
**COMMERCE SPECTRUM MANAGEMENT ADVISORY
COMMITTEE (CSMAC)**

**SPECTRUM TRANSPARENCY WORKING GROUP
(STWG)**

**May 19, 2010
FINAL REPORT**

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SPECTRUM TRANSPARENCY WORKING GROUP FINAL REPORT:

SPECTRUM TRANSPARENCY

I. INTRODUCTION

The need for access to wireless spectrum is a national priority today more than ever. Spectrum users – ranging from licensed wireless carriers, unlicensed wireless users, broadcasters, and federal agencies – have all indicated an increased need for spectrum access. The Government Accountability Office (GAO), Office of Management and Budget (OMB), Congressional Committees, Federal Communications Commission (FCC) and National Telecommunications and Information Administration (NTIA) have also indicated an increased need to account for how existing Federal and Non-Federal spectrum allocations and assignments are used.¹ Spectrum accountability *may never* occur without increased “spectrum transparency.”

“Artificial” spectrum scarcity² constrains innovation and/or federal mission performance and has a detrimental effect on public safety, homeland defense/national security, ‘smart grids,’ rural and municipal broadband,³ and commercial competition. In particular, the lack of long-term access to suitable, specific spectrum may carry an unnecessarily high or impossible barrier to entry for a commercial carrier or for an agency to be able to serve its mission. Spectrum transparency, which may have multiple definitions, would not just address “actual use” but may show the gap between real and artificial scarcity over time, space and frequency by initially revealing actual use.⁴ Increased transparency also may improve the ability of the FCC and NTIA to assess the spectrum landscape more accurately, thus improving their ability to develop and assess spectrum recommendations by various stakeholders. Given this is a critical national resource, it is important that we manage and make policy decisions with the most accurate data possible. The capability for security cleared

¹ Regarding Federal use, the term “spectrum allocation” refers to the government designation of a range of frequencies for a category of use or uses as defined by Allocation Tables, while the term “spectrum assignment” represents the government authorization for use of specific frequencies or frequency pairs within a given allocation. Federal, Non-Federal and Commercial spectrum allocation data is available via FCC and NTIA published databases and systems. Spectrum “use” spectrum may imply actual radiated services or “non” use by public or private sector entities for missions and/or future service requirements.

² Artificial spectrum scarcity reflects a belief that not ALL of the users with spectrum assignments by either the FCC or NTIA are radiating across the entire spectrum assignment today, or will be in the near future, with no current means of sharing or re-allocation. . As the FCC Spectrum Policy Task Force report noted, “In many bands, spectrum access is a more significant problem than physical scarcity of spectrum, in large part due to legacy command-and-control regulation that limits the ability of potential spectrum users to obtain such access.” FCC, Spectrum Policy Task Force Report, ET Docket No. 02-135, at 3 (Nov. 2002), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-228542A1.pdf.

³ See The Wireless Internet Service Providers Association, Reply Comments – NBP Public Notice #30, GN Docket Nos. 09-47, 09-51 and 09-137, at 2 (Jan. 27, 2010).

⁴ Use is described in footnote 1 above; topic which merits further discussion and understanding is spectrum efficiency, which is distinct from how much spectrum is assigned or allocated.

individuals and leaders to view and understand the specific macro spectrum landscape at both NTIA and FCC is a critical output of spectrum transparency.

Recent and multiple spectrum utilization studies⁵ show that there are frequencies and channels available across different geographies that are not “used”⁶ at all over long testing periods. For these tests, however, passive sensors were not accounted for, nor was the fact that some assignments are for systems in development or for intermittent, critical and/or emergency uses. Requiring use reporting and/or measuring specific use over specific geographies and time frames is a separate question from determining to whom spectrum has been assigned, which in the case of commercial spectrum can be discerned through FCC license records. Measurements of spectrum *occupancy* could be used in the short term to: (a) verify spectrum use methods and parameters; and (b) obtain spectrum use probability samples in metropolitan areas (where the spectrum demands are greatest). In the longer term, a system of spectrum use monitoring could be considered as described in recommendation 10. Particular sensitivity should be given to commercial carriers as there are competitive reasons why they would not want the competition to know how much or how little of the spectrum assets they control are used or not, as well as certain federal and non-federal uses which have homeland security, critical infrastructure or national security implications. If the FCC did collect usage data and make it public, this might be an 8-k reportable event therefore the FCC may need to collect the data and use this internally as it examines policy. However, a comprehensive measurement system would not be achievable within reasonable time and budget limitations. The goal of measurements in the context of “spectrum transparency” is to have more specific spectrum assignment and/or use data available, and for this data to be more easily quantified and qualified by appropriate personnel and/or systems like the FCC Spectrum Dashboard. While many may argue with the accuracy of spectrum usage measurements,⁷ the importance of knowing how much spectrum we are really using over a specific geography and time – whether it is 5 percent, 15 percent, or 25 percent – is undisputable especially from a federal and non-federal spectrum policy perspective.

⁵ See, e.g., Michael Calabrese, New America Foundation, Working Paper, *The End of Spectrum “Scarcity,”* available at http://newamerica.net/publications/policy/end_spectrum_scarcity; Tugba Erpek, Mark Lofquist, Ken Patton, Shared Spectrum Company Report, *Spectrum Occupancy Measurements: Loring Commerce Centre, Limestone, Maine, September 18-20, 2007,* available at <http://www.sharespectrum.com/measurements/recent.html>; A. Petrin and P. G. Steffes, “Analysis and Comparison of Spectrum Measurements Performed in Urban and Rural Areas to Determine the Total Amount of Spectrum Usage (Presentation),” in *7th Annual International Symposium on Advanced Radio Technologies (ISART)*. Boulder, CO: NTIA, 2005.

⁶ Full active, passive or planned use of specific frequency/channel, geography and time would indicate it is being “used” unless “technology” would allow sharing. Generally, there would need to be some system radiating power or capability of going into service for spectrum to be deemed “used.” If there were no radiating devices or plans (e.g., OMB Circular A-11 documentation submitted) to create systems, spectrum transparency would help provide a way to actually use the allocated or assigned spectrum.

⁷ Spectrum analyzer based measurement detects incumbent signal power and may not be as sensitive as a native incumbent receiver operating close to noise floor. Noise figure and desensitization (upon overloading) of the spectrum analyzer may also affect the result.

The costs and benefits of commercial, non-federal and federal spectrum transparency across multiple and diverse geographies should be evaluated over time by appropriate leadership within NTIA and the FCC. Recent high-level presentations from NTIA staff acknowledge full allocation of *all* federal spectrum allocations below 10 GHz as defined by the allocations tables. Moreover, the NTIA presentation focused not just on how much of the allocated spectrum is assigned, but *how* it is used to support specific missions. To this end, spectrum transparency must address not just density and specificity of spectrum assignments but actual use and what functions are supported. How a CMRS system uses spectrum will look fundamentally different than how a radar system uses a given band. For example, if cellular network architecture is viewed as the default for what is perceived to be “efficient” use, it may skew actual use, as efficient and effective use will vary across different kinds of federal systems and different missions. Therefore, any and all radiated power by a system over a specific geography at any given time would show as “used” for the sake of transparency.

A separate working group is examining spectrum efficiency, and the data supplied by transparency could be the impetus for more detailed analysis. Indeed, it is possible to get much more specific and granular about federal agency reporting by providing more specific spectrum assignment data like time, space and frequency data. NTIA is statutorily authorized to have purview over federal spectrum management and should have the capability to fully understand the entire spectrum picture. On the other hand, NTIA does not have authority over federal agency acquisitions, which are subject to Congressional authorization and appropriations committees and the Cabinet-level secretary of that federal agency. Nonetheless, NTIA should have easier access to spectrum data and be able to evaluate and recommend policy based on what the data describes relative to spectrum.

“Spectrum transparency” will provide NTIA and the FCC with more information, which could allow more informed spectrum policy decisions, and might help expand usage of existing spectrum allocations in the short and long terms. It might result in NTIA or the FCC identifying spectrum without (a) any short or long term “federal demand” or (b) full commercial system utilization which could then be considered for either reallocation for other federal or non-federal uses, or for sharing opportunities. . Spectrum transparency may also help decision makers analyze the current situation and determine how allocations and assignments might be appropriate for further study.

This group discussed transparency with NTIA and several federal agencies it supports. Some of the evaluation came from previous interviews from the first term of the CSMAC. We also made attempts to understand how the internal processes to achieve greater transparency for government systems might work, e.g., levels of security clearances, “need to know” requirements, which policymakers are receiving the data, how a transparency database would work, the key vectors for information, timelines that would be needed, etc. This working group will shed some light on these issues, and make some recommendations as to how to improve the process. Cross functional reporting and analysis by those at NTIA and the FCC with appropriate security clearances may bring new and valuable facts to light which might allow for better policy decisions to be developed and implemented.

The Spectrum Transparency Working Group (STWG) is made up of the following people: David Borth, Robert Gurs, Kevin Kahn, Darrin Mylet, Janice Obuchowski, Robert Pepper, Richard Reaser Jr. and Jennifer Warren.

II. SCOPE OF ISSUE EXAMINED

The STWG was established to examine spectrum transparency – what it means and how best to achieve it. As discussed more fully below in the working group’s initial recommendation, spectrum transparency refers to the capability of decision makers (and, in the case of non-classified and non- FOIA exempt information, the public) to know and understand how every frequency channel is assigned and used in the United States. In order to make recommendations about how best to achieve spectrum transparency, the working group examined transparency from the perspective of both NTIA, responsible for the Federal Government’s use of spectrum, and the FCC, responsible for all non-federal spectrum uses.

First, the working group attempted to understand the ability of NTIA leadership to view all federal frequency assignments. While this group does not have full knowledge or understanding of the current procedures and outputs of spectrum accountability and transparency, we do know that NTIA maintains a Government Master File (GMF) of federal frequency assignments. It is not in the public domain due to both classified and FOIA-exempt information contained in it. However, the Interdepartment Radio Advisory Committee (IRAC) membership does have full access to it, enabling other federal agencies to understand federal frequency assignments. Although the STWG group has not been able to examine the GMF to assess its utility for transparency purposes, members were given opportunities to speak openly with NTIA Office of Spectrum Management leaders, the Office of Management and Budget and several federal agency spectrum leaders in order to better understand the current and planned efforts of NTIA to improve spectrum transparency and internal agency processes. All of the stakeholders provided positive feedback and shared the objectives of improving spectrum processes, knowledge and skill development. In addition to the information gleaned from discussions with key officials, many working group members have experience working with or serving at NTIA and/or other agencies – in addition to their service on the CSMAC.

Second, the STWG considered transparency from an FCC perspective. Most members of the working group understand the current process and output of FCC spectrum transparency, as those FCC licensed spectrum data sets are made public. In addition, a few engineering companies have mastered the use of these data sets for useful outputs for analysis and debate. Recently, the FCC launched the Spectrum Dashboard, which is a step forward in creating more transparency. Our group acknowledges this as a positive direction in spectrum transparency. While data sets exist for certain levels of FCC spectrum transparency, there are nonetheless many issues the group identified. For example, trying to determine through the FCC’s web site (www.fcc.gov) who has been assigned 1850 MHz in Washington, DC, 2.3 GHz in Arlington, VA or 850 MHz in Converse, IN is challenging for even the most astute spectrum and telecom professionals. The actual use of this spectrum also is not known at the FCC, which is something that should be addressed in the very near term given the assertions of spectrum scarcity and looming shortages. Further, some analysis may also be done on un-licensed use across multiple spectrum bands as well. Accordingly, some of the specific recommendations made below (through NTIA) also relate to increased FCC spectrum transparency to address these issues. While the FCC Spectrum Dashboard appears to be the first step, it will be only as good as the data it uses and the capabilities of those who are designing and implementing the architecture. Therefore, the FCC and NTIA should each conduct a request for information (RFI) from data management tool vendors to determine how to move this process forward.

Overall, the STWG believes that there can be continued improvements in internal and external government spectrum transparency. This will require some new procedures and processes, consistent with existing public disclosure and/or classification rules and processes applicable to certain of the detailed assignment data. Furthermore, many aspects of the recommendations address fundamental elements, which are not designed to lay groundwork for any re-allocation of federal spectrum. Rather, the working group recommends increased efforts in federal agency reporting, internal processes and data processing in order to ensure, at a minimum, that the FCC and NTIA each have the spectrum facts, which is the ability to accurately and effectively account for spectrum assignment and use over specific time, space, for their respective licensees and federal agencies.

III. DELIBERATIVE PROCESS

The STWG was launched on October 27, 2009. Background material was distributed between November 13-27, 2009, and an initial conference call was held on November 27, 2009 to discuss the topic and procedure. The working group developed an initial draft of spectrum transparency issues for consideration and group discussion based upon members' individual views of current FCC/NTIA spectrum management and transparency. These topics were distributed to the working group members for review, editing and or elimination. On December 9, 2009, chairperson Darrin Mylet gave an overview to the Commerce Spectrum Management Advisory Committee (CSMAC) and select NTIA leadership, including a presentation on what spectrum transparency might look like in reality using FCC data and third party engineering tools. The chairperson also asked each member of the working group to identify a federal government agency spectrum stakeholder and to arrange an interview on spectrum transparency. Feedback and suggestions from these interviews have been incorporated into this final report.

The initial draft outline of the report was submitted to the full working group on January 24, 2010 for continued review and editing. Interim edited reports were distributed to the entire CSMAC group throughout February for review and edit. Those suggestions/edits were then added into the STWG draft report. A working group conference call was held the week of February 15, 2010. Further edits were made throughout the week of February 22, 2010. The final report was compiled and finalized the week of February 22, 2010, and submitted to the full CSMAC for consideration at the March 4 Advisory Committee meeting. Final edits and suggestions were made prior to the May 19, 2010 meeting.

IV. SPECTRUM TRANSPARENCY WORKING GROUP RECOMMENDATIONS

- 1. We recommend defining the term “spectrum transparency” and creating a subcategory of “internal spectrum transparency.” Further, we recommend NTIA develop improved systems and procedures for making spectrum data more accessible and available to those who are tasked with spectrum oversight and/or policy making roles.**

The working group recommends defining “spectrum transparency” as follows: the capability of appropriate personnel, both public and private sector, to more easily know and understand the aggregate quantification and qualification of every spectrum frequency and channel used and un-used in the United States, whether permanently or temporarily, as well as the radiating power across specific geographies, such as at the county, zip code or state level. The goal of maximizing spectrum transparency recognizes the necessary limitations due to needs to ensure protection of classified or FOIA-exempt information as well as potentially information pertaining to critical infrastructure.

If channels/frequencies are reserved as needed for specific federal missions or international harmonization, or at any given time/location are not available, and sharing techniques are not feasible, they are considered “used” and would be explained as such in a description of the specific spectrum use. If sharing techniques (either between federal users or between federal users/non-federal users) might be possible for these frequencies/channels, they could be considered “limited availability”, meaning open/available with conditions.⁸ Finally, there might be nationwide spectrum assignments under the allocation table but the actual system planned, built and/or operated is at a fixed site, and not transportable, and will only cover a small proportion of the actual geography assigned; in this case, the geographic areas without actual operations would be considered “assigned but not used federal spectrum.”⁹ The capability to know this information or query this information at a date certain is one goal of spectrum transparency.

A subcategory of spectrum transparency is “internal” spectrum transparency, which allows appropriate security-cleared staff the capability to see and understand detailed classified spectrum allocations and assignments. Real time internal spectrum transparency for all sixty-nine federal agencies and departments may be more difficult for some classified uses, but it could be implemented in less sensitive bands, or less sensitive missions. The STWG believes that it is important to ensure that NTIA has internal spectrum transparency so that it knows which federal users have assignments covering what amount of spectrum, and when, if or how it is or might be used, if at all. A list of who has “security clearance” to see this data should be developed and implemented using existing information security schemes and processes. For example, there is no limitation on FOIA-exempt info being reviewed by internal experts or political appointees. Consistent with the existing government-wide policy, classified data, particularly secret or higher, by contrast, is viewable only by those with a

⁸ Such conditions might include lower power, temporary use and/or available equipment. After transparency is achieved, a separate topic considering how sharing techniques might be achieved may be worthwhile.

⁹ An example of this would be a federal assignment where the actual buildout of any radiated power at any duty cycle of spectrum covers a small amount of the assigned land mass. This is relevant only for fixed, non-transportable systems.

“need to know,” regardless of their security clearances. The goal of internal spectrum transparency is to ensure that the NTIA leadership has the ability to access this data in a timely and efficient manner in order to make critical decisions and as a means of both satisfying, for example, the increased need for federal spectrum availability today and evaluating increased spectrum demands by both federal and non-federal. Such information also could ensure appropriate internal accountability and scrutiny with regard to spectrum allocation, assignment and use. The working group recommends that spectrum management can be improved with greater internal transparency through the provision of quality data from the federal spectrum agencies to the NTIA, and from the commercial users to the FCC. Today, it is not known how much spectrum commercial users use out of their total assignments. We make specific recommendations below on both NTIA and FCC improvements in data gathering and reporting.

- 2. NTIA should ask each federal agency confirm the specific spectrum assignment data provided to the GMF at least every two years, with the goal of near real time accuracy and on-demand reporting. We recommend that NTIA accelerate ongoing efforts to make this process more efficient and data more useable, and that it seek the appropriations for the additional resources needed to accomplish this.**

As background, 69 federal agencies have assignments and/or allocations of federal spectrum, and most use a “reservation based assignment process.”¹⁰ Much of the data on federal spectrum assignments is contained within the Government Master File (GMF); most of those assignments and sub-assignments are likely FOIA-exempt (85%) and/or classified. NTIA may provide some flexibility in use of federal spectrum to agencies via sub-assignments in some bands, which may be managed today by spectrum managers within those agencies. While in theory all federal assignments are supposed to be administered and monitored by NTIA, the lack of adequate resources and systems/processes might prevent the monitoring and oversight from occurring today for all spectrum assets.

Accordingly, the working group recommends that efforts be made to capture and report this data internally, and that each federal agency confirm the specific spectrum assignment data provided to the GMF every two years – rather than the current five years – with the goal of getting near real time accuracy and reporting as soon as possible. When NTIA administrated the AWS auction relocation in beginning in 2006, NTIA learned that a number of federal users had earlier ceased to use their spectrum assignments and actually did not need to relocate.¹¹ Although this might not be a common situation, we should endeavor to have complete accuracy and accountability which spectrum transparency can provide. The STWG further recommends that NTIA accelerate ongoing efforts to make this process and procedure more efficient by, for example, putting GMF data into more standardized, usable “formats” like Excel spreadsheets, which could be displayed/queried in

¹⁰ This process involves a centralized administration who provides spectrum on a temporary or permanent basis via command and control.

¹¹ This particular comment was made during one of the public CSMAC meetings by NTIA staff.

meaningful “outputs” - both web-based and printable. Improvements in processes and flows of information between federal agencies and NTIA would be a result of this endeavor. Finally, the working group recommends to NTIA, and through NTIA to the federal agencies, that they seek the appropriations for the additional financial and human resource allocations needed to accomplish this.

The STWG acknowledges that the macro and micro reporting of this GMF data would need to be discussed by those with appropriate security clearances within NTIA and the federal agencies. If appropriate, some of the data or results of the data could be made available to the public with appropriate considerations for how classified (e.g., national security) data is protected. It is important to note that for reasons of security, including national and homeland security, not all data can be placed in the public domain, including data subject to disclosure restrictions related to classification requirements. Such data is fundamentally different from public safety systems and other commercial systems that may only deploy within the U.S. National security operations must deploy worldwide, so domestic considerations also must be coordinated with international deployments. Finally, the threat to commercial or public safety versus federal is different (e.g., typically there is not an active effort to disrupt a firefighter’s RF band use, versus a military radio or radar; though we note that the utilities, as critical infrastructure, have submitted to the CSMAC security concerns with the public disclosure in aggregated form of such data for the electric grid. Nonetheless, this information should be readily available in private internal NTIA systems, which can be viewed by appropriate security-cleared NTIA and FCC staff and leadership. Further access to this information would be made using existing classification schemes and procedures. Further development of whom and how the spectrum transparency information can be analyzed is addressed in recommendation 7.

Ultimately, the objective of NTIA internal spectrum transparency is to have improved data flows between the federal agencies and NTIA. These improved analyses, procedures and outputs with regard to federal spectrum allocation/assignment should be quantified and qualified and more easily understood. For those with appropriate clearance, like the Assistant Secretary, this will provide the capability to understand the granularity of any agency’s assignments and use (defined previously) across specific time and space. For less sensitive bands, a macro picture with and without granularity should be achievable and should be put into the public domain, if possible. NTIA seems to have the authority to do this, as the specific agency statutorily authorized to have purview over federal spectrum management.

- 3. NTIA should ask each federal agency report to the NTIA how much spectrum they use so as to ensure that the NTIA understands the full federal use landscape. We also recommend through NTIA to the FCC that the FCC require this from all FCC license holders. Sensitivity to mission and/or competition data being released to the public is critical but should be captured and understood by appropriate policy makers. Non-sensitive use data should then be made easily accessible and in a readily understood format.**

We recommend that spectrum transparency include information on federal and non-federal spectrum uses that takes into account several variables. The first is the place the spectrum is being used – most FCC/NTIA authorized spectrum systems are either site based, point-to-point, government area based (state, county, etc.), commercial market based (e.g., Cellular Market Area, Major Trading Area, Basic Trading Area, etc.), or assignments for United States and Possessions

(US&P). The second is the level and time of use – i.e., whether a system is radiating power permanently, periodically or does not radiate (passive), as many federal situational systems do. The third is the type of use – there are four major radio service types: radar, satellite, fixed and mobile terrestrial radio. The fourth is the type of user – whether public safety, civil agency, military, commercial wireless broadband, etc. The last variable is efficiency of use, which is the most difficult to measure and is a topic being addressed by another CSMAC working group. Ultimately, the working group believes it is possible to get to fairly precise levels of use, which could then be compared to allocations and assignments across federal and non-federal spectrum using modern spectrum management techniques. After an initial baseline is created, only changes in use or assignment, or allocation would need to be updated.

We recommend that serious funding and leadership efforts be made to ensure that the collection and availability of use data be done accurately, efficiently and urgently. Comprehensive spectrum transparency in all FCC/NTIA spectrum allocations, especially in more demand spectrum bands such as those below 10 GHz to be determined by FCC and NTIA leadership, would provide policy makers with an improved and more accurate understanding of spectrum allocation, assignment and use. This specific data appears to be missing in many of the national dialogues on spectrum today, and may only be done by “requiring” all spectrum license holders on record at the FCC and each federal agency to periodically report their actual usage, with appropriate classified and non-disclosure conditions dictated by NTIA and FCC.¹² There should be parity in reporting requirements and expectations for federal and non-federal users. Indeed, the Spectrum Inventory recommendations suggest FCC market-based licensees submit more detail on their “total” use of spectrum, especially before getting or asking for additional spectrum. Once again, with respect to federal spectrum use - passive, emergency or temporary use - of spectrum would be considered “used” so as to not erroneously suggest available or un-used spectrum.¹³ In the end, transparency will lead to accountability; without knowing the actual facts, we will continue to assume and/or operate within the status quo, which may leave spectrum (federal or non-federal) not used or available.¹⁴

In terms of aiming for like-for-like transparency between federal and non-federal spectrum users, particularly in circumstances in which a commercial carrier chooses to protect some data because it is proprietary (i.e., tower locations, height, power, etc.), we recommend through NTIA to the FCC that it agree to keep this confidential, similar to the broadband mapping suggestions, but

¹² Such reporting requirements will need to take into consideration the potential burden on licensees (especially state/local governments and small businesses) as well as the sensitivity that some state/local government public safety entities and critical infrastructure industries may have regarding the release of sensitive information.

¹³ For example, if the Department of Agriculture uses assigned frequencies for fighting forest fires. When it is not have to fight any fires in a given geographic area for some period of time, this means that the frequency assignments are “un-used” in actuality – this will continue until new and innovative sharing technologies can prove the capability to cease operations when sensing in real time the Department of Agriculture’s need to use those assignments. . This example shows how sharing might occur and maximize use of existing spectrum.

¹⁴ For example, the planned use of spectrum databases will play a key role in the current FCC White Space proceedings as a method to safeguard against causing harmful interference, while allowing opportunistic use of “fallow” spectrum.

have the ability to make spectrum policy based upon the information provided by the commercial carriers on their current use. Those within the FCC and/or NTIA who have appropriate security clearances can analyze this business proprietary data and assure the public that the nation's spectrum resources are subject to appropriate FCC or NTIA oversight. This balanced approach allows for a "like-for-like" comparison of spectrum assignments and "use" by federal and non-federal spectrum users.

Finally, given the continued demand for spectrum, officers and leaders of commercial licensees and federal agencies might be required to sign-off on their spectrum data reporting with consequences for inaccurate reporting. Promises as to future use would need to be evaluated by the FCC and/or NTIA.¹⁵ The STWG suggests some form of enforcement mechanisms be put in place to ensure accuracy and validity of the data for analysis and policy making. For example, spectrum use testing might test compliance, which could occur with internal NTIA random spectrum measurement samples and assignment analysis. In addition, perhaps some new statutory or regulatory provisions could be developed to ensure compliance and related consequences for non-compliance with both the actual submission of the data and its accuracy.¹⁶

4. NTIA should make "non-classified and non-FOIA exempt" data on spectrum assignment/allocation available to the public via a web portal or database process. This would include potential "allocated but un-assigned" spectrum, as long as no national security issues are implicated.

Public availability of non-classified and non-FOIA exempt frequency assignments would allow technology companies, scholars and entrepreneurs a better understanding of the federal use of spectrum. This information should be made available to the public, as long as no national security issues are implicated. Coupled with improved FCC transparency, making this information available could lead to a more informed analysis of potential opportunities to deploy improved sharing technologies for the benefit of all stakeholders seeking increased access to spectrum – federal agencies, public safety and commercial users. For example, if fallow spectrum can be identified by the federal agency with the assignment, it may allow others to use the spectrum on a secondary basis either temporarily or long term in specific geographies (e.g., through a lease arrangement). And if there were any monetary funds from this use of spectrum, it could provide a new revenue stream to agencies or the Treasury. Making non-classified and non-FOIA exempt spectrum data more transparent could also result in the identification of some assignments where there is limited, permanently fixed geographic use.

As innovative technologies continue to mature, making non-classified and non-FOIA exempt spectrum data more transparent could be a near-term facilitator for new and cost effective systems and/or federal/non-federal sharing. Promising spectrum sharing techniques are evolving with the

¹⁵ More efficient use of existing spectrum might include new technology like OFDM or cell splitting, which transparency can help evaluate.

¹⁶ This might be a good next effort after NTIA and the FCC start to compile use data to achieve spectrum transparency.

developments in software defined radio (SDR) and cognitive radio. A lack of clear and defined spectrum policy may be hampering the rapid development of this opportunity; transparency could help move it along. Indeed, these promising new sharing techniques could put any “dark” spectrum into use through either short-term temporary licensing or opportunistic sharing, especially in cases where federal use might only occur under the worst of scenarios (e.g., foreign attack) and the technology would allow for immediate and sole federal use when needed.

The STWG is not proposing herein to pursue specific federal or FCC spectrum. What it is recommending is that the agencies pursue greater specificity and availability of spectrum data, which in turn may help enable the emergence of technologies that may provide some flexibility and utility to commercial and federal mission use of spectrum, and put specific spectrum to greater use by incumbent and new users alike. While various technologies develop and mature, now is the time to identify the spectrum reality. As an example, there might be federal systems in development now, which do not come online for 5-10 years. Without spectrum transparency, we would not know if there were “pockets” of un-used/un-assigned spectrum in certain jurisdictions. Given the amount of Experimental Licenses and other short-term assignments made over the past five years, one could assume these do exist in certain bands in certain areas. SDR or cognitive radio could put the spectrum to use in the short term to solve shorter-term missions or business objectives without the need for current assignees to give up the spectrum long term. There might be complex legal issues regarding what regulatory changes may be needed to further facilitate opportunistic use. Spectrum transparency could help make this analysis and justification more accurate and specific. One idea suggested, in order to ensure the appropriate jurisdictional control, NTIA would have to ensure that it retained the authority to set the rules for any short term uses, through explicit written agreement with the FCC. This could occur through a Memorandum of Understanding (MOU) reflected in the terms of any short-term authorizations to non-federal agencies to use any federally allocated spectrum. Creating policy and operational ramifications around specific spectrum facts may evolve using secondary market mechanisms, similar FCC white space rules and other innovative ideas not yet envisioned.

5. NTIA should ensure that security-cleared staff be able to see the “internal” FCC/NTIA spectrum transparency data outputs, which could provide for more innovation, use, oversight and accountability.

We propose different levels of user access to “NTIA/FCC Transparency” datasets. Security-cleared staff like the NTIA Assistant Secretary and senior staff, White House Officials, FCC Commissioners, and others with appropriate clearances would have improved access to this output at all times. Spectrum band managers within the agencies could then be incentivized to identify any un-assigned spectrum. Incentives and other creative mechanisms are being developed; however, these will not be specific enough without spectrum transparency. With appropriate transparency, federal agencies could try to find new uses or be incentivized to turn any underutilized spectrum into revenue.¹⁷

¹⁷ See *Ex Parte* Comments of Public Knowledge, National Broadband Plan Public Notice #6, GN Docket Nos. 09-157 & 09-51, at 11 (Dec. 29, 2009) (“47 U.S.C. § 923(g) explicitly creates an exception to the Miscellaneous Receipts Act by (Continued on next page)

These incentives cannot be achieved without better data collection, improved bi-lateral flow of information between agencies, including the FCC and NTIA, and improvements in understanding the specific outputs of the data. Internal spectrum transparency should provide FCC/NTIA leadership a new measure of understanding, accountability and increased agency opportunity to put more spectrum to use. This also could lead to changes in behavior. As spectrum demand continues to grow, FCC/NTIA will need to be more vigilant in requiring federal users and commercial operators alike to manage and report their assignments and uses, and provide them with the procedures, tools and systems to enable them to manage and report spectrum schedules/priorities/use, when appropriate and eventually in real time. While additional resources and skill sets would be required to enable this capability, getting the spectrum specificity via internal transparency should be a priority. In addition, at the federal level, federal assignments and system certifications should occur more rapidly, not in weeks or months, as current processes seem to work.¹⁸

Finally, improved internal spectrum transparency might allow for more cross-government (federal to federal, state and local) collaboration, as the GMF may not provide the utility it should even though each agency has access to it.¹⁹ Such collaboration could have a number of benefits. First, it could enable better, more interoperable communications systems, which might allow agencies to return some spectrum back to NTIA for other agency missions and/or non-commercial entities like utilities, public safety state and local municipal governments. Second, it could allow non-federal entities seeking to share federal spectrum to identify potential targets for further study and exploration with NTIA and federal agencies with relevant assignments (at present, those seeking spectrum lack sufficient information even to begin such an inquiry). Third, relative to radar and other systems, it might identify areas of opportunity for acquiring and deploying new improved systems, enabling perhaps a greater packing of the existing allocations. Fourth, it might enable multiple agencies to migrate to a more data-centric Internet protocol communications environment where interoperability is achieved as a result of the protocol (why have five different agency systems when one data communications systems could serve 10 agencies with half the spectrum used?). Collectively, internal transparency will help identification of opportunities for such collaboration.

6. NTIA should seek an increase in its federal budget for necessary funding to attract, train and retain key skilled spectrum personnel to support a

allowing private entities to compensate federal agencies for reallocation costs following an auction. Where an agency makes spectrum available via real-time secondary market auctions, this provision provides a means of compensating the agency for any expense associated with permitting shared use of the spectrum.”), *available at* www.publicknowledge.org/pdf/pk-exparte-spectrum-122909.pdf.

¹⁸ US Department of Commerce, National Telecommunications and Information Administration, FY 2010 Budget as Presented to Congress. The time frames for assignments can take up to two weeks according to this report.

¹⁹ The Integrated Wireless Network is a recent example. In part, it was intended to create a single system to support what appeared to be compatible missions. We cite this not to debate the pros and cons of this specific initiative but rather to illustrate the potential benefits of combining spectrum resources and budgets to address compatible or common mission needs.

dedicated spectrum management and transparency systems and processes which will help policy makers better understand the spectrum landscape.

Sufficient processes and funding may not currently exist within NTIA or the federal agencies to support implementing all of the recommendations in this report. Seeking a funding increase should be an immediate priority, especially as NTIA/FCC are working on spectrum inventories. Regardless of the outcome of pending federal legislation, both FCC and NTIA should move expeditiously in getting the resources and strategies in place to increase spectrum transparency. The mere notion that there is a looming “spectrum crisis,” whether real or artificial, should be enough impetus to “just do it.” Indeed, given the overall “need” among federal and non-federal users, investment made in this initiative should more than be paid back by gains in mission and/or commerce.

There are several potential funding opportunities. Perhaps funds from the American Recovery and Reinvestment Act (ARRA) Grant program could be allocated for this immediate effort over the next three years. The NTIA and FCC also could each decide to develop this internally as well which appears to be the direction of the FCC via the Spectrum Dashboard. Regardless, it should be done in the short term with appropriate resources and leadership. The outcome of this initiative would be tangible and is something that would be very easy for FCC and NTIA leadership to say works and provides the kind of transparency we are talking about in this document.

7. NTIA should promote and illustrate more external /public “spectrum transparency,” or to better understand specific security concerns/issues with doing so.

“External spectrum transparency” of NTIA assignments to federal agencies would require public availability of releasable data and/or outputs in a format that can be easily deciphered and used. When coupled with an improved FCC database, it will enable stakeholders to take a more informed approach to analysis of potential opportunities for technology innovation and for enhanced spectrum use under pre-determined use conditions.

There are legitimate concerns – and in the case of classified data, legal prescriptions about not releasing certain data on federal assignments. We do not recommend the entire federal spectrum assignment and use be made public as referenced in previous recommendations. A UTC Report on the September 11th attacks pointed to terrorist’s attempts to disrupt critical communications²⁰; as this Committee does not have requisite clearance or a “need to know,” however, we are unaware of any attacks on government or utility communication systems. We do not want to make it easier for terrorists or those who might have an interest in disrupting federal or commercial communications systems to get spectrum data, which could be used to harm our national security/and homeland defense. Further, this committee would suggest that NTIA, and through the NTIA the FCC, each undertake analysis as to what degree “external spectrum transparency” should be limited by concerns about security and potential threats to intended harmful interference or disruption of mission performance or operational security of critical infrastructure, such as the electric grid.

²⁰ http://www.utc.org/filesare/files/3/Public_Policy_Issues/Spectrum_Issues/finalspectrumcrisisreport0109.pdf

Some members on the committee are aware that most of the frequency bands for land mobile, and perhaps other more sensitive bands used by other communications services and agencies, can be identified via research, which is available in the public domain or other international documents. However, with respect to the federal users, the actual operational use of the spectrum may vary significantly from any published information on assignments in the public domain. Further relating to the concerns, are those based primarily on information regarding infrastructure (site locations) and/or potential disruption of sensors/radars or interception of any communications content? Internal transparency should be able to capture the data and make it more understood by senior policy makers and NTIA/FCC leadership. These issues are different and transparency is focused on the physical use of spectrum, not the content or missions riding over the airwaves. Nearly all state/local public safety agency radio frequency use is a matter of public record and public monitoring is commonplace (though less so with migration to digital systems that can be more easily encrypted). Moreover, as noted by the Spectrum Inventory group, it is not easy to readily access details about non-federal uses (commercial and public safety) through the FCC databases.

Another important suggestion might be to encourage federal agencies to explore greater sharing of information with state/local public safety agencies in order to create more “spectrum sharing” capabilities or shared platforms for nationwide communications interoperability. Federal agencies may be more willing to share sensitive information with state and local public safety entities than with the public-at-large. The state/local public safety community also could be encouraged to establish a clearinghouse for such information, which also might allow for an additional layer of security and more discrete management of information dissemination. There may be some federal allocation or assignments, which have little to no risk of critical mission performance. Efforts to identify and make available the less sensitive assignment data for commercial analysis and potential innovation would be another positive result of spectrum transparency.

8. NTIA should seek appropriations funding to continue to update and improve the Government Master File (GMF).

From what we understand, the GMF may not have evolved much over the past 10 years or so with regard to form and function. The data within the GMF may be excellent, but interpretation and ease of understanding may be challenging. We further understand there may be initiatives moving forward within NTIA regarding enhancements to the GMF and procedures. We believe this is an important issue as the data and process for modern spectrum management certainly exists. The GMF should be a central repository of data that a modern spectrum management system can pull from in order to maintain an updated overview of the federal assignment and use landscape. More recently, the former NTIA Assistant Secretary and current FCC Commissioner made similar remarks with regard to the National Broadband Plan. “We need a more vibrant secondary market. I’m talking about more spectrum sharing between private and federal. There’s going to be a lot that can be done in those areas that almost all depend on a better database. One of the recommendations you’re going to see is a more user- friendly, a more thorough database that can be used on an hour-to-hour, minute-to-minute basis.” - FCC Commissioner Meredith Attwell Baker, November 24, 2009, The Hills Hillicon Valley

Accordingly, we recommend that NTIA seek appropriations funding to continue to update and improve the GMF into a more modern system of input and output. It is important to make the GMF

data useful – an upgrade to the GMF along with tools and systems would be a positive step forward. Further, it is more important to establish new and enhanced spectrum training and management programs. This role should be given very high status and remuneration as to attract and maintain a high level of talent and capability. As it stands today, there seem to be limited capability to understand and interpret specific spectrum assignment and use at the central level without involving numerous people, time and know-how.²¹ With a more advanced real-time database and web-based portal, the capability to get this data immediately would be possible. Further, analysis could be done to determine more macro assignment and use by agencies. The current spectrum inventory should be the initiation of a more intense focus on spectrum database records and how these records can be viewed and analyzed. This is another result of more spectrum transparency.

9. NTIA should work more closely with the FCC spectrum transparency. It is a critical component to enabling a comprehensive landscape of spectrum allocation, assignment and usage.

FCC assignments and users are nearly impossible for the average person or entity to decipher, even though there are some 10,000,000 plus records available by most accounts. FCC spectrum transparency should hold the same priority, if not greater than that of NTIA spectrum transparency, and follow the same format. There are several priorities with respect to FCC spectrum transparency.

- Priority one is to make it easier to determine how much spectrum commercial entities control in aggregate at a given time within any type of geographic inquiry. This also would require ownership specificity from majority to partial ownership of the spectrum license down to the 10% level. The capability to easily view and compile this data across the entire United States would provide policy makers the capability to better understand the spectrum landscape from both a right to use and spectrum demand standpoint.
- Priority two might be to know if and how the commercial entities actually “use” their assigned spectrum.²² Further analysis on how much the entity actually uses vs. controls would be an interesting and useful metric.

²¹ An example today might look something like this. The Assistant Secretary or security-cleared staff would ask someone at the Office of Spectrum Management (OSM) about a specific frequency range in a specific jurisdiction. OSM personnel might then look at the GMF and determine if it is assigned to a specific agency and provide a report. OSM staff could call or email a point of contact at the agency to verify the data - this may be immediate or time consuming. The federal point of contact would go into their spectrum management program and confirm the assignment or use and provide this information back to OSM with a map or picture or explanation possibly. OSM would then carry this information back to the Assistant Secretary or staff for the answer.

²² The FCC requires certain levels of spectrum “use” through buildouts and other requirements. Spectrum transparency should understand more dynamically how spectrum is used today and those with appropriate knowledge in emerging communications technologies can debate what might be used in the future. However, it should be a pre-requisite for understanding requests to make more spectrum available for commercial uses.

- Priority three might try to comprehend how efficiently commercial mobile wireless spectrum is used before there is consideration of any federal spectrum or non-federal spectrum being re-purposed. This is a specific output, which would help policy makers analyze past spectrum actions and decisions along with supplying credible data to support policy-making decisions.
 - The FCC might require all spectrum license holders and state/local agencies to periodically sample and or/report their actual spectrum usage in their licensed area and or assignment areas and make such data available to the FCC, as discussed above.

In turn, spectrum transparency might lead to “spectrum accountability”²³ and may actually allow the FCC to re-farm spectrum from past FCC auctions/beauty contests, business failures and give aways. FCC spectrum licensees have legal rights based on past decisions and technologies, which may or may not be applicable today. Spectrum transparency would allow the FCC/NTIA to know how much spectrum an entity has, how long they have had it and how much the entity may actually use specifically and in aggregate. Comprehensive data on current spectrum usage will assist the FCC and NTIA in making strategic policy decisions to free up any underutilized or undervalued spectrum bands to meet the growing demands of wireless broadband and, for example, the Department of Defense. This also will allow the NTIA to know the specific spectrum situation on the commercial side with regard to allocation and use. Without “spectrum specificity,” or the facts about use, it is difficult to assess the efficacy of various assumptions and statements. Spectrum transparency will help with FCC consideration of spectrum utilization requirements, inventory and other policy proposals. The spectrum “crisis,” if there really is one, needs real spectrum data and real analysis. This should be a priority at both FCC and NTIA alike.

10. NTIA and the FCC should consider spectrum monitoring as a method, in the near term to conduct spot audits to verify the factual data on spectrum use in urban, suburban and rural environments. The goal is to overlay this data on top of allocation or assignment data to understand where there might be trends and evidence, which would lead to better policy and increased spectrum use by federal and non-federal users.

Measurements of spectrum *occupancy* could be used in the short term as spot audits to: (a) verify submitted spectrum use analysis methods and parameters; and (b) obtain spectrum use probability samples in urban and metropolitan areas (where the spectrum demands are greatest). In the longer-term, a system of spectrum use monitoring could be considered. However, a comprehensive measurement system may not be achievable within reasonable time and budget limitations.

For unclassified, non-FOIA exempt assignments and licenses available in the spectrum inventory, some of the parameters may be appropriate to verify and, if necessary ascertain, via measurements.

²³ Regardless of any legal build-out requirements, fundamental spectrum accountability would show metrics of assignment divided by use, i.e., 10 MHz covering 1000 square miles assigned but only being used in 20% of the geographic area.

However, this includes what assignments/licenses are built out and in use, where and when actual transmissions occur, the transmit duty cycle, the temporal transmit variations, the signal bandwidths, the use of frequency guard bands, and partial information on the scenario (mobile, fixed, number of users via the signal amplitude statistics).

- Unlicensed usage where many user parameters are not directly known to regulators
- Parameters that are not known by the users or contained in the frequency assignment, but are determined to be relevant by the regulator. For example, many users don't know their temporal usage²⁴ and their mobility.
- In some cases, particularly in the case of public safety, day-to-day spectrum management decisions have been delegated to regional authorities and in some cases delegated further to local authorities.
- There are signals that are not known or controlled by regulators, and when a set of frequencies are designated for further exploration by a regulator for sharing or other uses, understanding the man-made noise, "rogue" illegal or accidental signals, anomalous propagation loss events involving licensed signals that create unexpected signal levels, signals coming from across the US borders that are not well known and spurious transmissions can be relevant to spectrum decision-making.

It is important to also recognize that spectrum measurements will not accurately capture sensing-only technology, which is deployed for a range of military and civil uses; moreover, measurements and sampling may yield a further incomplete picture of intended and planned uses of the band given acquisition cycles and development periods. Therefore, spectrum measurements initially will best serve as an auditing function for certain assignments/licenses in the inventory, as determined by the relevant regulator.

V. FINAL THOUGHTS

In summary, the STWG recommends making FCC and NTIA spectrum assignment and use data more transparent both internally and externally. Both agencies should concentrate on bringing more spectrum transparency and accountability to commercial, non-federal and federal sectors, in order to ensure new, enhanced and/or redundant broadband and mission capacity needs.

By implementing transparency, we should be pushing more use of our spectrum resources by enabling focused development of new spectrum-efficient technologies and systems to access

²⁴ It is unlikely that the local police and fire fighters know their transmit duty cycles and the probability of X MHz wide and 1 second long spectrum holes within their spectrum. These spectrum holes depend on multiple contiguous spectrum users (not a single license holder) not transmitting. These spectrum holes could be used by a DSA radio system to provide video for a police robot video system. Only by spectrum measurements would these spectrum hole statistics be cost effectively determined.

spectrum that is either underutilized across specific time or space both Federal and Non Federal. This can only be achieved with spectrum transparency.

By implementing transparency, we will have information about specific spectrum resources in specific jurisdictions that can encourage network providers to build new and innovative network infrastructure. It will also allow our existing network providers to build more infrastructure by ensuring that network usage and spectrum access fairness is known and enforced by the FCC or NTIA. This can only be achieved with spectrum transparency.

Government's responsibility is to advance the public interest. Spectrum is a resource, which is unique and can be managed and measured more accurately. We need to move away from assumptions and hypothesis, which continue to occur in our country relative to spectrum. With spectrum transparency, we can start focusing on key responsibilities, which is driving innovative and simple actual "use" of our spectrum at the federal, non-federal, and commercial level alike, by and for citizens and the federal agencies and companies that have the "right to use" the spectrum.

Spectrum transparency gets us one step closer to a fact-based and data-driven assessment of its spectrum policy.