MAPPING RADIO FREQUENCY FROM SPACE:

CASE STUDY TO DEVELOPING A NATIONAL RF MAP

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U.S. GEOLOGICAL SURVEY: GEOGRAPHER

Support the Civil Applications Committee:
Facilitates the appropriate civil uses of overhead remote sensing technologies and data collected by military and intelligence capabilities, including from commercial sources.

Civil Applications Committee Fact Sheet

U.S. NAVAL RESERVE OFFICER:
National Geospatial Intelligence Agency
Command Pacific Fleet

FUN FACT:
Was a Park Ranger at Yosemite National Park 2017
OBJECTIVES:

**OVERVIEW**
05: What is Radio Frequency
07: Commercial Space Companies
08: Concept National RF Spectrum Map
10: National Transportation Noise Map
12: VIIRS Nighttime Lights Map

**OBJECTIVES**
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**Radio Frequency:**

- Apart of the Electromagnetic Spectrum

- Range 3 Kilohertz (KHz) to 300 Gigahertz (GHz)

- Federal Communications Commission and National Telecommunications and Information Administration are responsible for licensing and managing these bands for private, commercial and federal use.

- RF propagation describes the behavior of electromagnetic radiation from a point of transmission as it travels through the surrounding environment.
RADIO FREQUENCY:

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Example of RF Propagation Map
Credit: RF Propagation Map
COMMERCIAL SPACE RF SENSOR COMPANIES

HawkEye 360

aurora INSIGHT + MAXAR

KLEOS

PredaSAR

Commercial Space RF Providers
Credit: Hawkeye 360, Maxar, Aurora Insight), KLEOS, PredaSAR
Concept: Small Scale View of National RF Spectrum Map
Concept: Large Scale View of National RF Spectrum Map
National Transportation Noise Map - Department of Transportation
National Transportation Noise Map - Department of Transportation

Large Scale View of State College, Pennsylvania
VIIRS Nighttime Lights Monthly Cloud-Free Composite
OBJECTIVES:

Identify a commercial space RF sensor provider to assist in the development of a National RF Spectrum Map.

Develop a standardized process to generating a RF Spectrum Map.

Develop a report and recommendation on implementing a collection strategy and process to supporting a National RF Spectrum Map Initiative.
OBJECTIVES

IDENTIFY:

Identify a commercial space RF sensor provider to assist in the development of a National RF Spectrum Map.

1. Develop collection requirements needed for developing a RF Spectrum Map

2. Feasibility study of current commercial space RF sensor providers, that meet the collection requirements

3. Submit collection requirements for tasking of 2-3 sample sites

4. Receive collections for 2-3 sites for post-processing
STANDARDIZE:

Develop a standardized process to generating a RF Spectrum Map.

1. Generate a heatmap of RF Spectrum across the sample sites

2. Develop a 24-hour approximate average RF spectrum across the sample sites

3. Compare traditional RF Signal Propagation, Loss, and Terrain analysis tool (SPLAT) coverage maps to Space collected RF Spectrum Map
REPORT:

Develop a report and recommendation on implementing a collection strategy and process to supporting a National RF Spectrum Map Initiative.

1. Collection strategy recommendation

2. Identify storage requirements

3. Identify processing requirements

4. Generate a post-processing standardization procedure

5. Recommend web-hosting services

6. Generate an estimated timeline of National RF Spectrum Map completion
METHODS
METHODS:
Feasibility study on leveraging commercial space RF sensors in developing a RF Spectrum Map:

Assessment will be based on 3 primary factors: Spectrum Range, Maturity of Constellation, Access to sample data


2. Operational constellation of satellites currently in orbit

3. Must have access to sample data (requested through established government process or directly with the vendor)
METHODS:

Develop RF Spectrum heatmaps of sample sites:

1. Leverage the Institute for Telecommunication Sciences- Propagation Modeling Website (PMW) to model the propagation of RF
   **This step will produce a shapefile output**

2. Preform Raster calculations provided by the PMW output
   • Sum of total number of RF transmitters within a given resolution
   • Sum of RF power within a given resolution

3. Preform calculations to determine 24hr RF Spectrum average
METHODS:

Develop a report and recommendation on implementing a collection strategy and process to supporting a National RF Spectrum Map Initiative:

1. Determine a collection strategy

2. Identify storage requirements

3. Identify processing requirements

4. Generate a post-processing standardization procedure

5. Recommend web-hosting services

6. Generate an estimated timeline of National RF Spectrum Map completion
PRODUCTS:
The following products are intended to be produced from the research and efforts into the development of a RF Spectrum Map produced by commercial space RF sensor providers.

- Feasibility study on leveraging commercial space RF sensors in developing a RF Spectrum Map.

- Develop RF Spectrum heatmaps of sample sites.

- Develop a report and recommendation on implementing a collection strategy and process to supporting a National RF Spectrum Map Initiative.
PHASES:

The following timeline has been developed to support the research and efforts into the development of a RF Spectrum Map produced by commercial space RF sensor providers.

PHASE 1 – Identify a provider

PHASE 2 – Submit collection requirements for tasking for 2-3 sites (Est. 2-4weeks)

PHASE 3 – Develop a post-processing standardization procedure (Est. 1-3weeks)

PHASE 4 – Develop a report and recommendation on implementing a collection strategy and process to supporting a National RF Spectrum Map Initiative (Est. 2-4weeks)

PHASE 5 – Present Research Findings

Start Phase 1 Fall 2022

Complete Phase 1 by end of March 2023

Start Phase 2 upon completion of Phase 1.

Start Phase 3 upon receipt of sample data.

Start Phase 4 upon completion of Phase 3.

Complete Phase 5 upon completion of Phase 4.
MILESTONES:

The following are milestones within the research and efforts into the development of a RF Spectrum Map produced by commercial space RF sensor providers.

- Identify if it’s possible with the current providers constellations
- Create a collection plan or identify a previous collection sample
- Develop a standardized RF Spectrum Map process
- Develop a national collection strategy and implementation estimate
ASSUMPTIONS
ASSUMPTIONS:

The following assumptions apply to the research of developing a RF Spectrum Map.

• Commercial space RF sensor providers have mature constellations to meet collection requirements

• Access to sample data

• RF space sensor data supports the requirements to run the PMW
PROCUREMENT

MAPPING RADIO FREQUENCY FROM SPACE
PROCUREMENT:

The following are products and services identified as being key to supporting the research and efforts into the development of a RF Spectrum Map produced by commercial space RF sensor providers.

• Commercial space RF sensors provider’s capability and limitations
• Sample dataset provided by the identified commercial space RF sensors provider
• Access to the PMW
• ESRI license
REFERENCES
CITATIONS:

Civil Applications Committee Fact Sheet

National Transportation Noise Map Documentation

National Civil Applications Center Fact Sheet

## CITATIONS:

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RF Propagation Map


Commercial Space RF Providers Logos

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VIIRS Nighttime Lights Monthly Cloud-Free Composite
QUESTIONS?
THANK YOU