Future NOAA LEO Constellation:

Temperature & Moisture Sounding for NWP & Future Observations

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NESDIS, Office of System Architecture and Advanced Planning

National Environmental Satellite, Data, and Information Service
12-16 July 2021
Today’s Space Architecture

Planned Architecture, Program of Record (POR) 2025

NOAA National Environmental Satellite, Data, and Information Service
Orbital Diversity

Constellation Orbital Configuration

00:00
06:00 am
12:00 Noon
18:00 pm (6:00 pm)
21:46 (drift +2.20 min/month)
21:32 (drift -0.17 min/month)
21:30 (drift -0.25 min/month)
20:12 (drift -3.03 min/month)
19:23 (drift +0.67 min/month)
18:46 (drift +4.70 min/month)
18:00 pm (6:00 pm)

Sun

Constellation as of 16 April 2021
Dashed Lines are from July 2012

Mean Local Times at the First Ascending Node (hh:mm) of the Day
One degree equals four minutes
NSOSA Identified Desired Features of NOAA’S New Architecture: Prioritizing Disaggregated LEO

Mix of observations with higher mission impact
- Small and medium platforms
- Enhanced imagery and high-latitude coverage
- New & more observations

More agility
- Disaggregated LEO – smaller building blocks
- Onramps for new technologies
- Evolving partner observations

New business models
- Data purchases, ride shares, hosted payloads
- Commercial communication & data-relay services
- Instruments of opportunity
Trends Favoring SmallSats

- Intensifying demand for timelier and more accurate extreme weather predictions, delivered in faster, user-friendly ways.
- Increasing value in environmental assessments and projections to inform long-term land-use, infrastructure and commercial investments.
- Rapid rise in capability of U.S. aerospace industry and strategic partners in both launch and remote-sensing.
- An unprecedented pace of innovation in ground systems (artificial intelligence, quantum computing and machine-learning) is advancing forecast modeling.
LEO Broad Agency Announcement

NOAA issued a Broad Agency Announcement (BAA) in 2019 seeking industry input, focusing on temperature and moisture soundings:

- **Industry Concept Studies**: 15 studies with nine companies to study sounding instruments, missions and spacecraft in LEO

- **Instrument Concepts**:
  - Request concept studies at the NSOSA Target Baseline performance level
  - Request concept studies within total range to identify:
    - Where low increases in cost could yield higher increases in performance
    - Where small relaxations in performance could yield high cost savings
Sounder Project Industry Concept Analyses

Priorities in LEO:
- Sounder instruments providing critical data for NWP
- Small to medium instruments that can be built and launched comparatively quickly allowing for an agile constellation

Industry awards to explore design and capability options:
- Sounding instruments (microwave, infrared, radio occultation)
- New acquisition and observing system concepts:
  - Commercial services
  - Multi-orbit coverage
  - Common satellite bus for flexibility in instruments flown
  - Rapid launch cadence
  - Demonstration missions
  - Risk tolerance and observing system risk management

2020: Initial pre-Phase A studies completed
2021: Complete pre-Phase A and begin focused industry designs and collaborations
Mid-2020s: Demonstration Flights
The NESDIS Level Requirements support implementation of NOAA’s mission: Science, Service and Stewardship

<table>
<thead>
<tr>
<th>REQ-001</th>
<th>Data to be collected</th>
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<tbody>
<tr>
<td>REQ-002</td>
<td>Where the data comes from</td>
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<td>REQ-003</td>
<td>Timeliness of the data</td>
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<td>REQ-004</td>
<td>Data is accurate and we archive it and provide stewardship</td>
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<tr>
<td>REQ-005</td>
<td>We do science, research, and development</td>
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NLR REQ-O01:
NESDIS will provide environmental data, information, products and reports in the Foundational, Geophysical and Analytical thematic product areas.
Next Steps in LEO: Beyond Soundings

- Initiate Constellation Trade Study
- Enhance **critical sounding data** now, replenish later
- Launch satellites more frequently to **enhance global observations collected from earth observation satellites**, beginning in mid-2020s
- **Hybrid approach**: data from NOAA satellites, strategic partners, and commercial providers

### Global Environmental Observations

- “Real Time” Imaging
- “Non-Real-Time” Imaging
- Temperature and Moisture Sounding (IR, MW, GNSS-RO)
- Ocean Color
- Atmospheric Composition
- Ocean Surface Vector Winds
- Sea Surface Height
- Ozone (Profile and Total Column)
- Microwave Imagery
- 3D Winds
Joint Venture

• Leveraging capabilities being developed by other federal partners and industry to provide high return on funds

• New NOAA/NESDIS Funding Line Item
  – Exploit partner data (Data Exploitation)
  – Exploit partner technologies (Tech Exploitation)
  – Initial Concept Development to operationalize new data & technology

• Evaluates unproven technology/data sources with potential high return for missions and operations

• Prioritizes potential projects for funding based on NESDIS enterprise needs
Thank you