

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

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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.



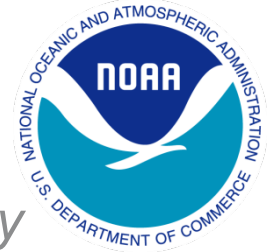
Technical Concept, Justification, and Impact



- 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.



Expected Outcomes

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.



Implementation: Acquisition Strategy



Aerospace Corporation:

Contract # SP-133E-17-CQ-0020,
Task Order 12
Program Support
POP: 11/30/2017 - 11/29/2020

Freedom Technologies Incorporated

Contract # SP-133E-18-CQ-0015
IDIQ Awardee
POP 2/6/2018 - 2/5/2020

Next Phase Solutions and Services, Inc.

Contract # SP-133E-18-CQ-0017
IDIQ Awardee, Projects 1, 2 & 9
POP: 2/1/2018 - 1/31/2020

Shared Spectrum Company

Contract # SP-133E-18-CQ-0016
IDIQ Awardee, Projects 6 & 8
POP 2/1/2018 - 1/31/2020



Contract Schedules & Status



Task Order	Description	Awardee	Planned Award Date	Actual Award Date	Award Amount	Duration/PO P (Months)	1/3 Complete Report	2/3 Complete Report	Draft Final Report Due	Status
Program Support - Task Order 12	Provide engineering and program management support to manage execution of projects	Aerospace Corporation	N/A	1/1/2017	\$782,818	01/01/2017 - 11/31/2020	N/A	N/A	January, 2020	On-track
Project 1	Map Spacecraft and End Users data flows and document user needs	Next Phase Solutions and Services, Inc.	1/31/2018	2/22/2018	\$250,417	6	4/24/2018	6/22/2018	January, 2019	Additional modification for site specific applications;
Project 8	Anomalous Propagation Interference Analysis	Shared Spectrum Company	1/31/2018	2/13/2018	\$184,929	7	4/26/2018	6/13/2018	August, 2018	100% completed
Project 9	Receiver Interference Thresholds	Next Phase Solutions and Services, Inc.	1/31/2018	2/22/2018	\$455,955	11	5/22/2018	11/27/2018	January 2019	RFI threshold test limits in development - 70%
Project 2	RFI Analysis	Next Phase Solutions and Services, Inc.	4/13/2018	4/20/2018	\$426,485	9	7/20/2018	10/23/2018	January, 2019	Awarded April 2018 Analysis of potential interference to downlink sites - 80%
Project 6	Survey of Receiving Equipment	Shared Spectrum Company	4/27/2018	5/24/2018	\$2,566,896	12	10/24/2018	1/24/2019	March, 2019	On-Site Assessment - 40%
Project 11	LTE TDD Simulations, Passive Site Surveys, and Active Testing	Shared Spectrum Company	7/15/2018	7/18/2018	\$530,034	9	11/29/2018	2/15/2019	April, 2019	Evaluate Standards and Protection Zones - 40%
Project 3	ID Alternative Architectures		7/16/2018	7/26/2018	\$470,789	8.5	10/24/2018	11/29/2018	January, 2019	Alternative GOES User Direct-Satellite-Broadcast Ground Architectures for DCS and GRB - 40%
Project 10	Interference Monitoring System Analysis		10/29/2018	On the street		9.5			June, 2019	
Project 7	Requirements/Methods to protect downlinks		12/10/2018	Solicitation being prepared		8			April, 2019	
Project 4	Develop costs for Alternative Architectures		4/19/2019	-		8.5			October, 2019	
Project 5	Alternative Satellite Downlink Communications		4/19/2019	-		6			September, 2019	9