrum available. At the same time, secondary markets provide potential underlay users a ready means of obtaining access to licensed spectrum best suited for their business needs. Because the contractual relationship will be crafted to reflect specific marketplace requirements, it can impose specific interference protection standards, establish specific interference mitigation procedures, and contain specific cost allocations (including allocations of interference mitigation costs) that cannot possibly be accomplished under "one size fits all" concepts like interference temperature.

Finally, while WCA understands the Commission's desire to obtain some "real world" feedback on how the interference temperature model might work in specific bands, the *NPRM*'s proposal to immediately implement interference temperature in the fixed service ("FS") and fixed satellite service ("FSS") uplink band at 6525-6700 MHz and the FS/FSS/BAS/CARS band at 12.75-13.25 GHz band will supply little relevant information to licensed wireless providers who provide a far more diverse range of services over lower powered facilities in other spectrum. As an initial matter, the contemporaneous comments filed in this proceeding on behalf of licensees in those bands strongly suggest that the Commission has underestimated their potential interference risk if underlays are forced into their spectrum. In any case, the Commission itself acknowledges, the 6525-6700 MHz and 12.75-13.25 GHz bands were chosen because (1) a receiver in these bands would not be located in close proximity to any potentially interfering unlicensed device, and/or (2) there is already extensive sharing of spectrum in these bands between high-powered licensed services. Relatively few frequency bands share these characteristics, and certainly not those which are used to provide mobile or portable voice or broadband services over cellularized systems. Failure to appropriately account for these distinctions could have potentially devastating "real world" consequences for licensed wireless service providers.

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Metric to Quantify and Manage Interference	)	ET Docket No. 03-237
and to Expand Available Unlicensed Operation	)	
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Frequency Bands	)	

COMMENTS OF THE WIRELESS COMMUNICATIONS ASSOCIATION INTERNATIONAL, INC.

The Wireless Communications Association International, Inc. ("WCA"), by its attorneys, hereby submits its comments in response to the Commission's *Notice of Inquiry* and *Notice of Proposed Rulemaking* ("*NOI*" and "*NPRM*," respectively) in the above-captioned proceeding.[1]

I. INTRODUCTION.

As the trade association of the wireless broadband industry, WCA has a direct and immediate stake in this matter.[2] The Commission's proposed interference temperature metric represents, as the *NOI* puts it, "a fundamental paradigm shift in the Commission's approach to spectrum management by specifying a potentially more accurate measure of interference that takes into account the cumulative effects of all undesired RF energy, *i.e.* energy that may result

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[1] FCC 03-289 (rel. Nov. 28, 2003).

[2] WCA's members include licensees, system operators, equipment manufacturers and consultants involved in the provision of wireless broadband services over licensed frequencies allocated to the Multipoint Distribution Service ("MDS"), Instructional Television Fixed Service ("ITFS"), Wireless Communications Service ("WCS"), Local Multipoint Distribution Service ("LMDS"), the 39 GHz service and the "millimeter wave" (70/80/90 GHz) services, as well as the unlicensed spectrum in the 902-928 MHz, 2.4 GHz and 5 GHz bands. Whether in its own name or through
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in interference from both transmitters and noise sources, that is present at a receiver at any time."[3] Certainly, WCA agrees with the fundamental technical premise that interference will occur at any given receiver at any given point in time when the cumulative level of undesired signals plus noise at the receiver exceeds its tolerance threshold. Similarly, WCA agrees that at any given point in time the same receiver will not suffer interference where the cumulative level of undesired signals plus noise at the receiver falls below its tolerance threshold. These basic principles, however, do not mean it is legal or desirable from a policy perspective for the Commission to rely on an interference temperature metric to force low-power underlays into licensed spectrum. Nor do they mean that the interference temperature metric is a feasible means of protecting all licensees from harmful interference caused by underlay devices.

Of course, the Commission should continue to "consider more flexible and market-oriented approaches [to spectrum management] that can provide incentives for users to migrate to more technologically innovative and economically efficient uses of the spectrum."[4] This philosophy lies at the core of WCA's efforts to promote flexible use models in both the licensed and unlicensed spectrum bands.[5] The *NOI* and *NPRM*, however, move the Commission into

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the License-Exempt Alliance, WCA has initiated or participated in virtually every major Commission proceeding relating to deployment of spectrum for wireless broadband service.

[3] *NOI* at ¶ 1.

[4] *Id.* at ¶ 6.

[5] Those efforts have included, for example, the creation of new rules to promote use of second generation technology in the Multipoint Distribution and Instructional Television Fixed Services ("MDS" and "ITFS," respectively), the establishment of a new streamlined licensing system for wireless service providers in the 70/80/90 GHz bands, and, through the License-Exempt Alliance, allocation of more unlicensed spectrum and modification of the Commission's Part 15 rules to enhance the ability of unlicensed service providers to deliver both short range Wi-Fi and wide-area broadband services. *See* Letter from Wireless Communications Ass'n Int'l, *et al.*, to

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unchartered and potentially dangerous territory – notwithstanding the Commission's recognition that the "[a] general implementation of the interference temperature approach would involve planning, study of existing RF noise and interference levels and other factors, and transition processes that would take a substantial amount of time to complete,"[6] it clearly is attempting to position the interference temperature metric as a near-term vehicle for facilitating forced underlays on licensed spectrum.[7]

Although no doubt well-intentioned, the Commission's proposal to force underlays into licensed spectrum through the interference temperature metric will actually thwart technological innovation, and raises a host of legal and practical problems that render the use of the interference temperature concept to force underlays unworkable in most frequency bands. At most, reliance on an interference temperature metric may at some time in the future permit low-power underlays in isolated cases where the "overlaid" licensed service utilizes relatively few receivers installed at fixed, known locations.[8] However, it cannot and should not be applied to

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Michael K. Powell, Chairman, Federal Communications Commission, ET Docket No. 00-258 (filed July 11, 2002); Comments of Wireless Communications Ass'n International, WT Docket No. 02-146, at 14-20 (filed Nov. 1, 2002); Comments of License-Exempt Alliance, ET Docket No. 03-201 (filed Jan. 23, 2004).

[6] *NOI* at ¶ 4.

[7] *Id.* at ¶ 1 ("To the extent that the interference temperature limit in a band is not reached, there could be opportunities for other transmitters, whether licensed or unlicensed, to operate in the band at higher power levels than are currently authorized."). *See also id.* at ¶ 9 (seeking comment on "whether unrealized opportunities exist for unlicensed, low-power users to access spectrum, and whether changes to the Commission's approach for managing interference would enhance access to the spectrum by such users.").

[8] In such situations it may be possible, for example, to limit the transmissions of underlay devices near fixed receivers via use of GPS technology and databases of where fixed receivers are located. *See Facilitating Opportunities for Flexible, Efficient and Reliable Spectrum Use Employing Cognitive Radio Technologies*, ET Docket No. 03-108, FCC 03-322, at ¶ 28 (rel.

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spectrum that is allocated for services where receivers are portable or mobile or are at fixed locations that need not be registered with the Commission (including the CMRS services, WCS, MDS and ITFS, DEMS, 28 GHz and 38 GHz services provided by WCA's constituents).

Fortunately, a solution is readily available here. Consistent with the recommendations of its Spectrum Policy Task Force ("SPTF"), the Commission can and should rely on secondary markets to define when (if at all) underlay operations on licensed spectrum are appropriate, and permit licensees and spectrum lessees to establish the terms and conditions of those easements via arms-length negotiations. The Commission's secondary market policy correctly assumes that the marketplace, not regulatory fiat, is the best means of determining how commercial spectrum should be deployed. To facilitate increased access to spectrum by low-power devices, the Commission should apply this policy across the board (both above and below the interference temperature threshold) and thereby give licensees and potential underlay users an opportunity to forge privately negotiated underlay arrangements that will be far more effective than an artificial regulatory construct in addressing the needs of all affected parties, including consumers.

Dec. 30, 2003) ("*Cognitive Radio NPRM*"). Of course, that is not truly an application of interference temperature, since the underlay device would presumably never be permitted within the exclusion zone. However, as discussed *infra*, the Commission also has recognized that it is very possible for "rogue" underlay devices to circumvent these mechanisms and cause harmful interference to licensed services. Moreover, comments being filed in this proceeding by the Fixed Wireless Communications Coalition (which represents fixed service interests) indicate that even here the Commission has underestimated the risk of interference created by forcing underlays onto licensed spectrum.

II. DISCUSSION.

A. Use Of The Interference Temperature Metric To Force Underlays Onto Licensed Spectrum Will Thwart The Technological Innovation The Commission's Spectrum Policies Are Supposed to Promote.

While the Commission rightly asserts that it "need[s] to provide opportunities for an ever increasing array of new digital radio technologies and services and to allow licensees to implement and modify these new technologies and services in accordance with the demands of market forces,"[9] the issue here is whether forcing underlays onto licensed spectrum via an interference temperature metric will achieve the SPTF's objectives more effectively than secondary markets. The answer, WCA submits, is no.

To the contrary, WCA respectfully submits that introduction of forced underlays through application of the interference temperature metric presents a clear and present danger to future improvements in spectral efficiency. Virtually without regard to the spectrum at issue, the Commission has sounded a constant theme of late in its effort to improve spectral efficiency – the promotion of cellular, low power network architectures that reuse spectrum and thus improve spectral efficiency. As reiterated even in the *NOI/NPRM*:

> We continue to believe that our focus should be toward decreasing power levels whenever possible. Such efforts will enable us to better manage, and make more efficient use of the spectrum.[10]

That focus, combined with the Commission's "hands off" approach to regulating technology choices by service providers, has much to do with the cellular telephone industry's highly successful evolution from high-power (but not particularly efficient) analog services to

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[9] *NOI* at ¶ 6.

[10] *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands*, WT Docket No. 02-353, FCC 03-251, at ¶ 100 (rel. Nov. 25, 2003).

more robust, spectrally-efficient lower power digital services that are providing consumers with a wide variety of new services through increasingly smaller handsets. Indeed, while one can only speculate, it is a good guess that had the Commission established an interference temperature cap for analog cellular telephone frequencies in the 1980s and allowed low-power underlay devices to litter that spectrum, more than a few of the innovative services provided by cellular telephone licensees today would have been impossible. As noted by Cingular:

> The move toward digital service has further lowered the power levels being transmitted at cellular frequencies, thereby reducing prevailing self-interference levels. As a result, the interference level resulting from signals of undesired mobile units has decreased dramatically, causing a reduction in the overall noise plus interference floor at base station receive sites. In addition, the system noise floor has also been reduced by improvements in base station receiver performance, with the noise figure dropping from about 8 dB to about 4 dB, permitting a further reduction of about 4 dB in the received noise floor.[11]

Similarly, as observed by AT&T Wireless:

> The CMRS industry continues to identify technologies that drive receivers' threshold sensitivity levels lower and lower – closer and closer to the thermal noise level for TDMA and GSM systems and even below the thermal noise floor for some IMT-2000 systems. A policy of underlay operations would undermine exclusive use licensees' ability to maximize the use of their licensed spectrum and would undercut the Commission's market-oriented spectrum licensing regime.[12]

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[11] Comments of Cingular Wireless LLC, ET Docket No. 03-126, at 7 (filed Aug. 21, 2003).

[12] Comments of AT&T Wireless Services, Inc., ET Docket No. 03-126, at 5-6 (filed Aug. 21, 2003). *See also Year 2000 Biennial Regulatory Review – Amendment of Part 22 of the Commission's Rules to Modify or Eliminate Outdated Rules Affecting the Cellular Radiotelephone Service and other Commercial Mobile Radio Services*, 17 FCC Rcd 18401, 18409-10 (2002) ("In the years since the cellular service was established, many CMRS providers using digital technology, particularly broadband PCS and SMR services, have developed and established a strong market presence. When the rules for market-based PCS and SMR services were established, the Commission declined to impose technological compatibility rules, and allowed carriers the flexibility to implement air interface technologies of their own choosing. In the absence of a Commission-mandated standard for PCS and SMR, carriers have nonetheless established systems providing seamless nationwide service in response to customer demand.") (footnotes omitted); Report of the Interference Protection Working Group, Spectrum Policy Task

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Indeed, as reflected in prior comments filed by Verizon, use of the interference temperature model to permit forced underlays would have crippled the development of CDMA technology, which relies on lower power to achieve spectral efficiency:

> Since the interference temperature analyzes the "worst case" scenario for interference under current technology and spectrum usage conditions, it precludes the licensee from implementing new technologies that may improve spectral efficiency and providing communications at levels that may not be possible today. Consider the introduction of CDMA technology – designed to replace first generation analog technology – less than a decade ago. Due to the inherent processing gain of CDMA systems, receivers have the ability to operate at signal levels that were unattainable with analog systems (i.e., "below the noise floor"). If an interference temperature had been established based on the higher analog signal levels and unlicensed devices were permitted to operate up to this level, it is unlikely that CDMA would have ever developed and the increased efficiency of CDMA cellular networks would not have been realized.[13]

And, of course, the Commission also is aware that broadband wireless service providers are favoring low power architectures that permit the delivery of very high speed data services to small, portable consumer devices (*e.g.*, laptops, PDAs) in a spectrally efficient manner.[14]

Force, Federal Communications Commission, ET Docket No. 02-135, at 41 (Nov. 15, 2002) ("IPWG Report") ("[T]he Personal Communications Service (PCS) at 1850-1990 MHz was conceived from its beginning on the basis of technical flexibility to the licensee to choose the transmission standard that would best achieve the licensee's own concept of service. Within the licensee's service area, the licensee is free to use the technology of its choice to offer the service it deems appropriate, consistent with the few limitations that were imposes. Fewer constraints on the terrestrial mobile (and fixed) services led to greater technical flexibility in the service.") (footnotes omitted).

[13] Reply Comments of Verizon Wireless, ET Docket No. 02-135, at 14 (filed Feb. 28, 2003) (footnotes omitted).

[14] *See, e.g., 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*, 18 FCC Rcd 6722, 6735 (2003) ("[M]ost MDS operators and a substantial proportion of ITFS operators would like to deploy low power, cellularized two-way systems, because they are more spectrally efficient than high-powered systems, can support provision of high-data-rate services to a large number of subscribers, can

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Unfortunately, the Commission's proposal to force underlays onto licensed spectrum subject to an interference temperature cap would throw cold water on this trend towards spectrally efficient, low power services. As discussed in the *NOI*, once the Commission sets the interference temperature cap at "X" degrees for a particular licensed frequency, any underlay device would be permitted to operate on that frequency so long as its contribution of RF energy keeps the frequency's interference temperature below the Commission-designated cap.[15] The Commission theorizes that forcing underlays under this approach would be benign, as a licensed station "would be assured of providing [interference-free] service at all locations where its signal exceeded the level of the interference temperature cap."[16]

The Commission's theory, however, is fundamentally flawed by its failure to consider the adverse consequences on licensee innovation. Even assuming that the Commission can properly set an interference temperature benchmark that protects licensees' current operations and can effectively police compliance with that benchmark (assumptions that WCA cannot, and the Commission should not, make for the reasons set forth below), one overriding problem remains: in setting the cap at "X" degrees to protect today's licensed services, the Commission is likely to leave insufficient margin to accommodate future licensee innovations designed to promote spectral efficiency. In other words, once a cap is set, a licensee may effectively be precluded from achieving greater spectral efficiency via lower power, since the Commission will have

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help overcome obstacles to line-of-sight service, and can more readily support mobile or portable services.") (footnotes omitted); IPWG Report at 11 (Nov. 15, 2002) ("The radio environment will be increasingly characterized by flexible service offerings with a multitude of signal waveforms and by higher densities of low power RF emitters with small signal ranges.").

[15] *See NOI* at ¶¶ 15-16.

[16] *Id.* at ¶ 15.

permitted the spectrum to be littered with low-power underlay devices that, while benign relative to the licensee's current technology, cause harmful interference to future technology.[17]

That, obviously, punishes licensee innovation – as licensed providers pursue lower power levels and maximum spectrum efficiency, they proportionately increase their risk of harmful interference from underlay operations that, but for the interference temperature model, would have no right to occupy their spectrum in the first place.

The potential preclusive effect of an interference temperature cap and forced underlays on innovative technology is hardly speculative. For example, the past few years have produced significant advancements in materials science, providing cryogenically and Peltier cooled receiver front ends and high temperature superconductor receivers. These new developments have enabled the creation of innovative, incredibly sharp filters and ultra-sensitive receiver front-ends, permitting operators to increase their receiver sensitivity while simultaneously lowering handset output power. For the most part, the cost of deploying these innovative technologies currently precludes wide-spread deployment. If, however, the rate of recent discoveries is any indication of the future, sensitivity enhancing devices will find their way into more and more radio systems. Yet, if increased sensitivity is rendered pointless due to arbitrary interference

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[17] *See* Comments of Ericsson Inc, WT Docket No. 03-66, at 10 (filed Sept. 8, 2003) ("[L]icense holders typically design their systems to operate down to the noise floor, one indication of spectrum efficiency. By introducing additional unlicensed devices into the band, the noise floor would necessarily rise. As a result, devices designed to operate in the original noise floor would need potentially major modifications, or they would possibly be rendered obsolete. In either case, it would represent a significant cost burden on the licensee. The rising noise floor would also require operators to install additional base stations just to cover the same geographical area. Again, this would be costly for licensees.").

temperature caps, nascent superconductor industries and the advancements in the state of the radio art that they promise will wither and die.

Interference temperature also is likely to have a chilling effect on the development of advanced antenna technologies. A phased array antenna, for example, consists of a group of radiating elements arranged and driven in such a way that their radiated fields add in some directions and cancel in others.[18] The combined fields can produce a single beam, or multiple beams pointing in various directions while minimizing radiation in other areas.[19] To produce this effect, the system divides the total power from a transmitter among various transmission azimuths and the power may be distributed equally or at varying levels among those azimuths.[20] If configured correctly, such systems can be used to increase spectral efficiency by assigning spectrum usage on a dynamic basis according to user demand and re-using the same frequency to transmit different information to customers who are in different directions. By the same token, a phased array antenna would be extremely complicated to deploy under an interference temperature model, since the system would need to be designed to ensure that the constantly changing power levels of multiple beams never fall below the interference temperature cap and thereby expose the entire system to harmful interference from underlay devices. The added interferers also increase the number of degrees of freedom required of the antenna to null them out, considerably increasing the size and complexity of the antennas.

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[18] *See Modification of Parts 2 and 15 of the Commission's Rules for Unlicensed Devices and Equipment Approval*, ET Docket No. 03-201, FCC 03-223, at ¶ 7 (rel. Sept. 17, 2003).

[19] *Id.*

[20] *Id.* at ¶ 12.

Another example of interference temperature's preclusive effect on innovation is adaptive modulation. Many of the broadband wireless devices used today have the ability to adapt their modulation density based on the quality of the transmission path between transmitter and receiver. In cases where the path is sufficiently low in noise, the devices will increase the modulation density of the transmitted signal and thus allow higher throughput for a given RF path. As the noise level into the receiver increases, however, the devices will lower the modulation density in order to keep the quality of the RF channel at levels necessary for acceptable error rates. In cases where an interference temperature cap has been set at anything other than the noise floor, the potential for devices to take advantage of adaptive modulation and improve channel performance will be significantly diminished. The ultimate result is a reduction in coverage area and an increase in the number of cells required to provide the expected level of service, neither of which are efficient.

In sum, the use of an interference temperature metric to accommodate forced underlays effectively locks licensed service providers, equipment vendors and consumers into a level of spectral efficiency defined by a regulatory construct (the interference temperature cap) rather than the marketplace – in other words, "command and control" *redux*.

B. The Use Of An Interference Temperature Metric To Force Underlays Suffers From a Host of Legal And Practical Problems.

WCA's view that forcing underlays into licensed spectrum is not good spectrum policy represents merely the first layer of its concern – the forcing of underlays into licensed spectrum via the interference temperature metric suffers from a variety of additional flaws that render it highly problematic for most, if not all, spectrum at this time.

The Commission correctly observes that the creation of a viable regulatory framework for interference temperature would require an enormous commitment of time and resources by both

the Commission and the wireless industry.[21] At the same time, however, the SPTF did not intend for the Commission to make interference temperature the centerpiece of spectrum policy reform – rather, it is but one of a number of tools the SPTF has recommended for promoting spectrum efficiency.[22] Indeed, the SPTF has acknowledged that existing flexible use bands are already producing the public interest benefits expected of them, and that accordingly "there is not a significant need for fundamental regulatory changes in these bands in the near term."[23] That, along with "potential cost of transition, both in terms of its impact on incumbents and on the public," should inform the Commission's assessment of the "real world" implications of the interference temperature paradigm for licensees, their equipment suppliers and consumers.[24]

It must not be forgotten that any *post hoc* mechanism for forcing underlays onto licensed spectrum must be squared with the interference protection rights and freedom to innovate that licensees have spent billions for in acquiring spectrum through the Commission's auction process. As WCA has highlighted in other proceedings, the D.C. Circuit "start[s] from the intuitive premise that an agency cannot, in fairness, radically change the terms of an auction after

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[21] *NOI* at ¶ 6. *See also* Report of the Spectrum Policy Task Force, Federal Communications Commission, ET Docket No. 02-135, at 23 ("SPTF Report") ("The Task Force believes that in order for the Commission to be able to meet the increasingly complex spectrum management demands being presented by the enormous growth in spectrum use, the Commission must devote sufficient resources to monitoring spectrum use and enforcing the spectrum management rules. The Task Force recommends that the Commission undertake an examination of its field offices' and monitoring facilities' needs and consider providing additional funding and resources to accommodate the spectrum management proposals made in this Report. In addition, the Commission should ensure that it has sufficient resources to independently obtain critical spectrum management data for decision makers and the ability to implement the proposals discussed in this Report.").

[22] *See id.* at 20-21, 46.

[23] *Id.* at 46.

the fact,"[25] and has confirmed that "a bidder in a government auction has a 'right to a legally valid procurement process'; a party allegedly deprived of this right asserts a cognizable injury."[26] It is also clear that post-auction decisions that defeat the auction process are actionable, even where the auction itself was conducted properly – as the D.C. Circuit has noted, "[t]here is no basis for suggesting . . . that *ex post* changes can never affect the validity of a government auction."[27] Equally important, Congress has directed the Commission to conduct its auctions in a manner that promotes, *inter alia*, "the development and rapid deployment of new technologies, products and services for the benefit of the public" and "the efficient and intensive use of the electromagnetic spectrum."[28] Rather clearly, adoption of interference temperature or any other regulatory model that thwarts innovation on auctioned spectrum would defeat this statutory mandate.

It is fair to say, then, that the Commission puts the integrity of its auction process at risk when it makes a post-auction decision to permit potentially interfering underlays on spectrum already bought and paid for by winning auction bidders who had no opportunity to factor those

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[24] *Id.*

[25] *U.S. Airwaves v. FCC*, 232 F.3d 227, 235 (D.C. Cir. 2000) ("*U.S. Airwaves*").

[26] *Id.* at 232, *quoting DIRECTV, Inc. v. FCC*, 110 F.3d 816, 829 (D.C. Cir. 1997).

[27] *Id.* at 232.

[28] *FCC Report to Congress on Spectrum Auctions*, 13 FCC Rcd 9601, 9616 (1997); *see also* 47 U.S.C. § 309(j)(3). In the case of MDS, for example, the Commission has emphasized that an MDS Basic Trading Authority ("BTA") auction winner may provide services beyond those provided at the time of the auction – indeed, the Commission adopted the MDS BTA licensing system to "[provide] both new and incumbent operators with maximum flexibility *to improve and expand service* and implement digital technologies." *Amendment of Parts 21 and 74 of the Commission's Rules With Regard to Filing Procedures in the Multipoint Distribution Service and in the Instructional Television Fixed Service*, 10 FCC Rcd 13821, 13836 (1995)(emphasis added).

underlays into their valuation of their spectrum. Similarly, failure to provide winning auction bidders with the interference protection they reasonably anticipated undermines their legitimate investment-backed expectations, and arguably is tantamount to an unlawful taking of property under the Fifth Amendment which, if not reversed, may leave the Commission vulnerable to a potentially endless parade of Tucker Act lawsuits in the Federal Court of Claims.[29]

But even leaving those serious legal impediments to imposing forced underlays onto auctioned spectrum aside, the use of the interference temperature metric to force underlays raises daunting practical difficulties that render the entire concept unworkable for most, if not all, licensed wireless services. While the *NOI/NPRM* presents several theoretical scenarios as to how underlays could be implemented based on the interference temperature metric, WCA is unable to envision a single practical mechanism by which licensees can operate without risk of interference from forced underlay devices.

As a starting point, the Commission's proposed mechanisms for monitoring interference temperature and controlling transmissions by underlay devices are not a reliable vehicle for protecting licensees from *all* potential harmful interference from underlay devices – even proponents of underlays concede that such protection is not possible.[30] Regardless of the monitoring and control mechanism used, it is inevitable that (1) multiple underlay devices will independently but simultaneously conclude that there is sufficient room under the Commission-designated interference temperature cap for their transmissions, (2) the resulting simultaneous

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[29] *See Penn Central Transportation Co. v. New York City*, 438 U.S. 104, 124 (1978).

[30] *See, e.g.,* Reply Comments of Microsoft Corporation, ET Docket No. 03-65, at 4 (filed Aug. 18, 2002) ("In any band in which the Commission authorizes underlay devices, there will be a non-zero possibility of interference.").

transmissions of those underlay devices will cause the interference temperature cap to be exceeded at a licensed receiver, and (3) the licensed service associated with that receiver will suffer harmful interference for an indeterminate period of time until the monitoring mechanism detects the problem and notifies the aberrant underlay devices of the problem, *and* those devices take whatever steps are necessary to eliminate the interference.[31] The dangers to licensed services of this inevitable latency in underlay devices' compliance with the cap are self-evident, and no proponent of forced underlays has yet to advance a technological solution. Until someone does, it is impossible to square the forced underlay concept with the Commission's assurance that licensed services "would be assured of providing [interference-free] service at all locations where its signal exceeded the level of the interference temperature cap" and would enjoy "certainty regarding the maximum permissible level of interfering RF energy in the bands in which they operate."[32]

That said, since the fundamental premise here is that interference only occurs when the interference cap is exceeded at a given receiver, the most effective (but hardly fail-safe) approach to implementing underlays is to provide all licensed receivers with interference

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[31] In the *NPRM*, where it is proposing to actually implement the interference temperature model in the licensed bands at 6525-6700 MHz and 12.75-13.25 GHz, the Commission attempts to minimize the problem by noting with no supporting evidence that "unlicensed devices would not all be in operation at the same time; would not have their emissions intentionally directed towards the fixed service receiver; and could have different path attenuations due to varying intervening objects between them and the FS receiver." *NOI* at ¶ 41. Given the inherently unpredictable nature of transmissions by underlay devices, WCA is mystified as to how the Commission could make such an assumption. In any event, it is simply wrong to assume that independent, simultaneous transmissions will not occur among potentially millions of "underlaid" devices in the marketplace (licensed or unlicensed), and that those transmissions will not create unpredictable periods of harmful interference to licensed receivers.

[32] *NOI* at ¶ 15.

temperature "thermometers" capable of distinguishing desired from undesired signals and noise (which is no trivial technical feat) and GPS or other location identification technology, along with the capability of transmitting pertinent location and interference temperature information to all underlay devices close enough to the receiver to pose a threat of exceeding the cap were they to transmit at maximum power.[33] Those forced underlay devices will similarly need to be equipped with location identification technology so that they can calculate their location relative to licensed receivers, as well as the intelligence to calculate their own contribution to the interference cap at each licensed receiver. Not only is this approach not 100% effective, it is impractical due to the significant costs it imposes on licensed incumbents, the increased spectrum requirements and the adverse impact on receiver form factor and power consumption associated with its implementation.

Indeed, this proposal raises a host of questions. What spectrum would the receivers in the licensed services transmit on? Certainly the Commission is not contemplating requiring licensees to surrender some of their own licensed spectrum to support a channel devoted to communicating with underlay devices? If all licensed receivers have to incorporate the capability of transmitting on some additional band to underlay devices, who is to bear the cost of incorporating that capability? Certainly the Commission is not contemplating requiring licensees to incorporate this capability at their own expense when the manufacturers and users of underlay devices will be the beneficiaries? And, how will the Commission explain to consumers of

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[33] *See id* at ¶ 11. Of course, underlay devices would also have to include GPS or other location identification technology, the ability to receive signals from licensed receivers, and the ability to calculate the impact their operations would have on the interference temperature at the licensed receiver.

licensed services that the form factor of their wireless devices has increased in size, and their battery life has decreased, because the Commission has mandated that all devices have the capability to transmit to underlay devices that may or may not ever prove commercially viable?

Indeed, the *NOI/NPRM* concedes the serious practical problems associated with converting all receivers in the licensed services into interference temperature thermometers and transmitters for the benefit of underlay devices, and suggests that it only be implemented in services "such as those involving fixed point-to-point operations where there are relatively few receive sites in a given area."[34] While it certainly would be easier to implement such a system in that case, the *NOI/NPRM* still begs the question of who will pay the costs associated with developing such a system and what spectrum will be used to communicate from licensed receivers to underlay transmitters. WCA will watch with interest to see how those promoting forced underlays address these questions.

Recognizing that this approach to ensuring protection of receivers in most licensed services is not practical, the *NOI/NPRM* presents other constructs that, while perhaps more practical, inevitably are less precise and thus subject receivers in licensed services to a greater risk of harmful interference from underlay operations. For example, the *NOI/NPRM* raises the possibility of a grid of monitoring stations capable of measuring interference temperature and transmitting pertinent information to underlay devices.[35] Putting aside the question of who will pay for securing and maintaining tower space and roof rights, building, operating and maintaining this monitoring network and what spectrum will be used to provide the network-to-

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[34] *Id.*

[35] *See id.* at ¶ 12.

underlay device communications, even the Commission appears to recognize in its parallel docket on cognitive radio devices that no monitoring grid can be sufficiently granular to serve as absolute insurance against violation of the interference temperature cap.

Again, it must be emphasized that the *NPRM/NOI* promises that if forced underlays are introduced, a licensed "station would be *assured* of providing service at all locations where its signal exceeded the level of the interference temperature cap."[36] Yet, the Commission's *Notice of Proposed Rulemaking* in ET Docket No. 03-108 discusses in detail the "hidden node" problem, which can result in an underlay signal causing the interference temperature cap to be exceeded at a licensed receiver. That occurs when a local terrain feature (natural or man-made) between an interference contributor and the local network sensor blocks the contributor from being detected by the monitoring network, but the contributor's signal is not blocked en route to the licensed receiver.[37] This problem is inevitable if a monitoring network is employed, and the extent of the problem will depend upon the granularity of the monitoring network – the fewer the number of monitoring stations deployed, the more likely licensed receivers will actually "see" contributors to the interference temperature that the monitoring network fails to detect. As a practical matter, the financial and logistical costs of a monitoring network with sufficient granularity to provide even a modicum of protection to licensed receivers appear daunting.[38]

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[36] *Id* at ¶ 15 (emphasis added).

[37] *See Cognitive Radio NPRM* at ¶ 25 n.35.

[38] Regardless of whether the monitoring mechanism is within each licensed receiver or achieved through a "grid," a "beacon" system would have to be deployed in order to promptly notify non-compliant underlay devices that their transmissions have caused the interference temperature to be exceeded at a licensed receiver. In a beacon system, an underlay device must be receiving a control signal in order to transmit. *See id.* at ¶ 57. The underlay device may not commence transmissions if the beacon signal is not being received; if the beacon signal stops being received
(continued on next page)

WCA will look with interest to see whether any commenting party is prepared to fund the development of a monitoring network designed to pay more than lip-service to the objective of protecting all receivers in the licensed services.[39]

The Commission should not fool itself into believing that the problems identified above can be eliminated by computing an area-wide interference temperature profile from a less granular network, as the *NOI/NPRM* seems to suggest.[40] As the *NOI* itself points out, any number of factors within the RF environment may compromise the accuracy of this approach.[41] Most significantly, any broad average measurement of interference temperature via a "proxy" network would not take into account the inevitable variations of the interference temperature

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while the underlay device is transmitting, transmissions must cease. *Id.* Theoretically, a beacon system gives the licensee protection because the underlay signal must cease transmissions if it does not receive the beacon signal. *Id.* A beacon system thus avoids the fundamental problem with "listen before talk," *i.e.*, the licensee's primary signal may not be heard by the underlay device, and thus the underlay device continues to transmit anyway. *Id.* at ¶ 56. The Commission suggests that the beacon approach is ideal for use where public safety systems lease spectrum in the secondary market because "the public safety licensee would have control of the beacon and could directly regain control of the spectrum when needed." *Id.* at ¶ 58. This is equally true of non-public safety licensees whose spectrum is subject to underlays. However, even the beacon approach remains an imperfect solution, since it would be burdened by the same myriad of technical and logistical problems that plague the interference temperature cap approach generally, as discussed in these comments.

[39] In the *Cognitive Radio NPRM*, the Commission suggests that the hidden node problem could be mitigated by deploying cyclostationary or feature detectors which use longer sensing times and internal computation to achieve signal sensitivities below the noise level for signals of known format, such that signals more than 30 dB below the noise floor could be detected. *See id.* at ¶ 25. While this theoretically would aid underlay devices in detecting signals, such technology remains in development and thus is currently impractical for the low-cost devices envisioned by the Commission for underlay operations.

[40] *See NOI* at ¶ 11.

[41] *See id.* at ¶ 10 ("The degree of certainty of the estimates would depend on such factors as the transmitter signal ranges, the uniformity of signal levels over an area, the density and location of temperature measuring devices and the sharing of the data taken by nearby devices . . . .").

over space and time. The fact that the average interference temperature in a region is below the cap provides little comfort to the service provider attempting to serve a consumer who just happens to be at a location where the interference temperature cap is exceeded.

The "grid" approach has other basic limitations. For example, the interference temperature consists of the cumulative level of underlay signals plus noise at the monitoring device, but does not include licensed signals. Hence, to accurately measure interference temperature at any given time, a monitoring station must have the ability to determine what portion of its received aggregate RF signal level consists of underlay signals plus noise, and calculate the interference temperature only with reference to those factors. There is nothing to suggest that technology exists that will allow a monitoring station to do this. Also, even under a monitoring grid approach, every underlay device would have to know the location of every proximate licensed receiver so that it can compute the path loss between it and the victim receiver, and thereby calculate the maximum amount of power it can transmit in order to stay below the interference temperature cap. A monitoring grid alone obviously cannot provide this information, since it cannot tell the underlay device where the victim receivers are.

Although the *NOI/NPRM* appears to acknowledge the complexities inherent in these approaches to implementing forced underlays, it goes in exactly the wrong direction by suggesting an even simpler approach – having each underlay device merely measure the interference temperature at its own location and only transmit if its own contribution to the interference temperature does not exceed the cap.[42] While this approach certainly avoids some of the complexities of the others, it ignores the very real possibility that the interference

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[42] *See NOI* at ¶ 11.

temperature will be higher at receivers of licensed services than at the underlay device itself, and that the interference temperature cap will be exceeded by virtue of that underlay device's transmissions.[43] At bottom, then, focusing on measurements taken at the underlay devices is a *non sequitur* in this proceeding – if the idea of interference temperature is to move the focus of interference protection from the transmitter to the receiver, it would be inexplicable to implement an approach that measures interference temperature at the underlay transmitter, rather than at the licensed victim receiver.

The comfort level of licensees in the ability of the Commission to police compliance with the interference temperature cap is further undermined by that fact that all of the Commission's schemes for introducing forced underlays depend upon the ability of cognitive radios to respect the rules established for complying with the cap. Regardless of how the Commission would implement a compliance system, it appears that there are a variety of means through which it could be circumvented by a "renegade" underlay device. As recognized in the *Cognitive Radio NPRM*:

> While [cognitive radio] capabilities . . . can enable cognitive radios to use spectrum more efficiently, relying on these capabilities in a radio raises the possibility of new types of abuse. A GPS receiver in a radio could be reprogrammed with a geographic offset that would make the radio behave as though it were at a location far from its actual location. Additionally, databases used to determine the location of other transmitters and/or receive sites could be altered so a device would not "know" about the presence of other users that require protection from interference. Further, software used to select the

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[43] Again, it must be emphasized that for forced underlays to work, the underlay device must know the location of the licensed receiver, the interference temperature at that receiver, and its own position relative to the licensed receiver so it can accurately calculate its contribution to the interference temperature at the licensed receiver.

> appropriate operating parameters could be altered to make a radio transmit at frequencies, power levels or locations where it should not.[44]

These potentials for abuse, coupled with the Commission's concern that underlay devices must be kept low in cost (and thus presumably will not include much in the way of security against tampering),[45] suggests that the Commission cannot yet rely on cognitive radio technology to ensure that receivers in the licensed services are protected against interference from underlay operations.

Simply put, the technical constructs necessary to implement the "one size fits all" interference temperature/forced underlay concept raise a host of unprecedented questions for which there appear to be no answers.[46] For that reason, it is imperative that the Commission aggressively pursue more readily-available alternatives for promoting market-driven efficiencies in the utilization of spectrum – alternatives that do not threaten current and future licensed service offerings.

C. The Commission Can and Should Rely on Secondary Markets to Establish When Underlays on Licensed Spectrum Are Appropriate.

In its November 2002 *Report*, the SPTF recommended that the Commission manage spectrum in accordance with three cornerstone principles:

- Spectrum users should have the maximum possible flexibility to decide how spectrum will be used, so long as they comply with the technical rules applicable to their spectrum.

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[44] *Cognitive Radio NPRM* at ¶ 30.

[45] *See NOI* at ¶ 19.

[46] *See*, *e.g.,* SPTF Report at 36-37 ("The Task Force agrees with the consensus view expressed by participants in this process that 'one size does not fit all' in spectrum policy. An examination of the exclusive use and commons models as they have been applied to date suggests that each model has encouraged different equally beneficial types of technical and economic efficiencies.").

- Spectrum users should be allowed to choose the technology that is best-suited to their proposed use or service. They should also be given the freedom to adapt their technology to their particular spectrum environment, *e.g.*, to use lower power in spectrum-congested areas and higher power in less-congested areas.

- An efficient secondary markets regime should be in place to facilitate the negotiated movement of spectrum rights from one party to another.[47]

Equally important, although the SPTF recommended that the Commission study the interference temperature paradigm, it did so with the caveat that

> the Commission can best promote economic efficiency by providing spectrum users with flexibility of spectrum use and ease of transferability in order to allow maximization of the value of the services provided. Flexibility provides incentives for economically efficient use. . . *In most instances, the application of flexible service rules and efficient secondary market mechanisms are the best means of achieving this goal.*[48]

In other words, secondary markets, not regulation, should be the Commission's engine for promoting underlay technologies:

> If the rights afforded to licensees are sufficiently well-defined and flexible, and the secondary market mechanism is fast and efficient with low transaction costs, licensees will have ample incentive to negotiate with potential secondary users for such access. It is also important to realize that a secondary markets approach to access by opportunistic devices does not necessarily require the prospective opportunistic user to negotiate individually with each affected licensee: band managers, clearing houses, and other intermediaries such as clearing houses can facilitate these negotiated transactions. Thus, the secondary market approach has significant potential to foster opportunistic technologies … at reasonable transaction costs. In fact, it is anticipated that as the access-enhancing potential of these technologies continues to improve, exclusive licensees will often wish to encourage and even develop such technologies in order to provide new services and devices and serve more customers.[49]

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[47] *Id.* at 17.

[48] *Id.* at 21 (emphasis added).

[49] *Id.*

Prominent members of the wireless industry agree. For instance, SBC Communications has stated that "[i]f a smart technology does not cause interference, incumbent licensees should be eager to permit smart technologies to use their spectrum and reap the revenue that would come from doing so."[50] Similarly, Sprint asserted that "[p]roviding access to licensed spectrum by ...'opportunistic' third parties through secondary market mechanisms represents a far superior option to government-imposed, spectrum easement approaches. Utilization of secondary market mechanisms would provide licensees with the important ability to identify and manage the radio frequency ("RF") signal contributions into their licensed bandwidth, establish mitigation procedures and allocate related costs and, thus, better prevent or control interference that could otherwise be experienced by their subscribers."[51] These statements of support are not surprising, given the wireless industry's broader preference for privately negotiated interference arrangements. As the SPTF recognized:

> A general sense from the comments is that if private parties have sufficient information at their disposal, and if the Commission's rules regarding licensee rights with respect to possible interference are clear, the preferred approach is to try to resolve interference problems directly among the affected parties. Only if such efforts fail should the interference problem be referred to the Commission

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[50] Comments of SBC Communications Inc., WT Docket No. 00-230, at 7 (filed Dec. 5, 2003).

[51] Comments of Sprint Corporation, WT Docket No. 00-230, at 3 (filed Dec. 5, 2003). *See also* Reply Comments of T-Mobile USA, Inc., WT Docket No. 00-230, at 5-6 (filed Jan. 5, 2004) ("The Commission is at the very beginning stages of exploring the potential of opportunistic devices. . . [I]n keeping with its market-based philosophy, the Commission should first gain experience in the evolution of its recently announced secondary market regime before embarking on a more intrusive path to opportunistic devices.") (footnote omitted); Comments of Cellular Telecommunications & Internet Association, WT Docket No. 00-230, at 5 (filed Dec. 5, 2003) ("CTIA believes that the only prudent course of action at this time is to allow licensees to control secondary market rights to their spectrum in order to ensure that opportunistic devices and other new technologies or uses do not create interference issues. This approach will, moreover, promote the most efficient use of spectrum . . . because licensed users subject to intense market pressures will have significant incentives to use their spectrum as efficiently as possible.")

> for resolution. Parties feel that private negotiations will lead, in most cases, to a much faster and more acceptable resolution of interference problems than using the Commission's regulatory processes.[52]

The above, in other words, confirms that the Commission need not drown itself or the wireless industry in the quagmire of forced underlays to achieve its objectives here. Consistent with the recommendations of the SPTF, the Commission can and should rely on secondary markets to define when (if at all) underlay operations on licensed spectrum are appropriate, and permit licensees and spectrum lessees to establish the terms and conditions of those easements via arms-length negotiations. In fact, the SPTF has already recommended that the Commission "look[] *primarily* at the use of secondary markets, . . ., to facilitate access to licensed spectrum for opportunistic, non-interfering devices that operate above the temperature threshold."[53] WCA is recommending that the Commission adopt this policy across the board, both above and below the interference temperature threshold.

Ultimately, secondary markets avoid the fundamental flaw in proposals for forced underlays on licensed spectrum. Rather than a "one size fits all" forced underlay scheme that will inevitably prove problematic for many licensees because the interference temperature cap does not provide sufficient margin to accommodate all possible future innovations, a secondary markets approach correctly assumes that licensees have economic incentives to maximize revenues from their spectrum, and thus give each licensee the opportunity to determine on an individual, case-by-case basis – in its discretion and under terms of its own choosing – whether to make capacity on its spectrum available. At the same time, secondary markets provide

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[52] SPTF Report at 36.

[53] *Id.* at 56 (emphasis added).

underlay operations with a ready means of obtaining access to licensed spectrum (in amount, location and duration) best suited for their business needs.[54] Because the contractual relationship will be crafted to reflect specific marketplace needs, it can provide for limitations on underlay use, impose specific interference protection standards, establish specific interference mitigation procedures, and contain specific cost allocations (including allocations of interference mitigation costs) that cannot possibly be created under a "one size fits all" concept like interference temperature.

D. The Commission's Trial Run of the Interference Temperature Concept in the 6 GHz and 12-13 GHz Bands is Not Indicative of Whether the Concept is Feasible in Other Frequency Bands With Different Technical Characteristics and Incumbency Issues.

While WCA understands the Commission's desire to obtain some "real world" feedback on how the interference temperature model might work in specific bands, the *NPRM*'s proposal to immediately implement interference temperature in the fixed service ("FS") and fixed satellite service ("FSS") uplink band at 6525-6700 MHz and the FS/FSS/BAS/CARS band at 12.75-13.25 GHz band will yield little relevant information to wireless licensees who provide a far more diverse range of fixed, mobile and portable services over lower-powered facilities in other spectrum. Indeed, as reflected in the contemporaneous comments being filed in this proceeding

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[54] Indeed, the Commission has already proposed to adopt rules and policies that will promote leasing of licensed spectrum to users of cognitive radio devices, which is merely another way of permitting underlays on a privately negotiated basis rather than regulatory fiat. *See Cognitive Radio NPRM* at ¶ 49 ("Cognitive radio technology could possibly drive transaction costs to a lower level by automating some or all of the process of negotiating the terms of a lease. A lease could specify the frequencies available, power levels, locations where the spectrum could be used and time limits on use, and the radio could ensure that the terms are met. . . [C]ognitive radio technology could eventually allow licensees and potential lessees to negotiate for leased spectrum use on an *ad hoc* or real-time basis.") (footnotes omitted).

by the Fixed Wireless Communications Coalition, the Commission appears to have substantially underestimated the potential interference risks to licensed services from forced underlays in the 6525-6700 MHz and 12.75-13.25 GHz bands, further minimizing the already limited relevance of the Commission's inquiry there.[55]

In any event, the Commission acknowledges that the 6525-6700 MHz and 12.75-13.25 GHz bands were chosen because (1) a receiver in these bands would not be located in close proximity to any potentially interfering unlicensed device, and/or (2) there is already extensive sharing of spectrum in these bands between high-powered licensed services. Relatively few frequency bands share these characteristics, and certainly not those which, for example, are used to provide mobile or portable voice or broadband services over cellularized systems. Failure to appropriately account for these distinctions within the interference temperature model could have potentially devastating "real world" consequences for licensed wireless service providers if the concept were extended to other bands.

III. CONCLUSION.

To achieve maximum spectrum efficiency, the Commission must remain focused on SPTF's core principles of flexible use and secondary markets, and let the marketplace, not regulatory fiat, determine the circumstances under which underlays on licensed spectrum will serve the public interest. At best, the concept of forced underlays is a flawed, highly impractical idea with potentially debilitating consequences for innovation in licensed services. As such, it is

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[55] Specifically, FWCC asserts that the Commission's reliance on the "isolated siting" of licensed facilities in the subject bands will not necessarily protect those facilities from harmful interference created by underlay devices, and that the high-gain antennas used by those licensed facilities does not protect them from interference sources (underlay or otherwise) that are not sufficiently off-axis.

an inferior option compared to reliance on the marketplace and will only compromise the substantial progress the Commission has already made towards meaningful spectrum policy reform. WCA urges that any further action on the *NOI* or *NPRM* be guided accordingly.

Respectfully submitted,

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