



# PUBLIC NOTICE

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DA 17-1165

Released: December 1, 2017

## OFFICE OF ENGINEERING AND TECHNOLOGY SEEKS COMMENT ON TECHNOLOGICAL ADVISORY COUNCIL SPECTRUM POLICY RECOMMENDATIONS

ET Docket No. 17-340

Comments Due: January 31, 2018

Reply Comments Due: February 15, 2018

The Office of Engineering and Technology seeks comment on spectrum policy recommendations that the FCC's Technological Advisory Council (TAC)<sup>1</sup> has made to the FCC through its Chairman and in more detail through several white papers<sup>2</sup>. Over the past several years, the TAC's Spectrum and Receiver Performance Working Group has developed recommendations to address the increasing challenges of efficient and fair allocation of spectrum in congested RF environments, and in particular, the challenges of finding a balance between the rights and responsibilities of transmitters and receivers. More recently, the TAC has recommended that the Commission adopt a policy statement, setting forth spectrum management guidance and principles based on TAC recommendations made to the FCC, including the following:

[1] Implement and formalize the TAC's recommendations for *Basic Spectrum Principles* as policies, and set clear expectations about the affected system's capabilities regarding interference, such as harm claim thresholds.<sup>3</sup>

[2] Adopt risk-informed interference assessment and statistical service rules more widely.<sup>4</sup>

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<sup>1</sup> The Technological Advisory Council is an advisory group operating under the authority of the Federal Advisory Committee Act and comprises a diverse array of leading experts that helps the FCC identify important areas of innovation and develop informed technology policies supporting America's competitiveness and job creation in the global economy, see <https://www.fcc.gov/general/technological-advisory-council>, last visited on November 30<sup>th</sup>, 2017.

<sup>2</sup> See, <https://www.fcc.gov/general/tac-reports-and-papers>, last visited on November 30<sup>th</sup>, 2017.

<sup>3</sup> See, December 2015 paper "Basic Principles for Assessing Compatibility of New Spectrum Allocations", <https://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting121015/Principles-White-Paper-Release-1.1.pdf> (*Basic Spectrum Principles White Paper*); and March 2014 paper, "Interference Limits Policy and Harm Claim Thresholds: An Introduction", <http://transition.fcc.gov/oet/tac/tacdocs/reports/TACInterferenceLimitsIntro1.0.pdf>; see especially *Section 5, Developing harm claim threshold values*.

<sup>4</sup> See, April 2015 paper, "A Quick Introduction to Risk-Informed Interference Assessment", <http://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting4115/Intro-to-RIA-v100.pdf>; see especially *Section 5, Recommended FCC Action*; and December 2015 TAC paper, "A Case Study of Risk-Informed Interference Assessment: MetSat/LTE Co-existence in 1695–1710 MHz",

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[3] Implement steps for improving interference resolution, including a next-generation architecture for radio spectrum interference resolution, creating a public database of past radio-related enforcement activities, and incorporate interference hunters in the resolution process.<sup>5</sup>

***Basic Spectrum [Management] Principles*** – The TAC has recommended that the Commission consider adopting nine spectrum management principles as set forth in the TAC’s *Basic Spectrum Principles White Paper*. The TAC believes that adoption of these principles – which are organized in three categories – could be useful in helping to improve the compatibility of services that operate under [existing or] new spectrum allocations.

### **Interference Realities**

*Principle #1* -- Harmful interference is affected by the characteristics of both a transmitting service and a nearby receiving service in frequency, space or time;

*Principle #2* – All [radio] services should plan for non-harmful interference from signals that are nearby in frequency, space or time, both now and for any changes that occur in the future;

*Principle #3* – Even under ideal conditions, the electromagnetic environment is unpredictable. Operators should expect and plan for occasional service degradation or interruption. The Commission should not base its rules on exceptional events;

### **Responsibilities of [Radio] Services**

*Principle #4* – Receivers are responsible for mitigating interference outside their assigned channels;

*Principle #5* – Systems are expected to use techniques at all layers of the stack to mitigate degradation from interference;

*Principle #6* – Transmitters are responsible for minimizing the amount of their transmitted energy that appears outside their assigned frequencies and licensed areas;

### **Regulatory Requirements and Actions**

*Principle #7* – Services under FCC jurisdiction are expected to disclose the relevant standards, guidelines and operating characteristics of their systems to the Commission if they expect protection from harmful interference;

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<https://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting121015/MetSat-LTE-v100-TAC-risk-assessment.pdf>; see especially *Section 8, Conclusions and recommendations*, and the *Executive Summary*.

<sup>5</sup> See, March 2016 paper, “A Study to Develop the Next Generation Systems Architecture for Radio Spectrum Interference Resolution”, <https://transition.fcc.gov/oet/tac/tacdocs/reports/2016/A-Study-to-Develop-a-Next-Generation-System-Architecture-V1.0.pdf> (*Next Generation Architecture for Interference Resolution*); June 2014 paper, “Introduction to Interference Resolution, Enforcement and Radio Noise”, <https://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting61014/InterferenceResolution-Enforcement-Radio-Noise-White-Paper.pdf>; see especially *Section V, Potential New Strategies or Approaches for Addressing Enforcement Challenge*.

*Principle #8* – The Commission may apply Interference Limits to quantify rights of protection from harmful interference;

*Principle #9* – A quantitative analysis of interactions between services shall be required before the Commission can make decisions regarding levels of protection.

***TAC White Paper*** -- These nine principles are further elaborated in the TAC's *Basic Spectrum Principles White Paper*, including how the goal of achieving more efficient and effective spectrum use can be achieved through the application of these nine principles. The TAC does not expect the application of these principles to result in a concrete set of regulations that fit all radio services in the same way, due to the many differences between the requirements of various types of systems. However, the TAC believes the principles can be applied to all systems and result in an optimal solution for each service. In the following sections we provide a fuller description of each of the principles as described in the white paper.

#### ***Interference Realities (Principles #1 - #3)***

The TAC notes that the Commission's definition of "harmful interference," is subject to interpretation depending on the particular radio service.<sup>6</sup> The determination of precisely what constitutes "harmful interference" will vary in different situations. Principle #1 states that harmful interference is affected by the characteristics of both a transmitting service and a nearby receiving service, in frequency, space or time.

Principle #2 states that all services should plan for non-harmful interference from nearby signals, now and in the future. The TAC posits that some interference can be expected and tolerable (non-harmful interference), up to a limit (interference limit).<sup>7</sup>

In principle #3, the TAC highlights various statistical factors that lead to an unpredictable electromagnetic environment. The TAC recommends that operators should expect and plan for occasional service degradation or interruption, and the Commission should not base its rules on exceptional events. Furthermore, in Example #2 (Aggregate Interference Analysis for Coexistence), additional statistical factors are discussed and the TAC says it is essential to bring realism into modeling of coexistence scenarios.<sup>8</sup> The TAC suggests that it would be useful for the Commission to influence the course of discussion in a way where worst case analyses, when applicable, are used only to determine the consequences of harmful interference, and tested statistical techniques to assess risk should be used to perform a thorough interference assessment.

#### ***Responsibility of [Radio] Services (Principles #4 - #6)***

Principles #4 - #6 state that receivers (#4) and transmitters (#6) both bear responsibility for minimizing and/or mitigating interference outside their assigned frequencies (channels), and principle #5 states that

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<sup>6</sup> 47 CFR §2.1 *Harmful Interference* – Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the [ITU] Radio Regulations.

<sup>7</sup> See, Principle #8.

<sup>8</sup> See, *Basic Principles White Paper*, at 29-31.

radio systems are expected to use techniques at all levels/layers to mitigate degradation from interference. While the Commission generally regulates transmitters by establishing emission power limits in radio service rules, the Commission generally does not regulate receiver immunity (e.g., filter) performance that vendors are responsible for in principle #4, nor does the Commission generally regulate the various system techniques for mitigating degradation from interference in principle #5, such as adaptive modulation, channel coding, power control, and retransmission protocols.

### ***Regulatory Requirements and Actions (Principles #7 - #9)***

These three principles address the tools that the TAC believes the Commission needs to make predictions of interference levels. Foremost, the TAC says the Commission needs sufficient technical details about all of the affected radio services, including detailed information about the operation of radio services and quantitative modeling about the interactions between radio services over a wide variety of expected conditions.

Principle #7 states that radio services are expected to disclose relevant standards and system characteristics if they expect protection from harmful interference. There are some radio services for which technical details of receiver, transmitter, and system operation with respect to interference are specified in industry standards specifications. Some of these industry standards are freely available to the public while others are available for a monetary fee. Some radio services have no industry standards or published detailed technical specifications. Limited receiver and transmitter specifications may be published in data sheets by vendors, or not published because of proprietary reasons. The 3<sup>rd</sup> Generation Partnership Project (3GPP) is an example of an industry standards development organization that publishes technical studies and consensus standards specifications, including terrestrial mobile broadband transmitter and receiver specifications. 3GPP member stake-holders study and publish RF model scenarios including quantitative impairments of transmitters,<sup>9</sup> receivers,<sup>10</sup> and the contribution of each to the degradation of a victim system.<sup>11</sup> The 3GPP studies and specifications are generally within or between spectrum bands used by multiple mobile broadband service providers.

Principle #8 states that the Commission may apply Interference Limits to quantify rights of protection from harmful interference. The TAC has recommended interference limits as a method for the Commission to communicate the limits of protection to which systems are entitled, without mandating receiver performance specifications. Interference limits are quantitative descriptions of the interference environment in which a radio system would need to operate without being able to make a claim of harmful interference. The limits are statistical in nature, stating the in-band and out-of-band signal levels that must be exceeded before a protected system can make a harm claim.

Principle #9 states that a quantitative analysis of interactions between services shall be required before the Commission can make decisions regarding levels of protection. The TAC describes the high complexity of quantitative models, such as propagation models for estimating the signal attenuation between a transmitter and receiver. The TAC also notes that differences between models can lead to widely different interference results, producing disputes and leading to costly delays in spectrum deployment. The TAC discovered a lack of transparency in some past interference studies that regulators have relied upon in making important spectrum allocation decisions, and recommends that the Commission improve the

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<sup>9</sup> See, 3GPP TR 36.942 v13.0.0, Radio Frequency (RF) system scenarios, Section 8, Rationales for co-existence requirements, Adjacent Channel Leakage Ratio (ACLR).

<sup>10</sup> *Id.* Adjacent Channel Selectivity (ACS).

<sup>11</sup> *Id.* Adjacent Channel Interference Ratio (ACIR).

transparency and reproducibility of the interference analyses underlying its major spectrum management regulatory decisions.<sup>12</sup>

**Risk-informed-interference-assessment (RIIA)** – The TAC has recommended that the Commission adopt risk-informed interference assessment and statistical service rules more widely. In judging whether to allow new radio service rules, the TAC observes that the Commission has to balance the interests of incumbents, new entrants, and the public. The process of analyzing the tradeoffs between the benefits of a new service and the risks to incumbents has to date been essentially qualitative.<sup>13</sup> The TAC has proposed the use of quantitative risk analysis to assess the harm that may be caused by changes in radio service rules. Such analysis considers the likelihood-consequence combinations for multiple interference hazard scenarios, and complements a worst case analysis that considers the single scenario with the most severe consequence, regardless of its likelihood. The TAC makes reference to lessons learned by the Nuclear Regulatory Commission’s (NRC) pioneering work in developing quantitative risk assessment in the U.S. In particular, two lessons are: 1) quantitative risk assessment can be applied successfully in an industry where safety-of-life is paramount, and 2) changing an industry’s culture takes time. The TAC recommends that the Commission start soon, and start small, and not attempt a major overhaul of its regulatory approach.<sup>14</sup>

The TAC recommends that the Commission use quantitative risk assessment in its own analyses and publish the results, and offers the following examples: the Commission could quantify likelihoods and consequences rather than merely using probabilistic language without quantification; it could require disclosure and analysis of both the likelihood and consequence of harmful interference hazards in Notices of Inquiry and Notices of Proposed Rulemaking; it could adopt a common practice to assess interference risk against a baseline of current impairments; it could also document relative and absolute changes in interference impact along with the probability of being unaffected by new rules.<sup>15</sup>

**Steps for improving interference resolution and enforcement** – The TAC has recommended that the Commission implement steps for improving interference resolution, including a next-generation architecture for radio spectrum interference resolution, creating a public database of past radio-related enforcement activities, and incorporate interference hunters in the interference resolution process.<sup>16</sup> The rapid evolution and increased densification / growth of wireless systems has changed the nature of interference risks and the need for more automated interference resolution tools for detecting, classifying, locating, reporting and remediating interference. The TAC has documented a variety of new strategies for consideration and has recommended that the Commission release additional information on interference complaints and investigations, including those that are voluntarily resolved by the affected parties. The TAC also proposed a study to develop a next generation system architecture for spectrum interference resolution, and recommended that the Commission initiate and collaborate with other government agencies, academia, and the private sector, to undertake the development of such an architecture. Budget, resource, and speed limitations of manually detecting, locating, reporting, and mitigating interference have propelled the urgency of the TAC’s recommendations. The TAC has said that resource gaps that slow the response to serious interference incidents involving the safety of life, property, and homeland

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<sup>12</sup> *Id.* at 24-25.

<sup>13</sup> See, *A Quick Introduction to Risk-Informed Interference Assessment*, April 1, 2015, at ii.

<sup>14</sup> *Id.* at 11-12.

<sup>15</sup> *Id.* at 12.

<sup>16</sup> See, *Next Generation Architecture for Interference Resolution*.

security, and, the lack of a next generation system architecture, could undermine the value of shared spectrum and the willingness of agencies to share spectrum.<sup>17</sup>

***Discussion*** - We invite comment on the above spectrum management principles recommended by the TAC. These comments will be considered by the TAC in making any refinements to the recommendations. We also solicit views as to whether and how these principles may be integrated into FCC spectrum policy. For example, should they be adopted by the Commission as a policy statement that may serve as a reference in considering various spectrum matters? Would doing so be helpful? For example, would it serve to promote deployment of receivers with improved interference rejection characteristics? Are there specific spectrum matters where the Commission should apply these principles, and if so, what are they? We also solicit views on any suggested additions, deletions or modifications to these principles that should be considered.

*Comments and Reply Comments:* Interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS). See *Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- *Electronic Filers:* Comments may be filed electronically using the Internet by accessing the ECFS: <http://apps.fcc.gov/ecfs>
- *Paper Filers:* Parties who choose to file by paper must file an original and one copy of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.

Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.

- All hand-delivered or messenger-delivered paper filings for the Commission's Secretary must be delivered to FCC Headquarters at 445 12<sup>th</sup> St., SW, Room TW-A325, Washington, DC 20554. The filing hours are 8:00 a.m. to 7:00 p.m. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes and boxes must be disposed of before entering the building.
- Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9300 East Hampton Drive, Capitol Heights, MD 20743.
- U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12<sup>th</sup> Street, SW, Washington DC 20554.

Comments and reply comments filed in response to this Public Notice will be available via ECFS. These documents also will be available for public inspection during regular business hours in the FCC Reference Information Center, Portals II, 445 12th Street S.W., Room CY-A257, Washington, D.C. 20554.

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<sup>17</sup> *Id.* at 6.

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