**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington, D.C. 20554**

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| *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 DIRECTV GROUP, INC.**

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## SUMMARY

"Interference temperature" is a theoretically intriguing concept that would mark a significant departure from past Commission approaches to spectrum management, and the *NOI/NPRM* raises a number of fundamental questions about its implementation in practice. However, the "ΔT/T" approach proposed for use in certain satellite bands has little in common with this new concept, as it does not identify underused spectrum, does not rely upon measured interference at the victim receiver, and does not provide certainty for licensees. This is more than just a matter of semantics. To the extent this proceeding is a precursor to other attempts to implement an interference temperature approach, it is crucial that the Commission recognize the true nature of its proposal. The Commission may choose to proceed with a "ΔT/T" methodology in the bands proposed in the NPRM, but it should explicitly recognize that it is not creating an interference temperature regime – or establishing a precedent for interference temperature regimes in other bands – by doing so. In addition, there are a number of important conceptual issues, including international implications and enforcement mechanisms, that should be carefully considered in connection with the "ΔT/T" proposal.

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**COMMENTS OF THE DIRECTV GROUP, INC.**

The DIRECTV Group, Inc. (formerly known as Hughes Electronics Corporation) hereby submits its comments on the *NOI/NPRM* recently issued in this proceeding.[1] In the Notice of Inquiry portion of this proceeding, the Commission seeks comment on a new "interference temperature" model for managing spectrum use by both licensed and unlicensed services. This new approach is envisioned as a fundamental paradigm shift from traditional "command and control" spectrum allocation and licensing policies toward a more flexible and market-driven approach that will encourage and enable more efficient use of valuable spectrum while defining and protecting the rights of incumbent users of that spectrum. In the Notice of Proposed Rulemaking portion of this proceeding, the Commission proposes "a mechanism for approximating a first step" toward

[1] *See 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*, 18 FCC Rcd. 25309 (2003)("*NOI/NPRM*").

implementing this new paradigm in two frequency bands currently used by licensed Fixed-Satellite Services ("FSS") – the 6525-6700 MHz and 12.75-13.25 GHz bands.[2]

The interference temperature concept is an interesting and intriguing one, but as evidenced by the number of fundamental questions raised by the Commission itself, such a change in the regulatory paradigm could, depending on implementation, cause ripple effects (if not shock waves) for current licensees throughout the Table of Allocations. In addition, as the *NOI/NPRM* recognizes, there are significant technological advances needed to achieve some of the long-term benefits of interference temperature regulation, such as real-time monitoring and compliance.[3] The NOI is likely to spark debate on the merits of an interference temperature framework, the proper metric for measuring interference temperature, and the best way to implement such an approach if warranted.

One would expect the Commission to designate bands as appropriate for an interference temperature metric based on an analysis of spectrum use patterns that demonstrate underutilized "white areas." However, that is not the manner in which the NPRM has been formulated. Rather, the NPRM appears to be a continuation of the *ad hoc* spectrum management practices that the interference temperature framework is supposed to supplant. Just as the Commission has done in a number of other recent proceedings, the NPRM proposes to make room for a new service in a band by making a judgment as to how much additional interference the incumbents can tolerate. This should not be confused with a "first step" approximation of the new paradigm.

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2 *Id.* at ¶ 33. The NPRM does not propose to permit unlicensed operation in the 13.15-13.2125 GHz band at this time as it is allocated predominantly for mobile operations. For ease of exposition, we will refer to entire 12.75-13.25 GHz band as the "target" for purposes of these comments, as the *NOI/NPRM* does.

3 *Id.* at ¶ 11.

This is not just a matter of semantics. To the extent this proceeding is a precursor to other attempts to implement an interference temperature approach, it is crucial that the Commission recognize the true nature of its proposal. The Commission may choose to proceed with a "ΔT/T" methodology, but it should explicitly recognize that it is not creating an interference temperature regime – or establishing a precedent for interference temperature regimes in other bands – by doing so.

Moreover, the NPRM's "ΔT/T" approach to the FSS bands raises a number of conceptual issues that the Commission should consider carefully. Chief among these, perhaps, is the fact that under the ?T/T proposal a new class of unlicensed devices would add at least *five times as much* new interference into satellite uplinks as ITU Recommendation ITU-R S.1432 – which the NPRM cites as the basis for its proposal – specifies for interference from *all* non-co-primary sources. In addition, if the Commission intends to derive a set of limits for unlicensed transmitters based on a sample link budget like that in Appendix B to the *NOI/NPRM*, then Appendix B must recognize that the differing characteristics of satellites in the band can result in disparate ΔT/T values. Finally, the Commission provides no suggestion as to how the total amount of interference from unlicensed devices is to be measured, or what the Commission will do if the interference is greater than expected. These issues should be fully considered before a ΔT/T approach is adopted for the FSS bands.

It is one thing for the Commission to identify underused or unused radio spectrum that could be exploited by unlicensed devices. It is quite another for the Commission to create "white space" where it may not currently exist. Whichever course it proposes to

follow, the Commission should recognize what it is doing and analyze the policy implications of that choice in the proper context.

### A. THE CONCEPT OF "INTERFERENCE TEMPERATURE"

Recent advances in technology have heightened awareness of the value of spectrum resources and intensified efforts to find ways to make even more productive and intensive use of spectrum than ever before. Unlicensed devices in particular have captured the imagination, growing from the realm of the garage door opener to become an ever more integral part of our networked existence. However, the increasing demands of wireless consumer devices have put great pressure on the spectrum currently available for their operations. This, among other developments, has led the Commission to look for improved spectrum management techniques that could allow new technologies to exploit "holes" or "white spaces" in current spectrum usage without adversely affecting incumbent licensees.

To this end, the Task Force Report recommended that the Commission, as a long-term strategy, shift its paradigm from "assessing interference – based on transmitter operations – toward operations using real-time adaptation based on the actual RF environment through interactions between transmitters and receivers."[4] In order to achieve this objective, the Task Force recommended the adoption of an interference temperature metric that would specify, in degrees Kelvin, the amount of "noise" received in a particular band. As characterized by the *NOI/NPRM* – the Commission's first effort to put the interference temperature concept into practice – this new metric is part of an effort to "evolve [the Commission's] spectrum management policies to consider more

[4] *Spectrum Policy Task Force Report*, ET Docket No. 02-135, at 27 (rel. Nov. 15, 2002) ("Task Force Report").

flexible and market-oriented approaches that can provide incentives for users to migrate to more technologically innovative and economically efficient uses of the spectrum."[5]

The Task Force Report identified two key benefits from this new paradigm. First, licensed spectrum users would obtain greater certainty with regard to the maximum permissible level of interference in their band, because the applicable limits would be quantified and expressed unambiguously in degrees Kelvin. Second, to the extent the actual interference temperature in a particular band is less than its allowed maximum, other users (including unlicensed devices) might find ways to operate in the same band without causing overall interference to rise above the level guaranteed to the incumbents.[6]

If properly implemented, the interference temperature technique could unleash the potential of underused spectrum without adversely impacting the incumbent operators in the band. In fact, those incumbents would also stand to gain by achieving a level of certainly not currently available under the existing licensing regime, which would allow them to capture improvements they made to enhance spectrum efficiency on their side of the interference temperature threshold. This is the basis on which the interference temperature concept is said to be more "flexible and market-oriented" than traditional command-and-control allocation decisions. By setting clear boundaries for assigned RF rights, the Commission creates incentives for proponents of newer uses to find ways to squeeze into whatever "white spaces" may exist – either by asking incumbents to permit those uses in RF rights that are unambiguously assigned to incumbents, or by asking the

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5 *NOI/NPRM* at ¶ 6.

6 Task Force Report at 29-30.

Commission to permit those uses in RF rights that are unambiguously *not* assigned to any existing licensee. Thus, the two key benefits that are typically advertised for the interference temperature concept are closely related, but it may require patient trust in the operation of market forces before the first benefit – the certainty that results from quantification of permissible noise levels – leads to the realization of more intensive spectrum use.

In theory, the mere setting of an interference temperature need not have any effect upon incumbent licensees, provided it is set properly. For example, existing service rules often *imply* a certain noise level at which receivers are supposed to function properly, and using the existing rules to derive this number in degrees Kelvin should be a purely mathematical exercise with no practical effect on the level of interference experienced by the incumbent. However, much of the interest in the interference temperature concept comes from the fact that by quantifying the amount of interference that receivers must withstand and then *measuring* the amount of interference in the real world, it may become easier to identify bands in which the total amount of noise actually present at the receivers is routinely significantly below the limit, indicating an opportunity for additional spectrum use by a different service. Accordingly, the essentially *mathematical* process of determining the maximum permissible interference temperature for any given band is distinct from the essentially *empirical* process of finding opportunities for further spectrum use. Attending to this distinction makes clear that interference temperature is an analytical tool that helps *identify*, quantitatively, instances in which spectrum is available – rather than a technological or regulatory technique for making spectrum available where it previously was not. Conversely, failing to distinguish between the

mathematical derivation of a limit already implied by the *status quo* and the conscious attempt to *change the status quo* by introducing new sources of interference leads to intellectual confusion at best and disruption of settled expectations at worst.

As the Commission proceeds with efforts to implement a new type of spectrum management based on the interference temperature paradigm, it is essential to keep the "certainty" benefits of quantifying the *status quo* analytically distinct from the "new use" benefits that innovation will bring over time given the requisite certainty. This distinction is particularly important when the Commission seeks to superimpose the new paradigm on top of an existing service that matured under the old one. Unfortunately, the Commission's proposal for unlicensed use of FSS uplink bands does not seem to have taken this distinction fully into account.

### B. THE ΔT/T PROPOSAL IS NOT AN IMPLEMENTATION OF THE INTERFERENCE TEMPERATURE FRAMEWORK.

As described above, interference temperature represents a fundamental paradigm shift in the Commission's spectrum management philosophy, an approach that breeds flexibility and innovation by providing greater baseline certainty. By contrast, the NPRM's ΔT/T proposal for sharing between licensed FSS services and unlicensed devices in the extended C- and Ku-bands appears to be a continuation of the very policies that interference temperature was intended to supplant. Specifically, the proposal in the NPRM (1) does not quantify the maximum level of interference that incumbent receivers must withstand; (2) does not rely on any measurement of the actual RF environment; (3) does not exploit "white spaces" in the RF environment; and (4) is not designed to lead to the sort of self-regulating behavior hypothesized for cognitive radios in the not-too-distant future. Should the Commission choose to proceed with this approach nonetheless,

no one should confuse this approach with a new, flexible, and market-oriented framework based on interference temperature.

### *1. The ?T/T proposal does not quantify maximum levels of interference at the receiver.*

At the outset, we note that any implementation of a ΔT/T proposal would require fairly complex and detailed rules. We believe that all interested parties would be in a better position to help the Commission craft its policy had the *NOI/NPRM* included proposed rules. However, based solely on the textual discussion in the NPRM, it appears that the proposed solution is not designed to lead to a true interference temperature for the FSS uplink bands. Instead, the Commission seems to be proposing to derive *transmitter* limitations for a new class of unlicensed devices, based on speculative forecasts of how much additional interference might be caused by a large number of relatively low-powered devices operating (presumably) nationwide.

If this is indeed the direction in which the Commission plans to proceed, then the ?T/T proposal has little in common with the interference temperature paradigm. As noted above, the first and most basic benefit of the new paradigm is supposed to be *certainty*, for both incumbents and prospective entrants alike, based on a *quantification of the maximum amount of interference at the protected receiver*. The ?T/T proposal does not achieve this certainty because it merely forecasts, rather than caps, potential interference from the new class of devices. Even if the forecasts were designed to preserve the real-world *status quo*, no forecast that relies on assumptions about the aggregate behavior of devices that have not yet been invented can possibly provide anything like "certainty." If the devices are more popular than expected, or if they are simultaneously in use more often than the Commission predicts in Appendix B to the

*NOI/NPRM*, satellite receivers will receive more interference than either they or the Commission currently expect. Considering that the absolutely critical assumptions about consumer take-up and usage patterns are of necessity highly speculative at this point, this approach creates a risk for incumbent FSS operators that is the antithesis of certainty.

Alternatively, if the number of devices in the band remains comfortably below what the Commission projects as the upper limit in Appendix B, but device manufacturers seek increases in the maximum permissible transmit power levels, then everyone is right back at square one, wondering how much new interference would be too much. The Commission would find itself in the middle of a second tug-of-war, no different from the first except that this time there would effectively be *two* incumbent services. Again, *regardless* of whether it is possible to add a new class of unlicensed devices to satellite uplink bands without interfering with the existing RF rights of incumbent licensees, this ? T/T proposal is similar to past methods used to settle inter-service sharing questions, not some new paradigm implementing new strategies for effective spectrum management.

***2. The ?T/T proposal does not rely on any actual measurement of the RF environment, now or in the future.***

The Task Force Report was based in large measure on the premise that portions of the radio spectrum are not in use for significant periods of time, creating "holes" in usage patterns that could be exploited. Because the existing characteristics of each band are different, the Task Force recognized that the appropriate interference temperature would vary for each band, region, or service, and should only be set "after the Commission has reviewed the condition of the RF environment in each band."[7] The Report discussed

[7] *Id*. at 27-28.

field tests of spectrum usage below 1 GHz in five cities, which revealed that some bands are heavily used but also confirmed that other bands are only lightly used.[8] From this preliminary evidence, the Task Force Report concluded that there may be opportunities for wireless devices to exploit spectrum that is unused during a given time or in a given geographic location.

Unfortunately, there is no evidence that the Commission conducted such tests prior to targeting the bands identified in the NPRM. This makes the selection of FSS uplink bands something of a mystery. The Commission indicates that it chose these bands because "the licensed receiver being protected is located on the satellite in space,"[9] but this argument fails to recognize that the *desired* signal is no closer to the satellite receiver than the undesired signal is. In other words, the 36,000 kilometers between the noise and the receiver do not provide as much protection as might be thought because satellite receivers are *designed* to pick up signals from 36,000 kilometers away. Indeed, if one looks at Figure 1 of the *NOI/NPRM* (taken from the *SPTF Report*), one might get the impression that satellite uplink bands are peculiarly *inappropriate* for the interference temperature approach because virtually all satellite transmitter/receiver pairs operate near the maximum path length; there is no class of short paths which presumably have excess margin and can therefore easily tolerate a little extra noise.[10]

The *NOI/NPRM* also notes that FSS uplink bands are shared by a number of licensed systems operating at fairly high power, which might lead to the conclusion that

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8 *Id.* at 10.

9 *NOI/NPRM* at ¶ 32.

10 Thus, for satellite services, the relevant portion of Figure 1 would be a single vertical slice somewhere near the right-hand edge of the graph.

the band is likely to be intensively used by its various licensees. Instead, the Commission seems to have reached exactly the opposite conclusion, stating that "[b]ecause of the extensive sharing of high power systems already present in these bands, we believe that additional unlicensed devices, even those operating above the current Part 15 power limits, will be able to successfully share spectrum with incumbent users using this new interference temperature approach."[11] The *NOI/NPRM* also justifies its decision to target these bands by noting the great disparity in magnitude between permissible emission levels for licensed services versus unlicensed devices – an observation that "intuitively suggests" that these bands can support expanded unlicensed operations without detrimental impact to incumbent operators.[12] However, once again, the antennas on the satellites are capable of "seeing" a huge number of the lower-power devices, and the cumulative effect of these devices can only be hypothesized rather than measured.[13]

Furthermore, it is not just the *status quo ante* that is to go unmeasured; there is also no proposal for any *future* measurement or monitoring of the amount of increased interference experienced at the satellite receiver. If satellites begin to experience significant degradations in performance as the installed base of unlicensed devices grows, how can it be determined whether the problem is caused by excess noise at the receiver? Alternatively, if the new devices enjoy early commercial success without harmful interference to the satellites, and proponents ask for liberalization of the transmit power

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11 *NOI/NPRM* at ¶ 36.

12 *Id*. at ¶ 37.

13 In fact, the desired uplink signal could be attenuated by rain while much of the interfering signal from more widely dispersed unlicensed devices could be coming from areas with clear sky conditions.

limitations, how will the Commission know how accurate the initial forecasts of in-space noise were, or how much room there might still be under the so-called "cap"? It is not clear how the noise level should be measured even in theory, since ?T/T caused by this interference noise would be different for literally every beam of every satellite in the entire geostationary arc. Empirical objectivity and quantitative precision are two of the most attractive and important elements of the interference temperature concept, and they are unfortunately absent from the ?T/T proposal.

***3. The ?T/T proposal will not lead to the sort of self-regulating behavior hypothesized for cognitive radios and will not stimulate incumbent innovations toward that end.***

As noted above – and in most public discussion of interference temperature – one of the most attractive possibilities opened up by this new regulatory paradigm is the potential for cognitive radios to make "opportunistic" use of spectrum that might be available in some times and places but not others, based on a real-time measurement of the local RF environment and a comparison of the prevailing conditions with objective standards for total noise at the receiver. As we have seen, the ? T/T proposal does not set any objective quantitative limit on noise and does not provide for any measurement of the actual RF environment, now or in the future. Consequently, this potential benefit of regulation based on interference temperature is also missing from the ?T/T proposal.

Cognitive radios on the ground will not be able to determine anything about noise at the receiver merely by monitoring the noise in their immediate vicinity, so the sort of atomized self-regulation that is the ultimate goal of interference temperature theory cannot occur. One could imagine some sort of infrastructure for monitoring actual noise levels in space and providing them to users on the ground to guide network access and

frequency selection decisions, but no such infrastructure exists and the Commission is not proposing one. Nor is there any obvious way that such an in-orbit monitoring infrastructure could distinguish between noise caused by unlicensed devices (which are subject to the ?T/T limit) and noise caused by licensed earth station transmissions to adjacent satellites (which are not).

One can imagine ways in which these practical obstacles might be remedied in order to facilitate an interference temperature approach. For example, one or more satellite operators might establish an in-space system for monitoring noise levels and sending "on/off" signals to millions of transceivers on the ground, with funding generated by a royalty on unlicensed devices in the band. The Commission might even propose such a service and auction off the band management rights subject to the requirement that satellite receivers be protected from noise temperatures in excess of a specified limit, verified by an appropriate measurement regime. Although we are not here proposing or endorsing such an approach, one can at least see the theory behind it, and the example usefully illustrates the elements that are missing from the proposed ?T/T approach.

***4. The ?T/T proposal does not exploit "white spaces"; it creates them.***

The easiest and cleanest way to determine an interference temperature for a given frequency band would be to derive the value that is "implied" by the Commission's rules for use of the band. Under such an approach, the Commission would essentially determine the level of interference that would be reasonably anticipated by its licensees, establish that level explicitly to give all parties greater certainty, and then allow other users to make use of the band so long as they did not create interference above the derived limit. Such a methodology would reveal whether there is "space" for additional

services consistent with the reasonable expectations of existing services in a band. In addition, it would explicitly provide that an underlay use was permitted only where it would not cause the aggregate noise temperature at the receiver to exceed a specified limit. This would tend to "smooth out" the peaks and valleys represented in Figure 1 of the *NOI/NPRM*.

The ? T/T proposal has little in common with such an approach. As preceding sections have demonstrated, there is no objective limit to aggregate noise temperature, no provision for measuring it at the satellite receiver, and no mechanism for regulating the transmitter depending on the interference environment. The result can only be a layer of noise that sits on top of whatever is already there, regardless of whatever peaks and valleys in the existing noise environment already exist. In other words, the new service would not just use "white space" spectrum; it would use whatever it needed, regardless of the effect on any given satellite receiver. This is a consequence of the conceptual flaws noted above: ?T/T is not an objective cap, is not empirically based, and does not include any feedback infrastructure.

***5. The DT/T approach is a continuation of past spectrum management practices.***

While the ? T/T proposal has little in common with the interference temperature paradigm, it is by no means unprecedented. On the contrary, it bears a striking resemblance to the command-and-control model the *NOI/NPRM* aspires to eschew. In essence, the Commission is choosing a band and trying to determine how much "loss" could be imposed on the existing licensees in order to make room for new unlicensed services. Rather than identifying and exploiting "white areas," this approach is very similar to past practices.

For example, in December 2000, the Commission adopted rules under which non-geostationary orbit ("NGSO") systems in the Fixed-Satellite Service would be allowed to share certain portions of the Ku and Ka bands with other satellite systems already authorized to operate in these bands.[14] To accomplish this sharing, the Commission adopted equivalent power flux density ("EPFD") restrictions on the new NGSO systems designed to limit the total aggregate interference caused by such systems to at most 10% of the time allowance for unavailability above the existing levels of the incumbent systems.[15] The 10% figure was not derived from a study of inefficiencies in the existing spectrum use environment, but instead reflected the negotiated agreement that ultimately settled the controversy first at the ITU and then domestically. There is no question that much of the analytical work in this multi-year effort was ingenious, but the paradigm was not designed to achieve a "flexible and market-oriented" result.

The Commission took a similar approach in 2002 in adopting rules that would allow the terrestrial Multichannel Video and Data Distribution Service ("MVDDS") to operate in spectrum previously licensed for Direct Broadcast Satellite ("DBS") use. In fact, the point of departure for the Commission's approach to MVDDS was the same 10% additional unavailability criterion used in the Ku/Ka-band NGSO-FSS context. While the Commission conducted an analysis of the interference that MVDDS systems could cause to DBS systems, that analysis did not attempt to identify "white spaces" in DBS spectrum use. Instead, the Commission made a qualitative judgment of how much

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14 *See Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, 16 FCC Rcd. 4096 (2000).

15 *See id.* at 4196-97. The 10% sharing criterion was used to develop the aggregate (*i.e.*, all NGSO FSS systems) EPFD value from which a single-entry (*i.e.*, single NGSO FSS system) EPFD value was apportioned.

additional unavailability of signals DBS subscribers should or would be willing to tolerate in order to make room for a new service.

> Some metric of acceptable DBS system performance must be quantified in order to determine appropriate technical requirements for MVDDS to ensure protection of DBS operations. Using a 10% increase in DBS service unavailability criterion as an initial benchmark to establish EPFD limits for MVDDS strikes a reasonable balance between protecting DBS from interference and deploying new MVDDS services.[16]

In both NGSO-FSS and MVDDS, the Commission (and in the case of NGSO-FSS, even the ITU) did extensive evaluation of the existing interference environment in the band, decided how much "loss" could be tolerated from increasing aggregate interference in the band, and used that figure to derive corresponding EPFD limits. Here, the exercise is very similar – except that in this case there is no extensive evaluation upon which to draw.

The fact that the ? T/T proposal is not an approach based on interference temperature is not, strictly speaking, an argument against it. Specific comments on the merits of the proposal are included in the section that follows. However, the Commission has presented this proposal as a "simplified"[17] or "first-step"[18] implementation of interference temperature limits; even as a way to "provide valuable information and experience to guide our formulation of approaches in the next phases of this effort."[19] Whatever the merits of the ? T/T proposal may be, the Commission should recognize that

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16 *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, 17 FCC Rcd. 9614, 9764 (2002).

17 *NOI/NPRM* at ¶ 31.

18 *Id*. at ¶ 33.

19 *Id*. at ¶ 30.

it is not a step toward interference temperature, or a reasonable approximation of interference temperature, or even an experiment on how interference temperature might work in a typical band. It is, rather, a continuation of past practices, and its public interest strengths and weaknesses must be judged on that basis.

### C. THE ΔT/T PROPOSAL RAISES A NUMBER OF IMPORTANT CONCEPTUAL ISSUES THAT SHOULD BE CAREFULLY CONSIDERED.

Quite apart from its deficiencies as an implementation of the interference temperature paradigm, the ΔT/T proposal raises a number of fundamental conceptual issues that merit serious consideration.

First, the ΔT/T approach proposed in the *NOI/NPRM* specifies 5% as the maximum allowable increase in noise the new underlay service should be permitted to create. "This particular interference value was chosen because it is less (i.e., more conservative – or more protective) than the 6% ?T/T figure used by the ITU for requiring coordination between co-primary satellite systems, recognizing the generally lower regulatory status of Part 15 devices."[20] However, the 6% coordination trigger for adjacent satellite networks is not the appropriate starting point because the ITU has developed a different interference allocation specifically applicable to aggregate interference from sources such as unlicensed devices. Recommendation ITU-R S. 1432 states that, for FSS systems practicing frequency re-use, interference from all non-co-primary sources (specifically including unlicensed devices) should account for no more than 1% of the total clear-sky satellite system noise.[21] This recommendation specifies

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[20] *Id.* at ¶ 38.

[21] Recommendation ITU-R S.1432, *recommends* 2 and 4.

that "the maximum allowable interference from all sources (aggregate) should be limited to . . . 27% [of the clear-sky satellite system noise] . . . for systems practising frequency re-use." Of this 27%, fully 20% is allotted to interference from other FSS networks, 6% is allotted to other co-primary services, and just 1% is allotted to "all other sources of interference," including unlicensed devices. Thus, if interference from unlicensed devices were the *only* source of interference from the category of "all other sources" into satellite uplinks, the relevant ?T/T threshold would be at most 1% rather than 5%. If, as the Commission states, the threshold number is intended to be "more protective . . . , recognizing the generally lower regulatory status of Part 15 devices,"[22] then a figure somewhat below 1% would be more appropriate.

Second, the Commission cannot regard this underlay question as if it were a completely domestic issue. Satellites frequently have footprints covering many countries – almost entire hemispheres – and the ? T/T threshold under consideration must be set to take into account *all* other sources of interference generated in *all* other countries. Conversely, a decision to allow a host of additional unlicensed devices to operate in this band would affect the operating environment of not only U.S.-licensed satellite systems, but also those licensed by other countries.[23] The United States should not unilaterally decide essentially to "use up" the entire 1% available for non-co-primary interference sources, thus placing both U.S.-licensed and non-U.S.-licensed satellites at the limits of their interference budgets even before non-co-primary interference in other countries is considered. This problem could be addressed by lowering the interference threshold

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22 *NOI/NPRM* at ¶ 38.

23 By contrast, MVDDS involves purely domestic interference from terrestrial systems into local earth stations, and the NGSO-FSS decision codified an international agreement.

number well below 1% in order to provide some additional "breathing space," or it could be addressed by assuming that the devices in question will be rolled out in every country in equal density and apportioning the 1% among the countries within the coverage area of GSO satellite systems. To assume, however, that the U.S. and only the U.S. will roll out devices that need to be accounted for within the recommended 1% ? T/T allotment would appear to be rather presumptuous on the part of the U.S.

Third, the Commission must ensure that its reference link budget is protective of the most sensitive receivers currently on file at the ITU. Part of the reason for this is that the ? T/T statistic would be different for literally every beam of every satellite in orbit, and an "average" or "typical" link budget is likely to upset settled expectations that deserve to be protected. These considerations are particularly weighty in light of the long lead time for satellite deployment and the even longer replacement cycles. On the one hand, there is virtually no chance that any satellite launched in the next five years will have an opportunity to take account of the proposals in this proceeding, because of the long lead time. That means, in turn, that it may be twenty years before *all* of the satellites in orbit are equipped to handle any additional interference. Whether or not this militates against any use of a satellite band as a test bed for interference temperatures, it certainly gravitates strongly in favor of an extremely conservative, protective approach to the derivation of the transmit power limitations themselves.

Finally, it would be imprudent to launch a new, unlicensed underlay service without some very clear expectation about how the resulting interference is to be monitored and what steps are to be taken if the resulting interference is too high. The Commission would presumably use the equipment certification process to ensure that all

devices operate as intended (and as the interference forecasts assume). But what happens as the aggregate interference from the community of unlicensed devices continues to grow and eventually degrades the service quality of the FSS? To whom does an affected FSS operator turn to remedy this excess interference or repair degraded service quality? What recourse does an FSS operator have on the community of unlicensed devices in the field (operated by end users), and how would excess aggregate interference issues be addressed? An ineffective enforcement regime would be particularly problematic for satellite operators, whose receivers (once launched) are not amenable to alteration in response to additional interference. These fundamental and practical questions should be carefully considered in this proceeding.

## CONCLUSION

While the concept of interference temperature presents some intriguing possibilities, many questions remain in formulating a practical method of application. Both the theoretical and practical issues are likely to be more pronounced wherever the implementation of an interference temperature approach (which by itself need not affect any incumbent's expectations) is joined with a proposal to introduce a new service into an existing band, as it is here. More fundamentally, however, the NPRM's $\Delta T/T$ proposal does not identify underutilized spectrum, does not rely upon measured interference at the victim receiver, and does not provide certainty for licensees. In other words, it is not an interference temperature approach, but is instead a continuation of spectrum management practices evident in other recent Commission decisions. Should the Commission choose nonetheless to pursue that approach, it should recognize the implications of doing so.

In addition, the ΔT/T approach raises a number of fundamental issues that the Commission should consider thoroughly. Such consideration is all the more important in this case, given that after-the-fact remedies for interference caused by thousands or millions of unlicensed devices used by individual consumers are likely to be highly problematic – to FSS operators and unlicensed device users and manufacturers alike.

Respectfully submitted,

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