SPECTRUM PIPELINE REQUEST
1675 – 1680 MHZ ENGINEERING STUDY (SPRES)

December 13, 2018

Al Wissman
Overall Scope

- To perform a Spectrum Pipeline Reallocation Engineering Study (SPRES) that assesses the potential for sharing the 1675-1680 MHz frequency band and the adjacent frequency bands with commercial mobile wireless carriers, nationwide.

- Establish a user/customer data flow and user needs baseline to facilitate quantifying impacts to end users resulting from a loss of access to data received directly from the satellite, and identify alternatives to mitigate such impacts.

- Perform interference analysis to determine Interference Protection Criteria (IPC) for federal Earth stations and protection zones around these downlink sites.

- Recommend Radio Frequency Interference (RFI) monitoring and mitigation techniques will be examined.

- Recommend alternative architectures will also be examined for future implementation on space and ground based assets, e.g., GOES-Next.
Technical Concept, Justification, and Impact

- Technical Concept: The study will be done using engineering analysis including models and simulations and field testing.

- Justification: With the possibility of another Advance Wireless Services (AWS) auction for the 1675 – 1680 MHz Frequency, Congress provided funds to study the impact, possible mitigations/alternative, and recommendations to facilitate successful spectrum sharing.
Description of Projects

11 major tasks to meet the goals of the engineering study

- 1 – Spacecraft to end user data flow analysis
- 2 – Analysis of impacts to users
- 3 – Alternative GOES ground system architectures
- 4 – ROM costs for implementing alternative architectures
- 5 – Alternative communication techniques for satellite downlinks
- 6 – Detailed survey of receiving equipment
- 7 – Protection studies
- 8 – Anomalous propagation interference to critical GOES stations
- 9 – Interference thresholds for federal GOES-R broadcast receivers
- 10 – RFI monitoring analysis for the 1675-1680 MHz band
- 11 – LTE TDD simulations, passive site surveys, and active test

The critical Project Path are projects 1, 3, and 4

BOLD = project completed
BOLD = project in progress
Italic = project in pre-award phase

Each project is self-contained, with an end result, and some are interdependent.
With Dependencies (prerequisites to start)

- **1 – Spacecraft to end user data flow analysis**
  - Comprehensive list of federal GOES receive sites
  - Representative list of non-federal GOES receive sites
  - Baseline characteristics, ops availability requirements, RFI impacts to users

- **2 – Analysis of impacts to users**
  - More detailed analysis of GOES receive ground equipment, environmental factors, and user impacts
    - Dependent on Project 1 outputs (incrementally)

- **3 – Alternative GOES ground system architectures**
  - List and detailed description of viable alternatives for legacy GOES and GOES-16+
    - Dependent on Project 1 outputs (completed)

- **4 – ROM costs for implementing alternative architectures**
  - Cost and schedule for design, development, and implementation of alternatives
    - Dependent on Project 3 outputs (completed)

**Anticipated results of individual projects – most require information and findings from other projects before they can start.**
Expected Outcomes (cont’d)

With Dependencies (prerequisites to start)

• 5 – Alternative communication techniques for satellite downlinks
  Latency and availability information of data in alternative architectures
  Recommendations for GOES-Next bandwidth and modulation requirements
  ➢ Dependent on Project 3 outputs (completed)

• 6 – Detailed survey of receiving equipment
  Details of federal earth station GOES satellite broadcast receiver susceptibility to RFI, based on on-site assessments of a representative group of sites
  Mapping of data distribution architectures, commercial and national relationships
  ➢ Dependent on Project 2 outputs (incrementally)

• 7 – Protection studies
  Quantified impacts from in-band and adjacent-band LTE and other RFI sources
  Definitive protection criteria and protection zones
  ➢ Dependent on Project 6, 9, and 11 outputs (incrementally)

Anticipated results of individual projects – most require information and findings from other projects before they can start.
Expected Outcomes (cont’d)

With Dependencies (prerequisites to start)

• 8 – Anomalous propagation interference to critical GOES stations
  Analysis of anomalous propagation conditions and effects
  Recommended requirements and actions for mitigation

• 9 – Interference thresholds for federal GOES-R broadcast receivers
  Bit error and frame error rate thresholds before degradation occurs
  Analysis of the benefits of spectrum sharing by using AWS carrier ID

• 10 – RFI monitoring analysis for the 1675-1680 MHz band
  Trade study on the state of current and future monitoring capabilities
    ➢ Dependent on Project 6 outputs (incrementally)

• 11 – LTE TDD simulations, passive site surveys, and active test
  Details on susceptibility to LTE TDD interference, possible mitigation approaches
  Includes in-band and adjacent-band interference
    ➢ Dependent on Project 2 and 9 outputs (incrementally)

BOLD = project completed
BOLD = project in progress
Italic = project in pre-award phase

Anticipated results of individual projects – most require information and findings from other projects before they can start.
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<thead>
<tr>
<th>Company</th>
<th>Contract Details</th>
<th>POP Dates</th>
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<td>2/1/2018 - 1/31/2020</td>
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<tr>
<td>Program Support - Task Order 12</td>
<td>Provide engineering and program management support to manage execution of projects</td>
<td>Aerospace Corporation</td>
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<td>Project 1</td>
<td>Map Spacecraft and End Users data flows and document user needs</td>
<td>Next Phase Solutions and Services, Inc.</td>
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<td>Project 2</td>
<td>RFI Analysis</td>
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<td>Interference Monitoring System Analysis</td>
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<td>Requirements/Methods to protect downlinks</td>
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<td>Develop costs for Alternative Architectures</td>
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<td>Alternative Satellite Downlink Communications</td>
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