WILDLAND FIRE PRE-FORMULATON CONCEPT STUDY
REQUEST FOR INFORMATION (RFI)

RFI # BA-2671-02212024

Exhibit I
List of Desired Capabilities

Preliminary Conceptual Studies for the Wildfire Architecture Study

INTRODUCTION

This document lists capabilities and characteristics of interest that we'd like to understand about all responding proposals to properly evaluate each. It is expected that responses will range in detection methods/technology, implementation approach, and overall scope, so one should not interpret this list as a strict checklist or grading rubric. Various responses may inform more or fewer of the listed items. For RFI, capabilities listed in *blue and italics* is required.

The items are grouped into categories ranging from details on the observation performance to overall mission architecture/project-level characteristics. Each line is uniquely numbered for ease of reference.

If a value is listed, that is our desired level of performance, but should not be interpreted as requirements or absolute thresholds.

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List of Wildland Fire Application Objectives

The driving objectives for the concept study are listed below for active fire detection and tracking. A primary goal of the architecture study is to determine the extent to which any given architecture meets all, most, or some of the objectives derived from these priorities to address the stakeholder needs.

- **Large Area Fire Detection:** Rapid detection of new fire starts, with low false positive rates (<5%) for fires as small as 10x10 m during daytime (sunlit) conditions. Coverage of the entire US (including Alaska, Hawaii, and Puerto Rico) to improve the frequency of active fire detection capabilities from existing civil space assets. Detection information to include the ability to estimate fire radiative power (FRP) and/or other measures of fire intensity.
- **Large Fire Perimeter Mapping:** Capability to scan and collect desired thermal data on multiple large fires in one operational period to provide fire map products that track fire behavior and changes over time due to fire spread and suppression efforts.
- **Support dashboard displays with infrared heat detects of emerging and on-going large wildland fire** to provide common operating picture of the national wildland fire situation: Infrared heat signature data is collected and used in conjunction with other sources of data/fire information in a Dashboard to spatially display location and periodic updates of the fire situation as part of a Common Operating Picture that provides situational awareness for wildland fires nation-wide.

The following objectives for the concept study are listed below for the pre-fire and risk monitoring. A secondary goal of the architecture study is to determine the extent to which any given architecture meets all, most, or some of the objectives derived from these priorities to address the stakeholder needs. The pre-fire environment is a key driver of fire hazard and fire risk and, also influences fire impacts to ecosystems and communities. The **composition, structure, and moisture status of fire fuels**, along with topography and weather, interact to drive fire behavior, while the proximity of hazardous fuels conditions to valuable assets (homes and infrastructure) is a key component of fire risk. Having an accurate characterization of the pre-fire environment can help managers mitigate fire risk (e.g., fuels treatment) and aid in the management of active fire. Responses that pertain to the pre-fire environment must specifically articulate how additional monitoring capabilities contribute to a reduction of wildfire risk across the US (including Alaska, Hawaii, and Puerto Rico).

- **Live fuel moisture:** Changes in live fuel moisture contribute to changes in wildfire risk in US ecosystems. Passive observations of live fuel moisture, or related information on vegetation water content or soil moisture, can improve preparedness by identifying areas at higher risk of fire activity, rapid fire spread, or extreme impacts on ecosystems and communities.

- **Fuel structure:** Passive observations that characterize fuel structure can contribute to improvements in situational awareness regarding mitigation measures for fuel treatments and/or fire behavior models to anticipate changes in fire behavior due to fuel continuity and structure.
- **Fuel composition:** Passive observations that specifically target fuel composition can improve situational awareness to reduce wildfire risk by identifying areas with flammable/inflammable mixtures of fuels in natural ecosystems and human dominated landscapes.

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List of Desired Capabilities and Characteristics

1. **Instrument Performance**
   1.1. Observable
      1.1.1. Type of passive observable (e.g. visible, IR, GNSS): *passive IR*
      1.1.2. Number of bands/channels
      1.1.3. Definition of each band [nm]
   1.2. Resolution- for each mode (e.g. monitoring vs. taskable)
      1.2.1. Ground sampling distance [m]: *<100 m, ability to modify for specific event monitoring.*
      1.2.2. Field of View [deg] and shape of view
      1.2.3. Angular resolution [urad]
      1.2.4. Swath width [km]
      1.2.5. Saturation limits in each band
      1.2.6. Minimum detectable fire size [m, m2], by temperature and/or time of day: goal: *10x10 m at 800 K, in daylight*
      1.2.7. Fire Radiative Power (FRP): *<= 15% error for fires >5 MW @nadir*
   1.3. Expected false positive, false negative rates and identification strategy: *<5%*
   1.4. Capabilities for composition, structure, and moisture status of fire fuels
   1.5. Observation geolocation accuracy and implementation approach [m]: *<100 m*
   1.6. Requirements & synergy with outside inputs (e.g. signals of opportunity, occultation, other data sources needed)
   1.7. Mass
      1.7.1. CBE, MGA%, and MEV [kg]
   1.8. Power
      1.8.1. Orbit average power consumption, peak power, survival power [W]
   1.9. Volume
      1.9.1. Volume as hosted aboard the space platform [m, m3]
   1.10. Data production
      1.10.1. Data generation rate and interface w/platform
      1.10.2. Does the instrument have integrated avionics/data storage, or does it rely on the spacecraft for processing, compression, packaging, storage?
   1.11. Instrument Calibration: Plan for calibration of instrument and stability throughout the mission

2. **Platform Characteristics**
   2.1. Instruments on each platform

- 2.1.1. Instrument complement on each platform
- 2.2. Mass
  - 2.2.1. CBE, MGA%, and MEV [kg], single platform
  - 2.2.2. Propellant and other consumables
  - 2.2.3. Launch stack mass (if applicable) and launch configuration
- 2.3. Power
  - 2.3.1. Generation method, deployments, articulation
  - 2.3.2. Power generation capability, demand [W], contingency, and margin [%]
- 2.4. Volume
  - 2.4.1. Volume in launch/stowed configuration [m, m3]
- 2.5. Telecommunications architecture
  - 2.5.1. Terrestrial downlink vs. relay (e.g. TDRSS), crosslink, or other
  - 2.5.2. Downlink and uplink bands
  - 2.5.3. Baseline communications network, as well as any additional compatibility with alternate, existing systems
  - 2.5.4. Downlink latency
- 2.6. Command & data handling
  - 2.6.1. Description of the C&DH approach
  - *2.6.2.* Data storage capacity onboard, in terms of bits and in terms of number of orbits or duration of time, in case of missed downlink opportunity or desire to retransmit corrupted data: *>1 day of onboard storage margin.*
  - *2.6.3.* Level of autonomy and level of task-ability: *ability to operate and monitor autonomously, raise alerts autonomously, ability to be tasked to follow-up observations of other vehicles on demand, ability to be tasked to support an ongoing event.*
- 2.7. Heritage and commonality
  - 2.7.1. Risk reduction and implementation streamlining by way of heritage design, commonality between units, etc.
- 2.8. Design lifetime (single platform)
  - 2.8.1. Hardware design life: *prefer 3-5 yr, dependent on replenishment strategy*
  - 2.8.2. Radiation tolerance: *depends on orbit, expect ~½ krad per year x2 RDF*
  - 2.8.3. Fault tolerance and redundancy
  - 2.8.4. De-orbit compliance approach: *<5 yr from end of mission*
  - 2.8.5. Storage tolerance and time from storage to launch for constellation replenishment: *non-zero storage duration tolerance for rapid replenishment.*
  - 2.8.6. Identification of hazardous or perishable materials: *no radioactive or biological materials, minimal dense components that will cause re-entry risk.*

3. Mission Architecture Characteristics

3.1. Number of platforms

3.2. Concept of operations

3.2.1. Launch strategy, number of launches, and launch cadence.

3.2.2. Number of space platforms, number of orbital planes, description of orbital planes (e.g. altitude, inclination), revisit cadence and time of day

3.2.3. Constellation formation and commissioning

3.2.4. Monitoring ConOps

3.2.5. Active event/taskable ConOps

3.2.6. Communications architecture/strategy to deliver near-realtime data.

3.3. Coverage

*3.3.1. Spatial coverage figures of merit for the identi*fied region: *Full coverage for all vegetated landmass of the 50 US states, plus Puerto Rico*

3.3.2. Temporal coverage figures of merit for the identified region:

3.3.2.1. Active Fire: *>= 4 revisits/day for any location in US50+PR. No more than 8 hours between any successive revisit.*

3.3.2.2. Pre Fire: *<1 day*

3.3.3. Data latency- duration between observations and end-user access of geo-tagged data, including differences between any variable modes or ConOps: *<30 min from detection to end-user receipt*

3.3.4. Any cross-calibration strategy (e.g. swath overlap)

3.4. Other architectural constraints

3.4.1. Mission fully operational lifetime: *>= 5 yr*

3.4.2. First launch date

4. Data Products and Deliverables

4.1. Definition of data products

4.1.1. Monitoring products

4.1.2. Detection alerts

4.1.3. On-demand/taskable products

4.2. Ground data processing architecture

4.3. Open accessibility: *free & open access to all data and data products (per NASA SMD SPD-41a)*

4.4. Synergy/Dependance with existing/planned systems

5. **Project Characteristics (costs in FY24$)**
   5.1. Project schedule
      5.1.1. Timeline from project start to first launch
      5.1.2. Timeline of subsequent launches up to full capability
      5.1.3. Timeline of any planned replenishment
   5.2. Cost per observing platform
   5.3. ROM Cost for full proposed architecture(s)
      5.3.1. Cost reserves
   5.4. Cost for any degraded/threshold architecture(s)
   5.5. Incremental costs for architecture expansions or replenishments
      5.5.1. Storage and maintenance costs
   5.6. Cost (initial and recurring) of any proposed data product distribution systems