CSMAC

Report of the Future Spectrum Requirements of Non-Federal Users Subcommittee

July 30, 2020

FINAL REPORT

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I. INTRODUCTION

The subcommittee, "Future Spectrum Requirements of Non-Federal Users" provides this report summarizing our activities, efforts and recommendations to support NTIA's desire to identify sources of data to help determine current and future non-Federal spectrum requirements.

II. NTIA QUESTION

The subcommittee examined the following question/task:

"Explore the feasibility and utility of requesting information about future spectrum requirements and current usage from industry and other non-Federal users and, considering that, identify what information is already available (including prior CSMAC reports and recommendations) and recommend possible approaches to obtaining future spectrum requirements and current spectrum usage of non-Federal users."

III. BACKGROUND

A. Additional Information Provided by NTIA

In order to gain insight into NTIA's intentions and desired outcomes with the task, the subcommittee asked NTIA to clarify the task by providing background on the intended use and desired outcome of the efforts. NTIA responded that their intentions included:

- To see what information might be available to facilitate compatibility analyses to consider sharing between Federal and non-Federal systems
- To anticipate non-government (industry) needs that might involve use of or sharing in Federal spectrum
- To compare with the data NTIA is collecting about Federal agency use and expected requirements in order to ascertain whether Federal agencies may be overlooking opportunities identified by the commercial sector, and
- To allow comparison between Federal and industry use trends.
- To obtain descriptions of approaches and options to collect data on present and future spectrum use and use trends
- Descriptions of limitations in data collection options and sources
- Descriptions of the categories of data available (*e.g.*, geographic, temporal, spectral, etc.)
- Identification of the elements most likely to be needed to support sharing opportunities

The subcommittee used this additional information in our discussions to arrive at the Recommendations in Section IV.

IV. APPROACH

Based on NTIA's additional guidance, the subcommittee took the following approaches to address the tasks.

A. Reforming the Task

Considering the initial task contained potentially several subtasks, the subcommittee broke the task into the following subtasks:

1. Explore the feasibility and utility of requesting information about current usage and future spectrum requirements[1] from industry and other non-Federal users.

2. Considering that, identify what information is already available (including prior CSMAC reports and recommendations).

3. Recommend possible approaches to obtaining future spectrum requirements and current spectrum usage of non-Federal users.

B. Work Breakdown

The subcommittee held 10 meetings. Through the course of those meetings the subcommittee developed additional questions and considerations to help address the subtasks.

1. Explore the feasibility and utility of requesting information about current usage and future spectrum requirements from industry and other non-Federal users.

The subcommittee looked at this task in the context of whether data were feasibly available and what the utility of those data might be. The subcommittee developed the following questions:

Date Feasibility

- Is information available?
    - Is the information readily available from existing data sources or will it require effort to research and assemble?
- How far in the future?
    - To what extent can contemporary data provide insight into future spectrum requirements?
- What are the challenges to collecting the data?
    - Are the data readily available? If not, what efforts will be required to locate and assemble it? What resources will be required to make use of it?
- Are users willing to provide data?
    - Some of the data may be considered private and sensitive. To what extent will affected users be willing to make this data available?
- What are the costs of collecting or acquiring?
    - If data are available from third party or commercial sources, what are the costs to acquire and what are the limitations on use?

Data Utility

- Can NTIA use available data for their intended purposes?
    - Is the data too sparse or detailed to be usable without significant effort on the part of NTIA? Will NTIA have to get help working with and analyzing the data?
- Are the data accurate, comprehensive, and in a workable format?

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[1] Reordered from original question to put current use ahead of future requirements.

- How "good" are the data? Does it meet NTIA's needs? Will it require substantial effort to work with it?
- Does NTIA have ability to acquire, receive, manage, analyze and draw conclusions from the available data?
  - To what extent will NTIA be able to use the data or will it require external resources?
- If not, what resources are likely needed to perform those tasks?
  - Are these resources available at ITS or will it require some degree of out-sourcing?

2. Considering that, identify what information is already available (including prior CSMAC reports and recommendations).

The subcommittee considered this task in the context of data that may be available to document current usage and data that may useful to identify and predict future trends.

Current Usage

- Federal regulatory databases (*e.g.*, ULS, LMS, IBFS, etc.)
- Commercial databases, including non-public and restricted-use databases
- See list of Spectrum Information Sources in Appendix 2.

Future Usage

- Technology drivers and evolution
- Standards Development Organizations (SDOs) and Special Interest Groups (SIGs)

3. Recommend possible approaches to obtaining future spectrum requirements and current spectrum usage of non-Federal users.

The subcommittee addressed this subtask in Section VI, Recommendations.

The subcommittee also developed the following list of questions that may be useful to include or exclude possible data sources:

- What data are needed?
- How will the data be used?
- What level of accuracy, specificity, and/or granularity is needed?
- What are the limitations to data availability (costs, form, etc.)?
- Are data and information on new technology implications and advances useful predictors?
- Does NTIA have authority (OMB approval or other permissions) to gather this data?

The subcommittee observed that particular types of data on certain commercial operations may be difficult to obtain due to the commercial sensitivity of this information:

- Can NTIA make use of commercially restricted data through an NDA or other means?

Considering the diversity of data sources and the complexities of acquisition and analysis, NTIA may wish to consider outsourcing data collection and compilation:

- Can collection tasks be constrained?

- Can empirical occupancy data be collected through drive-testing, monitoring, sampling, etc.?
- How practical are the available options?

The subcommittee recommends considering the implications of the SC #1 recommendation on establishing a Spectrum Research Agency R&D element in deciding the most efficient and effective means of obtaining the necessary data.

The subcommittee took the following approach to address the tasks.

- Identify non-Federal radio services for study
  - Use FCC rule parts/services as a template
- Categorize spectrum need by radio service as
  - Growing
  - Stable
  - Declining
- Suggest possible sources for data on specific services

The results of this categorization are provided as Attachment 1: FCC Services Showing Spectrum Need Trend and Possible Data Sources.

The subcommittee developed recommendations based upon our research and discussions which are provided in Section VI.

V.   FINDINGS

The subcommittee encountered concerns about the authority of the NTIA to collect current or future spectrum usage data from commercial licensees. For many commercial spectrum licensees, the potential information collected is considered proprietary. These concerns generally centered around how the data will be used, by whom, and how will it be protected.[2]

Before current spectrum usage data and future estimates of usage are made available to NTIA from commercial licensees, these issues will need to be addressed, as well as the cost of providing/acquiring this data.

The subcommittee notes that data for some services is available publicly, but the quality of the data should be verified. In addition, the data formats are not consistent and will likely require NTIA resources to be useful. The utility of the data for evaluating sharing or relocation (or other spectrum use trends) will therefore be highly variable without post-processing.

VI.   RECOMMENDATIONS

These Recommendations are based on discussions within the subcommittee and are intended to advise NTIA on possible approaches and methodologies to identify and analyze data sources considering the concerns identified above regarding the sensitive nature of certain commercial licensee data and information.

The subcommittee provides the following recommendations:

Recommendation #1: Review sources of spectrum usage provided in Appendix 2.

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[2] For example, from Freedom of Information Requests (FOIA)

The list provided in Appendix 2 represents several possible sources of current and future spectrum usage data. In addition, there are several SDOs and SIGs, industry trade associations and commercial database providers. While these are presented as examples of data sources and information that may currently be available, the subcommittee believes there is much information in these sources that NTIA should find useful.

NTIA should research these sources to determine the availability of data, reports, surveys, analyses, etc. to fulfill the need for current and future spectrum needs.

Recommendation #2: Survey existing Federal resources for data on spectrum usage.

The subcommittee understands that NTIA is aware of the substantial amount of data in Federal regulators' licensing systems and databases. Nonetheless, NTIA should survey all pertinent Federal databases for information on commercial spectrum usage. For example, there is substantial information contained in the both FCC's Equipment Authorization System and Experimental Licensing System on trends in technology advances and implementations, including trends that span both commercial and federal use. Also, the FAA's Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) contains information on spectrum use on towers that must file form FAA-7460-1 Notice of Proposed Construction of Alteration that may be useful.

In addition, the interrelationships in these data sets can also help identify how trends are developed in each of these sectors.

NTIA may want to undertake an effort consistent with Recommendation #3 below to survey/identify federal databases that might contain information on commercial spectrum usage.

Recommendation #3: Identify existing commercial data resources and collaborate on data available to identify current and future spectrum needs

In addition to Federal data resources, there are many commercial databases available on current and future spectrum use, some of which are noted in Appendix 2. Commercial databases can contain more comprehensive information than regulatory data, especially those used by frequency coordinators.

NTIA should identify commercial databases that may provide more extensive, accurate and current data on spectrum use and operations. These could include frequency coordination databases, tower location databases, aggregated mobile coverage data, etc.

Recommendation #4: Consider working with or contracting to third parties to gather and format data from commercial spectrum users.

As identified above, commercial spectrum users may be reluctant to release data directly to NTIA on their current and future spectrum uses or needs. These users may have concerns related to how NTIA plans to use the data and whether the data can be sufficiently protected.

The subcommittee believes this reluctance may be mitigated, at least in part, by using a third-party or contractor who may be able to gather the required information and provide aggregated or obfuscated results without divulging sensitive information on any specific spectrum user.

NTIA should consider contacting industry and trade associations who already have relationships with commercial spectrum users and make aggregated data available as shown in Appendix 2. This could also be conducted considering Recommendation #5 below.

In addition, there may be other Federal sources of information on commercial spectrum use that NTIA may be able to leverage as mentioned in Recommendation #2 above.

NTIA should consider working with a third party with knowledge of Federal spectrum databases to identify data sources suitable for assessing current and future spectrum use (either directly or using data mining techniques as mentioned in Recommendation #6 below). The variety of formats might be processed into a common format that meets NTIA's needs. The Institute for Telecommunications Sciences (ITS) may be able to support this task.

To the extent that this task leads to a need to develop new databases to contain this aggregated information, NTIA should consider tasking third parties with setting up such databases strategically to make most use of this aggregated data.

Recommendation #5: Work with research and development entities to identify and quantify technology trends and advances regarding impact on spectrum demand and potential usage efficiencies.

There are manifold technology trends and advances that will have an impact on current and future spectrum usage. Keeping track of these trends and their implications requires specialized knowledge and capabilities.

NTIA should work with consultants who can identify trends and advances in technologies that will have an impact on spectrum usage and needs. Also, consider technology advances that may improve the efficiency of spectrum use.

This effort should commence with identification of key technology trends and the resulting impact on spectrum use and future needs. In addition, the effort should consider the work ongoing in commercial SDOs.

Recommendation #6: Review and analyze existing data resources using advanced data-mining techniques.

Data mining is the process of finding anomalies, patterns and correlations within large data sets to predict outcomes.[3] Considering the collection of data described above will likely yield numerous and disparate datasets, NTIA should consider using advanced data mining techniques to help identify potentially hidden trends in spectrum use and predict future spectrum needs.

Recommendation #7: Utilize the Research and Development function described by Subcommittee #1 to take on much of the suggested R&D functions.

Subcommittee #1 has described a Research and Development function that could be used to perform much of data-gathering and analysis described above.[4] Two key functions described in the SC #1 report include:

- Gathering data about consumer demand or other relevant parameters about demand growth.
- Gathering data about evolving technologies and how they will utilize spectrum.

NTIA should consider the above recommendations as additional justification for creating the suggested R&D function.

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[3] See https://www.sas.com/en_us/insights/analytics/data-mining.html
[4] See Subcommittee #1 Final Report, Section III. A. Research and Development Option [link]

VII.   APPENDIX 1: SUBCOMMITTEE MEMBERS

- Co-Chairs: Mark Gibson / Bob Weller
- Bryan Tramont
- Carl Povelites
- Carolyn Kahn
- Chris Weasler
- Claude Aiken
- Jennifer Manner
- Kurt Schaubach
- Mark Crosby
- Mark Lewellen
- Mark Racek
- Mary Brown
- Michael Calabrese
- Ruth Pritchard-Kelly
- Steve Sharkey
- Thomas Dombrowsky
- Mariam Sorond
- NTIA Liaisons: LiChing Sung / Bruce Jacobs

VIII.   APPENDIX 2: SOME SOURCES OF SPECTUM INFORMATION

This Appendix provides several sources of spectrum information or information that can be used to derive spectrum usage.

There are several reports from trade associations, member organizations and manufacturers that attempt to identify key drivers of future spectrum need and quantify the impacts of those drivers. These reports are provided based on to the committee members' awareness of their existence and are not intended to be comprehensive. NTIA might identify other similar organizations who make such reports and analyses available.

Data or reports from SDOs and SIGs provide insight into technology advances and trends that should be useful in identifying their impact on spectrum demand.

Regulatory and commercial databases can be used to identify direct trends in spectrum usage, but can also be used in concert with data analysis techniques to identify relationships and dependencies. For example, the FAA's Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) contains information on spectrum use on towers that must file form FAA-7460-1, "Notice of Proposed Construction of Alteration," that may be useful as mentioned in Recommendation #2.

- 5G Spectrum Vision (Feb 2019): https://www.5gamericas.org/5g-spectrum-vision/
- 5G Americas Spectrum Recommendations for the U.S (Apr 2018): https://www.5gamericas.org/5g-americas-spectrum-recommendations-for-the-u-s/
- Spectrum Landscape for Mobile Services (Nov 2017): https://www.5gamericas.org/spectrum-landscape-for-mobile-services/
- 5G Regulatory Policy Considerations & Spectrum Sharing (Aug 2017): https://www.5gamericas.org/5g-regulatory-policy-considerations-spectrum-sharing/
- 5G Spectrum Recommendations (Apr 2017): https://www.5gamericas.org/5g-spectrum-recommendations/
- Identifying Key Characteristics of Bands for Commercial Deployments and Applications Subcommittee (CSMAC, Final Report, Nov 2017): https://www.ntia.doc.gov/files/ntia/publications/key_characteristics_sub-committee_final_report_nov_17_2017.pdf
- Quantitative Assessments of Spectrum Usage (Nov 2016): https://www.ntia.doc.gov/files/ntia/publications/ntia_quant_assessment_report-no_appendices.pdf
- Ericsson Mobility Report: Ericsson Mobility Report
- CTIA National Spectrum Strategy : https://www.ctia.org/national-spectrum-strategy
- Cisco Annual Internet Report: https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.html
- Current and Future Spectrum Use by The Energy, Water, And Railroad Industries (Jan 2002)
  - Although the report is old it is worth reviewing the methodology used to collect the information
- U.S. National Spectrum Requirements - Projections and Trends (Mar 1995)
  - Although the report is old it is worth reviewing the methodology used to collect the information
- Standards Development Organizations (examples):
  - IEEE
  - 3GPP
  - Wireless Innovation Forum

- o Wi-Fi Alliance
- o IETF
- o ATIS
- Special Interest Groups (examples):
  - o Bluetooth
- Other organizations (examples)
  - o Zigbee Alliance
  - o UWB Alliance
- Regulatory databases (examples)
  - o FCC (*e.g.*, ULS, LMS, IBFS, etc.)
  - o FAA Obstruction Evaluation/Airport Airspace Analysis (OE/AAA): https://oeaaa.faa.gov/oeaaa/external/portal.jsp
- Commercial Databases (examples):
  - o Allnet
  - o American Tower
  - o EWA
  - o AFTRC
  - o ASHTO
  - o MARFAC
  - o Comsearch
  - o Crown Castle
  - o Mosaik

ATTACHMENT 1

FCC Services Showing Spectrum Need Trend and Possible Data Sources