Before the
Federal Communications Commission
Washington, DC 20554

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

REPLY COMMENTS OF AT&T WIRELESS SERVICES, INC.

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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

Pursuant to Section 1.415 of the Commission's rules,[1] AT&T Wireless Services, Inc. ("AT&T Wireless") respectfully submits these reply comments to the *Notice of Inquiry and Notice of Proposed Rulemaking* in the above-captioned proceeding.[2]

INTRODUCTION

The comments filed in this proceeding amply demonstrate the theoretical and practical problems associated with implementing the interference temperature concept. There is little support for the idea, and no convincing justification of the need for unlicensed underlays has been presented. The degradation to existing licensees' operations, and to mobile systems in particular, has been exhaustively documented. From all the information presented, the simple conclusion is that the interference temperature concept—even if it could be implemented—is not worth the harm it would cause to either fixed or mobile systems. Therefore, AT&T Wireless recommends that further development of the interference temperature regime be halted and the *NPRM* portion of the proceeding be terminated. Further testing of approaches to improving spectrum access for unlicensed devices and applications should be confined to unlicensed bands.

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[1] 47 C.F.R. §1.415(c) (2002).

[2] *Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Band*s, FCC 03-289, *Notice of Inquiry and Notice of Proposed Rulemaking*, ET Docket No. 03-237 (rel. Nov. 28, 2003) ("*NOI/NPRM*").

I. THE TECHNICAL ASSUMPTIONS IN THE NOI/NPRM ARE FAULTY.

A. No Unused Margin Exists.

The fundamental premise upon which the interference temperature concept rests is that part of the spectral resource is unused and therefore available for others to occupy. However, as numerous commenters point out, the unused space the Commission believes exists—the so-called "New Opportunities for Spectrum Access"—is illusory. Commercial Mobile Radio Service ("CMRS") operators, for example, have designed their systems to operate as close to the noise floor as possible, and in the case of Code Division Multiple Access ("CDMA"), below it.[3] Making best use of that "unused" space is thus an integral part of operators' efforts to maximize coverage, capacity, and data throughput. Likewise, Fixed Service ("FS") licensees rely on this margin to deliver high-quality, reliable services, and because FS links have been engineered to operate down to the threshold level of the equipment, the high levels of margin that are designed into FS links are critical to the reliable functioning of those links.[4] Cingular notes that the effect of allowing underlay devices to share that margin

> is that the performance margin that was designed into the system will no longer be available when it is needed. For example, if a microwave link has been built with a 10 dB margin to account for fading due to rainfall and the Commission then allows the interference in the band to "fill up" this margin with co-channel interference then the margin is effectively gone. During the next rainfall event, the system will have no margin left to overcome the fading and will experience harmful interference.[5]

As the Fixed Wireless Communications Coalition states, that margin "is not a public resource the Commission can allocate for use by others."[6]

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[3] *See* Comments of AT&T Wireless at 11-13; Comments of Verizon Wireless at 6-7; Declaration of Dr. Charles L. Jackson regarding Limits to the Interference Temperature Concept (filed with the Comments of Verizon Wireless); Comments of Thomas Hazlett and Matthew Spitzer at 12; Comments of Sprint Corporation at 9-10. *See also* Comments of Sprint Corporation at 9 (noting that the "gaps" between the interference peaks shown in Figure 1 of the *NOI/NPRM* may not exist; that noise in the CMRS bands is actually much more constant than the Commission believes).

[4] *See* Comments of Comsearch at 6-7.

[5] Joint Comments of Cingular Wireless LLC and BellSouth Corporation at 39.

[6] Comments of the Fixed Wireless Communications Coalition at 3.

The comments also demonstrate that the imposition of an interference temperature limit cannot be viewed as a simple repurposing of spectrum (information space) that is unused. Rather, such a limit would function more like a brick wall to shut off licensees from a portion of the spectrum they had previously occupied. Instead of allowing licensees to develop innovative technologies to take advantage of the existing RF environment, the interference temperature limit would essentially reallocate that spectrum for unlicensed use; amounting to an appropriation of part of the spectrum resource that licensed operators rely on every day to deliver services throughout their licensed areas.[7] As one commenter succinctly stated: "Permitting underlay equipment to raise the *interference temperature* would take away spectrum just as surely as would taking 10 MHz from a 30-MHz license"[8] Several commenters point out the regulatory and legal risks inherent in such an approach.[9]

B. The Interference Temperature Cannot Be Effectively Monitored in the CMRS Context.

Perhaps the most intractable problem with the interference temperature concept is the necessity for real-time monitoring. AT&T Wireless has already documented many of the theoretical and practical difficulties with measuring the interference temperature in a way that will provide useful information and effective interference avoidance.[10] Because the RF environment is neither static nor uniform across a band, a geographic region, or time, meaningful real-time interference temperature measurements would be problematic at best.[11] The introduction of unlicensed underlay devices would introduce an added layer of interference

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[7] *See* Comments of Sprint Corporation at 11.
[8] Declaration of Dr. Charles L. Jackson regarding Limits to the Interference Temperature Concept (filed with the Comments of Verizon Wireless) at 22 (emphasis in original).
[9] *See e.g.,* Comments of Nextel Communications, Inc. at 5; Comments of Verizon Wireless at 15; Joint Comments of Cingular Wireless LLC and BellSouth Corporation at 13; Comments of Thomas Hazlett and Matthew Spitzer at 5; Comments of Sprint Corporation at 49-51.
[10] *See* Comments of AT&T Wireless at 5-8.
[11] *See* Comments of New York State Office for Technology at 28.

variability that would make any measuring system even more complex.[12] Beyond these factors, however, the complexity of evaluating the RF environment in a band populated with constantly moving receivers, as is the case with CMRS, is far beyond the capabilities of any system.

As the Commission has correctly recognized, and commenters agree, the only relevant point for determining the interference temperature is at the victim receiver's location.[13] Despite postulating several ways in which such monitoring could be done, however, the simple fact is that no set of measurements taken outside the victim receiver can accurately capture the RF environment actually experienced by that receiver.[14] This is true whether such measurements are taken by the unlicensed devices themselves or by a monitoring network (no matter how extensive), and is because CMRS receivers experience intra-system interference and external interference differently. CMRS operators have developed sophisticated techniques to monitor and reduce intra-system interference—based on intimate knowledge of the systems' operating parameters and device characteristics—but have almost no ability to alleviate interference from unknown and unpredictable outside sources.[15] Because external sensors have no ability to see how an individual receiver is actually processing interference, no monitoring system will be fully able to capture the interference environment the receiver actually faces—or to judge how much additional interference it could accept.

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[12] *See e.g.,* Comments of United Telecom Council at 3; Comments of WiFi Alliance at 3. *See also* Comments of Agilent Technologies, Inc. at 5 (noting that "one must allow for a system that involves thousands of devices. On this scale, the presence or absence of any single device will have an insignificant impact on the overall noise temperature at the satellite receiver, so an individual device cannot reasonably determine its impact on interference temperature. This suggests the possibility of unstable interference levels, as large groups of devices independently respond to the interference temperature metric."

[13] *NOI/NPRM at ¶¶ 1, 10. See* Comments of WiFi Alliance at 3 (noting that "local propagation conditions vary so much that measuring the noise level at any given point does not provide reliable information about the observed noise level at a nearby point"). *See also* Comments of AT&T Wireless at 5-6; Declaration of Dr. Charles L. Jackson regarding Limits to the Interference Temperature Concept (filed with the Comments of Verizon Wireless) at 18; Comments of Sprint Corporation at 13, 22.

[14] *See* Comments of AT&T Wireless at 6. *See also* Comments of Motorola, Inc. at 13 (noting the problems associated with victim receivers and monitoring stations using different bandwidths—a wider bandwidth monitoring station would underreport the interference potential from narrowband noise sources).

[15] *See* Comments of V-Comm, L.L.C., at 34-36.

Other commenters raise additional issues in accurately quantifying the interference temperature at a given receiver, including shadowing (hidden transmitters); antenna directionality and gains; path loss; and different transmission formats.[16] Based on such considerations, Motorola concludes that "[t]he net result of all these variables is that it is impossible to predict whether dynamic interference temperature measurements precisely model the nearby radio environment. If they do not, then the primary user will likely experience significant interference that could potentially cripple, or at least substantially impair, its operations…"[17] This analysis applies to *any* system that relies on the interference temperature measuring/monitoring concept.[18]

Simple "tweaks" to the Commission's concept will not solve the underlying fundamental problems. Shared Spectrum's "Open Loop Architecture," for example, suffers from similar flaws as the Commission's three possible monitoring scenarios in that it relies on measurements from afar to "estimate" the RF environment, and would appear to work only if the underlay device knew the signal characteristics of the system(s) it was attempting to measure.[19] In addition, Shared Spectrum's proposal for setting the interference limit 3 dB below the typical noise figure of the victim receiver would increase the total cumulative noise in the band by 1.764 dB, a 50% increase.[20] Based on AT&T Wireless's analysis, this translates to between 15 and 25 percent coverage losses in a GSM system. Finally, Shared Spectrum's conclusions that degradation to licensed wireless systems can only happen if a number of probabilities occur at the same time (the probability of which Shared Spectrum believes is negligible) is misleading and distorts the true effects of underlay interference.

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[16] *See* Comments of Motorola at 11-13.
[17] Comments of Motorola at 13.
[18] The system envisioned by Agilent, for example, assumes that valid measurements "(how ever and where ever they are collected)" can be taken, which would then be processed by internet-based servers that would direct underlay devices. Without valid measurements, however, the Agilent system fails.
[19] *See* Comments of Shared Spectrum Company at 6-9; Comments of Sprint Corporation at 14 (noting that "the waveform sensitivity of the licensed receiver must also be factored in."
[20] *See* Comments of Sprint Corporation at 15.

1. Monitoring by an underlay device is not useful.

In the first and simplest scenario suggested by the Commission, the unlicensed device itself would perform the measurement function. Given that unlicensed devices would not be collocated with the victim receiver, they would have no knowledge of what the interference temperature was at the victim, nor what impact their transmission would actually have on its operation. Motorola, for example, notes that:

> [t]he secondary device has little or no knowledge of the difference in propagation conditions between the two locations [of the licensed device and the unlicensed device] (assuming it knows the locations), and cannot know what kind of path losses its transmissions would experience. Nor could it know if another secondary user is already transmitting elsewhere and causing interference to the incumbent primary use, but whose contributions are not measurable at the secondary unit in question.[21]

After modeling this case, Proxim Corporation reached a similar conclusion: "Based on our initial analysis, we have not been able to discover an efficient method for a sharing device to determine, based on measurements that it, itself, makes, whether or not it can transmit without causing harmful interference."[22] AT&T Wireless agrees with the analysis and concurs with Proxim that any measurements based on a single underlay device monitoring its local RF environment cannot accurately determine whether or not it will cause harmful interference to a licensed receiver.

2. Even the most extensive monitoring system would be inadequate.

Likewise, the establishment of a monitoring system would not solve the fundamental problem that the sensors are not collocated with the victim receivers. Two examples demonstrate the difficulties involved. First, as in the case above, because the monitoring site and the victim receiver would not be collocated, the monitoring sensor would not be able to adequately assess either the actual RF environment around the receiver or the impact that an underlay device would

[21] Comments of Motorola, Inc. at 14.
[22] Comments of Proxim Corporation at 2.

have on it. Because of the differences in path characteristics between the underlay device and the monitoring station as compared to the path between the underlay device and the victim receiver, the propagation loss could be misinterpreted by the monitoring station by up to 60 dB.[23] Ericsson provides a simple model to assess the level of measurement error that could be present in a mobile receive environment, and concludes that "the underlay transmitter can cause up to 20dB higher interference than what is measured."[24]

Second, several commenters identify the "hidden transmitter" or shadowing problem.[25] In this case an interference temperature sensor would not "hear" a source that is already generating interference to a licensed receiver because the signal from that source is blocked (by a building, for example). Meanwhile the path from the interfering source to the victim receiver is clear. Because it cannot hear this interference, the sensor would generate a too-low estimate of the local interference temperature, leading underlay devices to start transmitting. The victim receiver would then see interference from two sources; the original interferer and the underlay device.

Mobility exacerbates this problem. In an environment where both interference sources and licensed receivers may be mobile, interferers will be hidden at some points in time and visible at others. The answer to this problem may seem simply to build a system with a sufficient number of sensors to avoid such problems. A system to monitor effectively the interference temperature in the Mobile Service bands, however, would have to place sensors virtually everywhere; a possibility that, due to the complexity and cost, is neither practical nor realistic.[26] Ericsson, for example, concludes: "the RF monitoring model, therefore, will require installing a potentially enormous network of expensive and complex infrastructure to monitor interference

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[23] *See* Comments of Shared Spectrum Company at 5.
[24] Comments of Ericsson, Inc. at 16.
[25] See Comments of Motorola, Inc. at 11; Declaration of Dr. Charles L. Jackson regarding Limits to the Interference Temperature Concept (filed with the Comments of Verizon Wireless) at 18.
[26] *See* Comments of New York State Office for Technology at 32; Comments of Shared Spectrum Company at 6; Comments of United Telecom Council at 7. AT&T Wireless agrees that if such a system were built, the construction and cost should be borne by the unlicensed device manufacturers and users.

temperature universally, *without any guarantee that it will actually address the interference from underlay transmitter.*"[27] IEEE concurs, noting that

> the cost of creating, not to mention maintaining, a ubiquitous network of monitoring stations would completely overwhelm any short term or long term benefit in new economic activity. Further, the complexity of the monitoring process (e.g. time, 3-D space, frequency, polarization, antenna characteristics, etc.) itself appears to us to cast doubt on the reliability of the resulting data and may effectively limit the mass market adoption of such measurement and control solutions.[28]

For these reasons, among others, AT&T Wireless agrees with those commenters who believe that "some spectrum segments, like mobile bands including public safety, deserve special protection from interference and should not be considered for unlicensed use on the basis of the interference temperature concept."[29] Even nominal supporters of an interference temperature-like approach recommend against using bands that are mobile and that support large numbers of users.[30] Thus, the CMRS bands, which support more than 160 million subscribers, would seem to be a poor candidate.

3. Monitoring by licensed services is impractical.

The most potentially complex example of a monitoring network would utilize the receive sites in a licensed service to perform the measuring function.[31] The logistical and operational implications of such a system are staggering. The type of system naively envisioned by HYPRES, for example, would use the licensee's own infrastructure and equipment to measure the RF environment, despite the fact that the licensees have absolutely no economic or interference-related incentive to do so.[32] Tellingly, despite its focus on mobile systems, HYPRES ignores half the equation—the more important and difficult case of measuring the interference temperature at the mobile receiver's location. Nor do HYPRES's comments provide any justification or support

[27] Comments of Ericsson, Inc. at 17 (emphasis added).
[28] Comments of IEEE 802 at 6.
[29] Comments of IEEE 802 at 8.
[30] *See* Comments of Shared Spectrum Company at 19.
[31] *NOI/NPRM* at ¶ 11.
[32] *See* Comments of HYPRES at 3-6.

for the notion that there would be "no impact on existing equipment or services," and that there would be a "reduction in dropped calls, fewer hand-offs, and increased effective system capacity."[33] To the contrary, a whole new monitoring system would have to be set up as well as the software to support it, and—in the CMRS bands, at least—such a system would have to be duplicated in *each and every* licensees' network. Contemplating a similar approach, IEEE concludes that "requiring licensed services to install expensive and complex infrastructure to universally monitor interference temperature is an unnecessary and counter productive approach to interference prevention."[34]

Aside from the difficulties on the network infrastructure side, mobile devices would have to be designed with new features to measure and process received power from multiple sources and transmit that information to underlay devices.[35] Such complexity would not come without cost; consumers would be faced with higher handset and/or service prices, and would be, in effect, subsidizing unlicensed underlay deployment. More importantly, such an approach cannot be applied retroactively. Mobile devices currently in use cannot be appropriately modified to incorporate such capabilities, and so, in theory, the interference temperature concept could not be implemented until each subscriber had acquired the new equipment that would protect them from underlay interference. In practice, subscribers who would want to keep their old handsets would be subjected to potentially debilitating interference.

4. The technology to implement the concept does not exist.

Aside from the theoretical and practical difficulties noted above, the interference temperature concept is unworkable because the technology to implement it does not exist. Motorola, for example, notes that:

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[33] Comments of HYPRES, Inc. at 6, 7. Indeed these two comments are contradictory; improvements do not magically come without upgrades to network equipment.
[34] Comments of IEEE 802 at 6.
[35] *See* Comments of Sprint Corporation at 28. The question of how the interference temperature information would then be transmitted to the underlay devices is also an issue; spectrum resources would have to be diverted from information-carrying duties to support the administrative notification function.

> the industry is not sufficiently advanced to provide the real time monitoring of the noise floor that is necessary for a successful implementation of this concept. The industry only now is starting to develop the types of sensory and control technologies that could even begin to govern the action of emitters in response to real-time interference temperature data. Technologies that will effectively protect licensees are, therefore, either beyond the current state-of-the-art or so prohibitively expensive that the Commission cannot reasonably expect consumers to buy equipment that utilizes these technologies. As such, it is impractical to begin implementation of an interference temperature metric when the technologies that will adequately protect incumbent licensees do not exist.[36]

Telcordia has similar reservations. In discussing the technical requirements that would need to be met on both the base and mobile transmit sides, it concludes that the interference temperature concept is not practical.[37] Given such concerns, it would be unwise to establish policy or regulations based on technological advances that may or may not come into existence and at prices that consumers may not be able to support. TIA notes: "[s]pectrum management decisions based on anticipated advances in technology are dangerous, and should await the demonstrable existence of such technology at reasonable costs for widespread deployment and market acceptance."[38]

C. Application Of An Interference Temperature Limit in the CMRS Bands Would Not Be Technology Neutral.

Finally, the Commission appears to assume that the imposition of an interference temperature limit will impact all licensees in a given radiocommunication service equally. This, however, is not the case. In bands where licensees utilize multiple technologies, the establishment of a uniform interference temperature limit will affect different systems differently, and will have a disproportionate effect on some users.[39] This is particularly true in the CMRS bands, where operators use a variety of technologies (analog, TDMA, GSM, CDMA, iDEN) that have different operating characteristics and utilize different receivers.[40] Given the differences in technical characteristics, modulations schemes, and susceptibility to interference, it is difficult to

[36] Comments of Motorola, Inc. at 4.
[37] *See* Comments of Sprint Corporation at 30, quoting the Telcordia Report at section 4.1.
[38] Comments of Telecommunications Industry Association at 4.
[39] *See* Comments of New York State Office for Technology at 29; Comments of Sprint Corporation at 14.
[40] *See* Comments of Motorola, Inc. at 7-8.

see how one interference temperature could even be set.[41] The use of vastly different technologies in a band makes a uniform interference temperature limit unworkable if technology neutrality is to be maintained.

II. THE HARMS ASSOCIATED WITH IMPLMENTING AN INTERFERENCE TEMPERATURE REGIME FAR OUTWEIGH ANY POTENTIAL BENEFITS.

Even setting aside its theoretical infirmities and practical difficulties, the interference temperature concept should still be abandoned. The real world impacts of an interference temperature limit—even if it could be implemented perfectly—would reduce the coverage, capacity, and service quality of CMRS systems and cause link failures in FS operations. The purported benefits of unlicensed underlay devices do not appear to justify these harms.

A. Impacts On CMRS Would Be Severe.

Several commenters note the difficulties associated with imposing an interference temperature limit in the mobile bands generally and CMRS bands specifically.[42] In fact, as AT&T Wireless noted in its comments, even if the interference temperature concept could work exactly as the Commission envisions, CMRS operators and consumers would be seriously impacted.[43] This is due to the fact that the interference temperature limit would—by design—result in an increase in the amount of interference in the CMRS bands.[44] By establishing an interference temperature limit above current peak noise levels and protecting unlicensed devices operating up to that limit, the Commission would effectively remove part of the information space that CMRS operators use to provide existing levels of coverage, capacity and services. Ericsson summarizes:

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[41] *See* Comments of United Telecom Council at 6. It is not clear that a "least common denominator" approach would solve the problem. Such an approach assumes that a limit can be determined that would protect the most sensitive service. The reality is that picking any limit will raise the interference level—with inherently differing impacts on technologies that have different interference experiences.

[42] *See e.g.,* Comments of Ericsson, Inc. at 10-18; Comments of Motorola, Inc. at 2.

[43] *See* Comments of AT&T Wireless at 15-19.

[44] *See* Comments of New York State Office for Technology at 8. While AT&T Wireless appreciates the Commission's attempt to provide it with certainty regarding the interference environment, this supposed certainty clearly should not come at the cost of higher interference.

> In this scenario, systems that were designed to operate to the level of the noise floor will receive additional interference. Therefore, they will no longer be able to operate to the expected performance or costs since the noise floor will be permitted to rise to the limit of the defined interference temperature. Consequently, many existing products will become obsolete without potentially expensive modification.[45]

1. Capacity, coverage, and service quality would be reduced.

The impacts of an interference temperature limit would be felt in a number of areas, including coverage/range, capacity, and service quality.[46] The most obvious negative effect of an interference temperature limit is seen in the reductions that would occur in service range, and the corresponding loss of coverage that would result both within the area served by a single transmitter and across the network. As AT&T Wireless and other commenters note, the Commission's own Figure 1 graphically shows this reduction in service range.[47] NY State states the case plainly: "[i]f the ITC [interference temperature cap] is considered, the distance where the communications link will deteriorate is substantially sooner than without the use of the ITC."[48]

In most urban and suburban areas, reductions in capacity would be the most important impact. Although specific estimates vary depending on approach, commenters all found the effect of an interference temperature limit to be significant. Sprint calculates a 33 percent reduction in uplink capacity if the interference temperature limit were to be set at the noise floor, while Motorola estimates that a 1dB increase in noise caused by the devices operating under the interference temperature would result in a 10 percent decrease in uplink capacity.[49] Likewise, Ericsson explains that in systems that use power control, interference to just one licensed receiver

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[45] Comments of Ericsson, Inc. at 12.
[46] *See* Comments of Sprint Corporation at 15-17.
[47] *See* Comments of AT&T Wireless at 15; Declaration of Dr. Charles L. Jackson regarding Limits to the Interference Temperature Concept (filed with the Comments of Verizon Wireless) at 6; Comments of Thomas Hazlett and Matthew Spitzer at 10; Comments of Sprint Corporation at 15.
[48] Comments of New York State Office for Technology at 10.
[49] *See* Comments of Sprint Corporation at 16; Comments of Motorola, Inc. at 7.

could impact the capacity of a whole cell/sector.[50] At a time when consumers are increasingly relying on their CMRS phones as their primary phone, it is clear that such reductions in capacity and coverage would have serious impacts, especially in emergency situations.[51]

Faced with such losses, carriers would have no choice but to build additional cell sites *just to maintain existing coverage/capacity*.[52] Ericsson notes that the imposition of an interference temperature limit "…would require replacement and/or modification of existing equipment to compensate for loss of coverage, capacity, and service quality. Therefore, the transition to an interference temperature model will likely require additional antenna sites and equipment to maintain existing service coverage, reliability, and quality."[53] It is clear from the comments that licensees would have to spend hundreds of millions of dollars to mitigate the effects of an interference temperature limit.

2. Innovation would be stifled and efficiency gains stalled.

The comments also make clear that the imposition of an interference temperature limit would stifle innovation.[54] In response to market demands, CMRS operators and manufacturers are continuously developing new technologies to make more efficient use of their exclusively licensed spectrum. Converting the CMRS bands effectively into shared bands with unlicensed underlay users will undercut those incentives and reduce existing licensees ability to innovate.[55] Ericsson, for example, notes that "[i]nterference temperature will redirect the focus of manufacturers' research and development efforts and will impede the progress of these [indoor reception and multipath signal handling capabilities] and other innovations."[56]

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[50] *See* Comments of Ericsson, Inc. at 13.
[51] *See* Comments of Nextel Communications, Inc. at 7; Comments of Ericsson, Inc. at 6, 13; Comments of Sprint Corporation at 17.
[52] Ericsson, Inc. at 13; Hazlett at 11.
[53] Comments of Ericsson, Inc. at 6.
[54] *See e.g.,*Comments of Nextel Communications, Inc.at 2 and 4-5; Ericsson, Inc. at 6; Comments of New York State Office for Technology at 8; Joint Comments of Cingular Wireless LLC and BellSouth Corporation at 7; Comments of Sprint Corporation at 48.
[55] *See e.g.,* Joint Comments of Cingular Wireless LLC and BellSouth Corporation at 14; Comments of V-Comm, L.L.C. at 40; Comments of Sprint Corporation at 35-37.
[56] Comments of Ericsson, Inc. at 5.

In the FS bands, the introduction of unlicensed devices would also have a chilling effect on industry incentives to develop and use the most spectrum efficient and least interfering technologies. In the presence of unlicensed devices, FS operators would have every incentive to increase power (or stop the use of power control techniques) in order to maximize the chances that an unlicensed device would sense the presence of an operating link and not transmit—thereby preventing interference to the FS receiver.[57] For the same reasons, operators would have an incentive to use antennas with less front-to-back discrimination. Both situations would thus result in operators being forced to adopt less efficient and perhaps more interference-prone techniques—all to prevent or mitigate interference from unlicensed devices. Such an outcome appears completely at odds with what the Commission is trying to accomplish.

B. Fixed Service Operations Would Also Be Degraded.

In addition to the more general issues raised in the *NOI* portion of the proceeding, the *NPRM* also requests specific comment on proposals for introducing underlay devices in the 6 and 13 GHz bands.[58] As a FS licensee with hundreds of licenses in these bands, AT&T Wireless is extremely concerned with the potential for interference from underlay devices to its microwave links. AT&T Wireless uses these links to haul traffic from its cell sites back to its switching centers. Consequently, any interruption to the traffic on a single microwave link will affect not one or two users, but all the users being served by a particular cell. The United Telecom Council ("UTC") makes clear that "[t]he risk of error is particularly high for microwave, because interference is likely to result in complete loss of communications between links."[59] Thus, this type of outage could result in perhaps hundreds of users in a cell being cut off by a single underlay device that could be miles away.

[57] *See* Comments of Comsearch at 16.
[58] *NOI/NPRM* at ¶ 29.
[59] Comments of United Telecom Council at 14.

AT&T Wireless is not alone in its misgivings; a number of commenters warn of the negative impacts that underlay devices would cause to FS operations.[60] In discussing relative power levels in the 6 and 13 GHz bands, for example, Comsearch concludes that "[i]ntroducing omni-directional unlicensed transmitters to the bands has a huge potential for causing interference to FS receivers, even if the EIRP level allowed to the unlicensed transmitters is much lower than that of the FS transmitters."[61] Nor does Dynamic Frequency Selection ("DFS") appear to be useful in the instant case to avoid interference. Several commenters note that this technique, which will be used in the 5 GHz band to address interference from unlicensed devices to radars, would not have the same effects when applied in the 6 GHz band to FS operations, and could, in fact, cause interference more than 60 dB greater than that experienced at 5 GHz.[62] Because of the extremely low signal levels that FS links have to operate with during severe fade conditions, "[a]n unlicensed device in the receiver boresight, unable to ascertain the band is in use and having no reason to refrain from transmitting, would almost certainly override the weak FS signal and cause harmful interference."[63] Given such difficulties, Agilent concludes that "it is difficult to envision a system based on the interference temperature alone that would efficiently share spectrum with a secondary user while maintaining high reliability in the primary service."[64]

Because of the potential for harmful interference and the ineffectiveness of DFS in avoiding it, AT&T Wireless concurs with those who believe that the NPRM portion of this proceeding is premature and should be terminated.[65]

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[60] *See generally* Comments of Comsearch; Comments of New York State Office for Technology; Comments of United Telecom Council; Comments of Fixed Wireless Communications Coaltion; Joint Comments of Cingular Wireless LLC and BellSouth Corporation.
[61] Comments of Comsearch at 9-10.
[62] *See* Comments of Comsearch at 10-11; Comments of Motorola, Inc. at 15; Comments of Sprint Corporation at 44.
[63] Comments of FWCC at 3. *See also* Comments of Comsearch at 11 (noting that "[a] device may not hear any use of the channel but cause catastrophic interference."); Comments of United Telecom Council at 13.
[64] Comments of Agilent Technologies, Inc. at 4-5.
[65] *See* Comments of Verizon Wireless at 18; Comments of Motorola, Inc. at 15.

C. The Benefits of Underlays Have Not Been Demonstrated.

The comments filed in response to the *NOI/NPRM* evidence no pent-up demand for unlicensed underlay uses. In fact, none of the commenters suggests what types of devices might be developed, why they need to operate as underlays (as opposed to using some of the more than 500 megahertz of spectrum identified specifically for unlicensed use) or the number of devices that might come into operation. Without such information, the Commission appears to have proposed a solution in search of a problem.

Given the lack of support from potential underlay proponents, the overwhelming opposition to the interference temperature in conceptual and practical terms, and the established harms that would be experienced by existing licensees, it is difficult to see how implementation of the interference temperature concept would pass any kind of cost-benefit test. Commenters that addressed the economic and demand aspects of the interference temperature conclude that the purported economic benefits of setting aside spectrum for underlay use in the CMRS bands are outweighed by the costs associated with the loss of service (and the associated costs of overbuilding to maintain coverage and capacity).[66] Furthermore, on the purely technical side, the benefits of underlays for maximizing the use of spectrum may be overestimated. Calculations performed by Telcordia, for example, indicate that the imposition of an interference temperature limit might actually *reduce* the efficiency (measured in terms of throughput) of spectrum used by CDMA systems because of the tradeoffs that would be required to make the interference temperature concept work.[67] In addition, there is also evidence that the number of underlay devices that could be supported by the interference temperature limit while still providing

[66] *See* Comments of Thomas Hazlett and Matthew Spitzer at 9 (noting that the "New Opportunities for Spectrum Access" portion of the Commission's Figure 1 could produce $100 in benefits for unlicensed users, but could also reduce benefits to licensed users by by $10,000), 30.
[67] *See* Comments of Sprint Corporation at 19-20. Because two dissimilar systems are being forced to coexist, the spectrum can be optimized for neither.

adequate protection to existing licensees could be limited.[68] Likewise, in the FS bands, the restrictions on power that would be needed to protect FS receivers from underlay interference could make unlicensed applications not viable.[69]

III. REGULATORY POLICY MUST PROVIDE CERTAINTY TO LICENCEES.

A. The Interference Temperature Concept Creates Uncertainty.

Rather than inspiring confidence and certainty, it is clear that the concepts in the *NOI* and the mistaken assumptions and proposals in the *NPRM* have already created more uncertainty and concern among licensees and manufacturers alike.[70] The general consensus among commenters is that the Commission has made a number of unwarranted assumptions about how both fixed and mobile systems work, and has developed a framework that is not only conceptually flawed, but practically very difficult, if not impossible, to implement.[71] The net result is a high degree of uncertainty among licensees and manufacturers alike as to just how injurious the impact on existing services will be. As Cingular notes, "[t]he only 'certainty' that application of the IXTemp will give incumbent licensees is the certainty that interference levels will increase uncontrollably and that, as a result, the value of their spectrum for accommodating the public's communications needs will increasingly diminish."[72]

Compounding the uncertainty that exists regarding the technical feasibility of the concept, there appears to be no way to remedy interference if the interference temperature limit does not work in practice. Given the questions asked in the *NOI/NPRM*, and the fundamental inability to control tightly radio waves in a changing environment, it seems inevitable that there

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[68] *See* Comments of Ericsson, Inc. at 15-16.
[69] *See* Comments of Comsearch at 15.
[70] *See* Comments of Ericsson, Inc. at 3-4; Joint Comments of Cingular Wireless LLC and BellSouth Corporation at 12; Comments of Sprint Corporation at 3.
[71] The Fixed Wireless Communications Coalition, for example, lists 10 pages of assumptions the Commission has made regarding the operation of FS systems that it believes are incorrect and concludes "**None of these points, alone or in combination, provides adequate assurance against disruption to FS communications."** Comments of Fixed Wireless Communications Coalition at 10 (emphasis in original). *See also* comments of Sprint Corporation at 3.
[72] Joint Comments of Cingular Wireless LLC and BellSouth Corporation at 8.

would be instances when the interference temperature is exceeded by one device, a class of devices or devices throughout a region. At this point, the Commission has failed to identify potential actions that could prevent interference from recurring. Indeed, it appears that there is no effective remedial action the Commission could take retroactively when devices exceed the interference temperature limit.[73] It is clear that once unlicensed underlay devices are unleashed in the marketplace, the Commission will have limited ability to track them and if enough devices come into use, they will achieve "squatters" status that will be will be next to impossible to undo.[74] Licensees would thus have no recourse if either the interference temperature concept does not work, or particular devices routinely exceeded the interference temperature limit.

B. New Unlicensed Devices Should Be Confined to Unlicensed Bands.

AT&T Wireless continues to believe that the best place for unlicensed underlay devices is with other unlicensed devices. Rather than imposing an unproven concept that will increase interference to licensed users, AT&T Wireless believes that a wiser course of action would be to test the interference temperature regime in either a new or existing unlicensed band.[75] The use of a band reallocated for this purpose—preferably above 5 GHz—would be most effective since regulations and expectations could be set up front rather than forcing ineffective and uneconomic changes in bands with incumbent licensees.[76] This approach is consistent with the recommendation in the Spectrum Policy Task Force Report that "like" services should be grouped together,[77] is likely to maximize flexibility and innovation and would promote the clarity and certainty the Commission seeks to provide to both new and existing licensees.[78]

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[73] *See* Comments of New York State Office for Technology at 14 (quoting Lockheed Martin).
[74] *See* Joint Comments of Cingular Wireless LLC and BellSouth Corporation at 10.
[75] *See* Comments of New York State Office for Technology at 41; Joint Comments of Cingular Wireless LLC and BellSouth Corporation at 9, 56.
[76] *See* Comments of New York State Office for Technology at 41.
[77] *See* Spectrum Policy Task Force Report, ET Docket No. 02-135, (rel. Nov. 15, 2002) at 22; Comments of Telecommunications Industry Association at 5.
[78] *See* Comments of New York State Office for Technology at 13

CONCLUSION

The comments filed in response to the *NOI/NPRM* make clear that the interference temperature concept is neither feasible nor practical and would result in unacceptable interference even if the concept could work as designed. Nor does an interference temperature limit provide any regulatory certainty for licensees and Commercial Mobile Radio Service ("CMRS") operators in particular. In fact, the comments show that the only certainty that an interference temperature regime provides is that interference will increase and that the quality and capacity of mobile operators' networks would be degraded, perhaps severely. Nor do the benefits of the interference temperature concept appear compelling; given the lack of support from potential device manufacturers. For these reasons, AT&T Wireless believes that the interference temperature concept is not viable and that the NPRM portion of the proceeding should therefore be terminated.

Respectfully submitted,

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