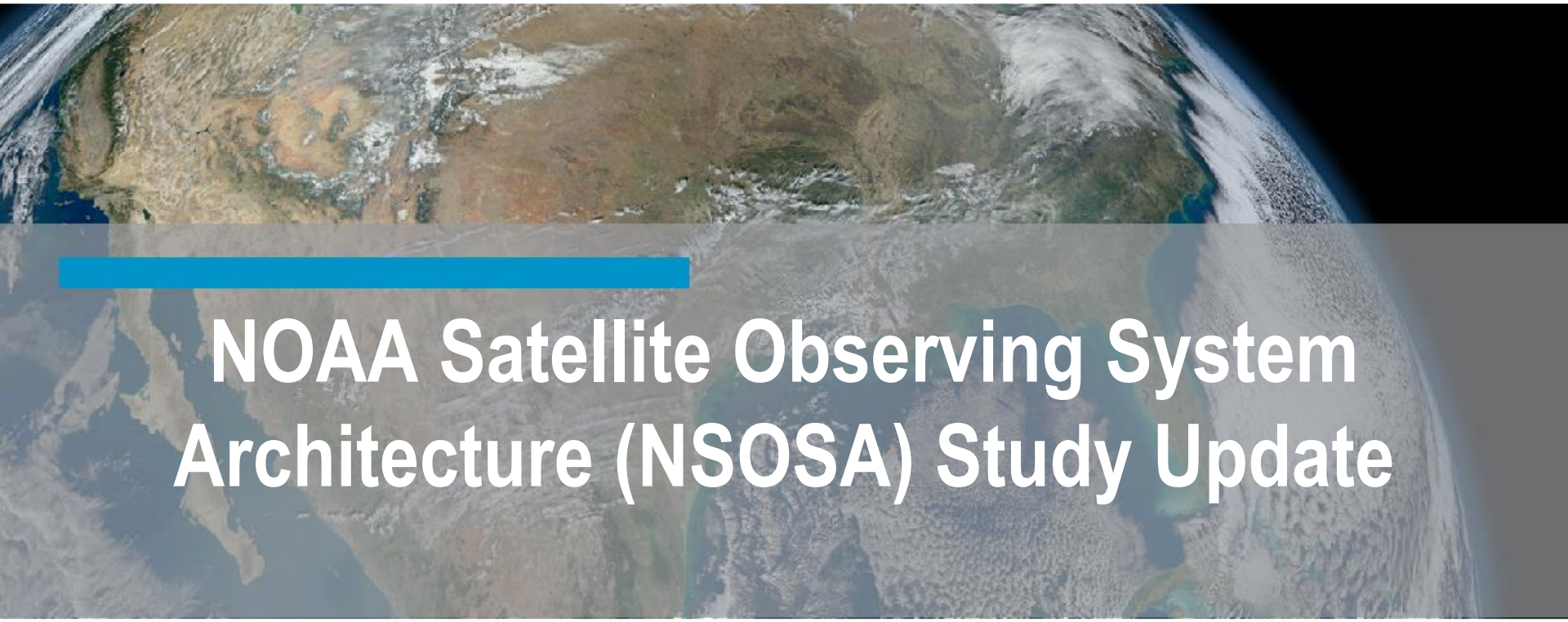

NOAA Satellite Observing System Architecture (NSOSA) Study Update

Dr. Karen St. Germain
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NOAA/NESDIS
Office of System Architecture and Advanced Planning (OSAAP)

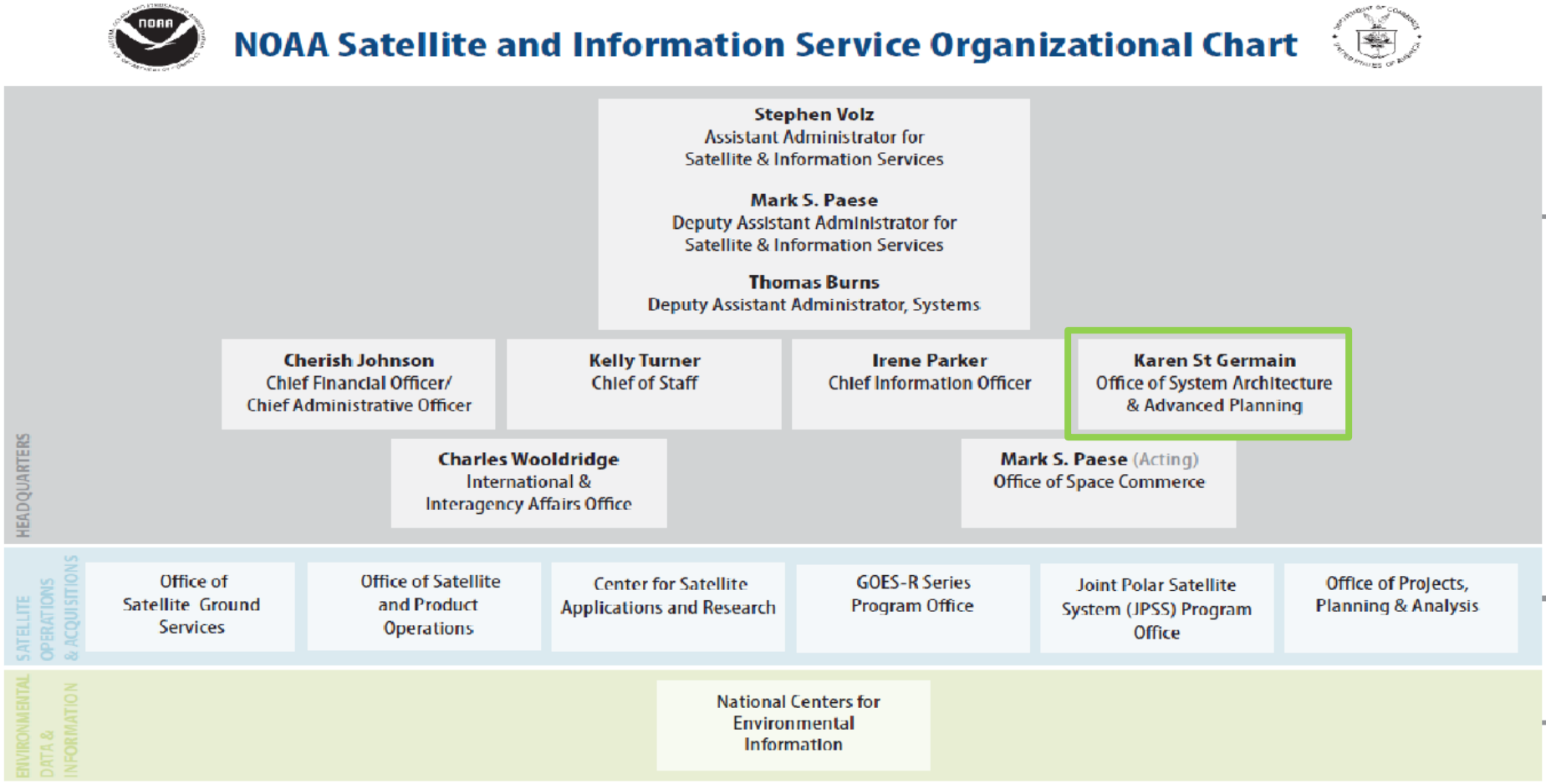
Spring 2017 Meeting of the Committee on Earth Science and Applications from Space

29 March 2017

Agenda

- **OSAAP Overview**
- **Background to the NSOSA study**
- **NSOSA Value Model (requirements) Process**
- **NSOSA Study Follow-ons**

OSAAP Overview & Responsibilities



Strategy, Prioritization, Consistency, and Communication

Architecting the Future

Develop a space-based observing enterprise that is flexible, responsive to evolving technologies, and economically sustainable.
--FY15 NOAA Annual Guidance

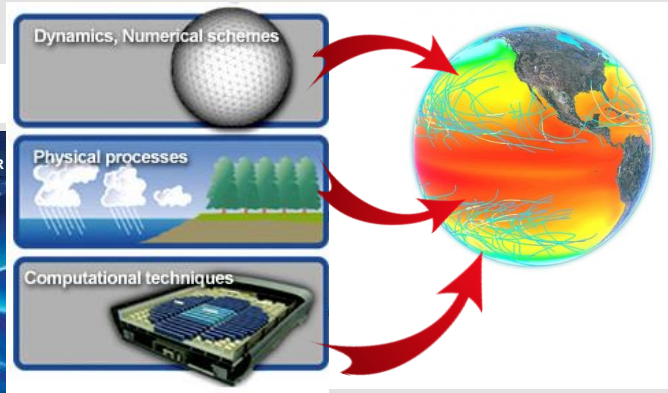
Global Earth Observing Satellite System

Defining the next observations

Next Generation Integrated & Adaptive Ground

Defining the integrated operations and data management system

Integrated & Assimilated Operational Data Flow



Merging the data with models to meet user needs

How is NESDIS Approaching This?

- How to Find Balance: Capabilities vs Cost, New Technology vs Continuity?
  - NOAA Satellite Observing System Architecture (NSOSA) Study
- How to Fuse More Sources?
  - Enterprise Systems Engineering
  - Enterprise Ground Architecture
  - Transparency
- How to Effectively Engage with New Entrants?
  - Commercial Space Activities

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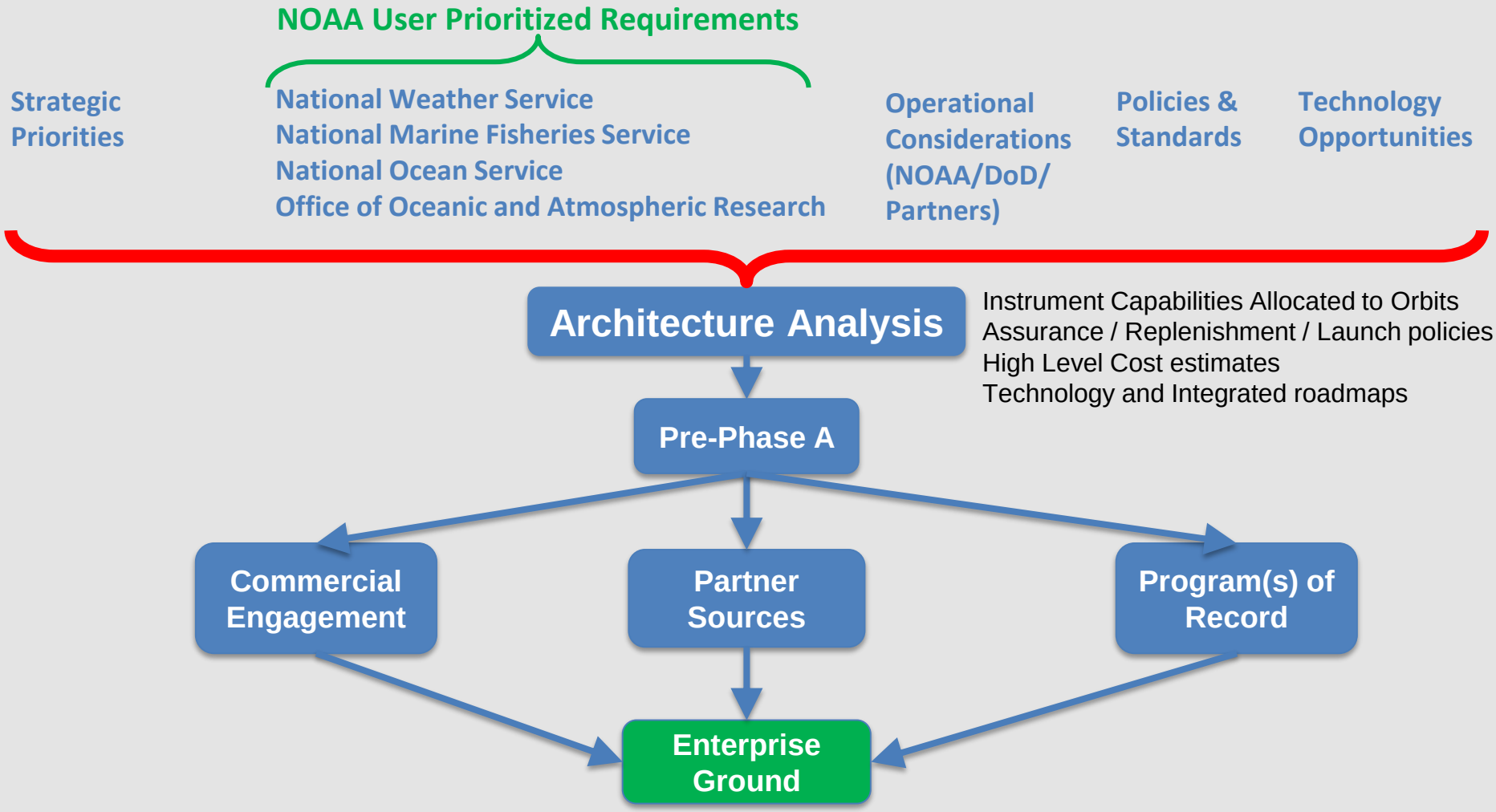
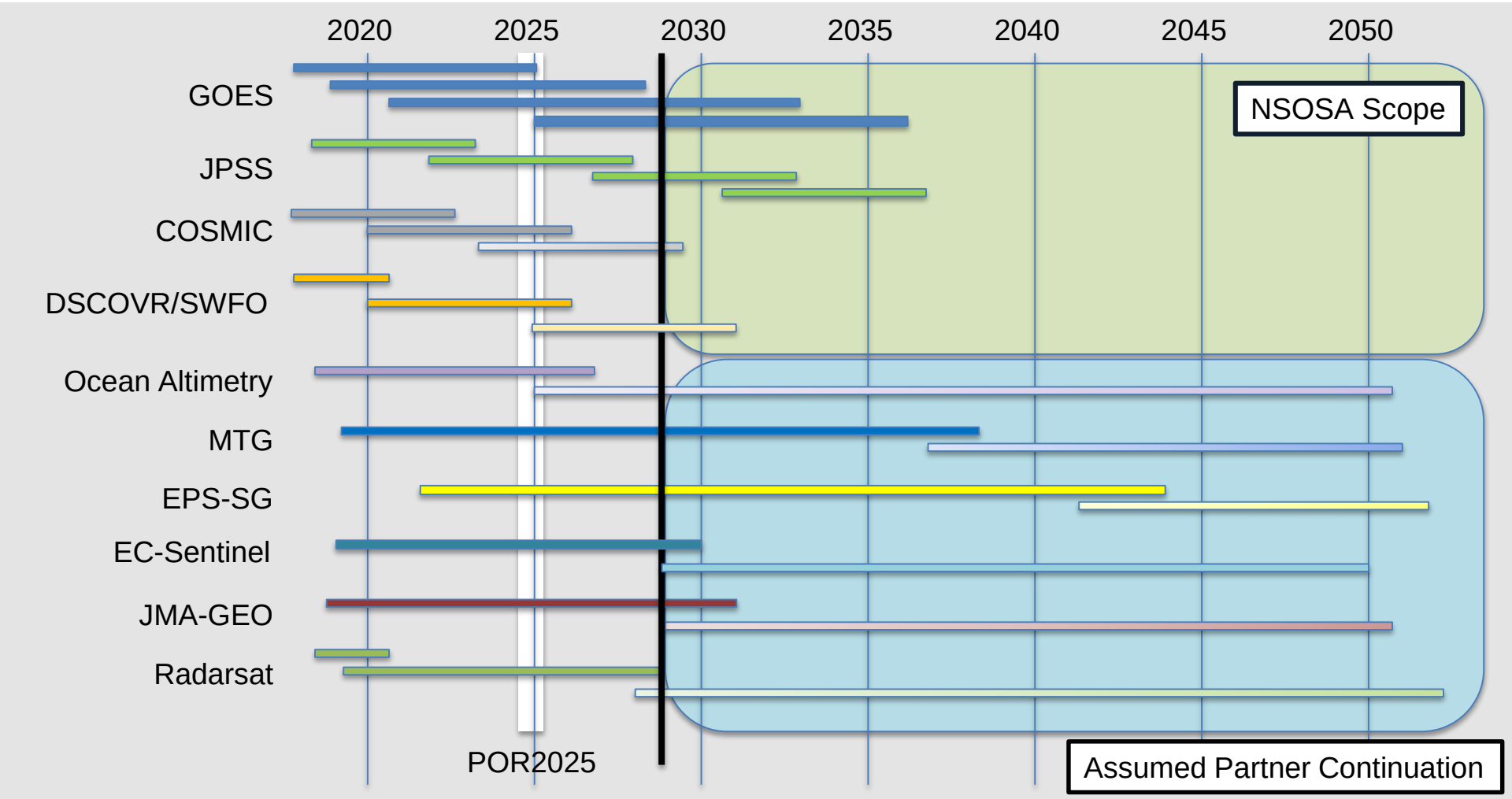
NSOSA Study Background

- **The NSOSA study is examining the space segment architecture decisions for space systems post GOES-R/S/T/U and JPSS-1/2/3/4**
  - ➢Which observation functions should be allocated to which orbits?
  - ➢Should we retain the legacy architecture or seek major change?
  - ➢Which observation functions should be improved?
- **Primarily addressing NOAA operational needs**
  - ➢Observations that result in warnings, watches, baseline weather and space weather forecasts, and ocean or fisheries actions
- **Scoped to NOAA systems, with a backdrop of partner contributions and relationships**
- **Intended to result in Pre-Phase-A program activities**

Planning for the Future



Baseline and Timing



Study Methodology

Functions / Goals
NOAA Operational
NOAA Non-Operational (Science)

NOAA Leadership Priorities

Strategic & Cost Goals
Obs Mission Value

NSOSA

Results

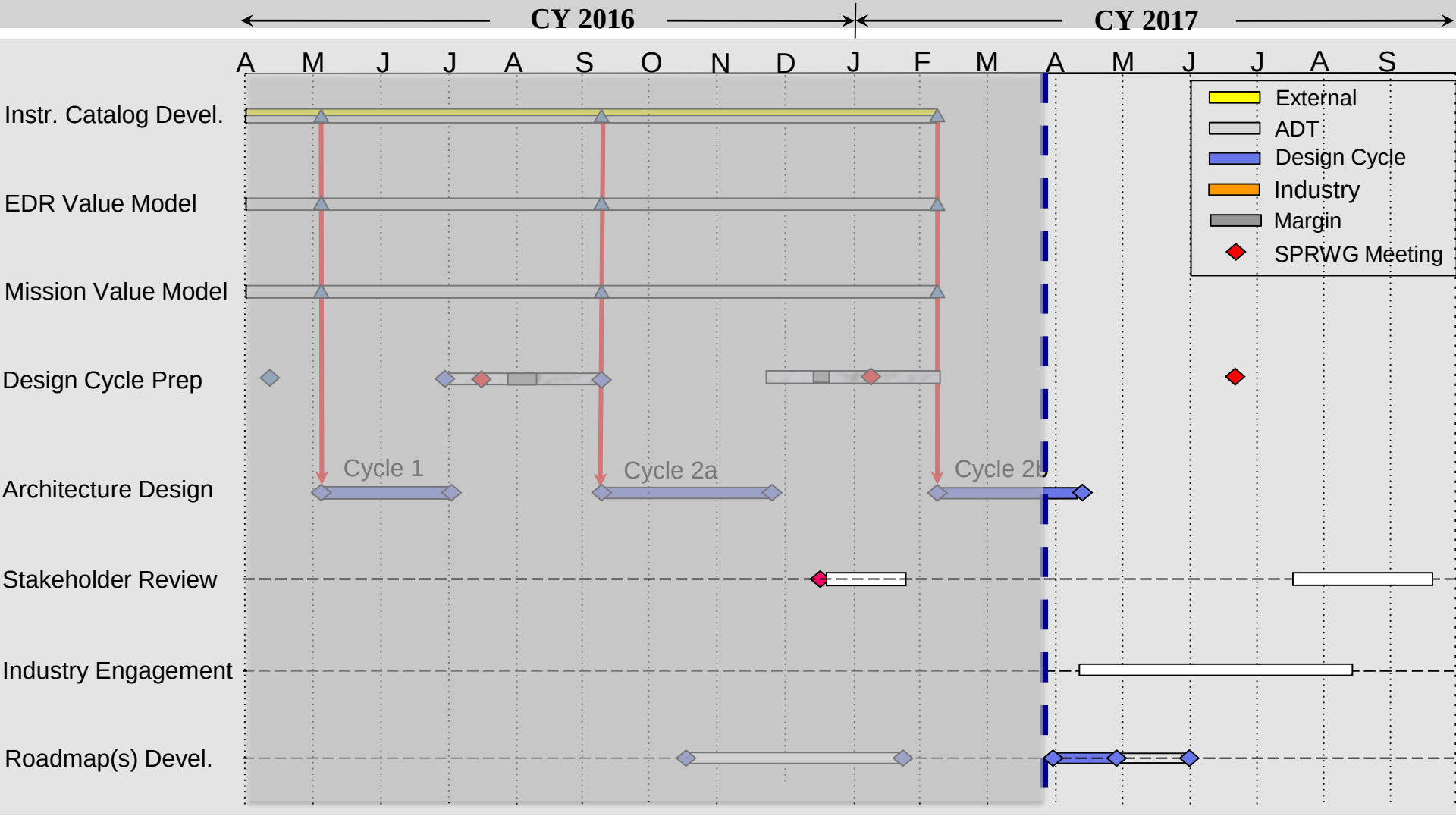
High-Value Alternative Architectures

- Architectures
- Cost Estimates
- Integrated Roadmaps
- Technology Roadmaps

SPRWG
Space Platform Requirements Working Group

Enterprise Ground
Software and Hardware capability and capacity

Study Schedule



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Linking NOAA Requirements to the NESDIS Architecture Study

- **NSOSA team selected a value model (Environmental Data Record [EDR] Value Model) based on classes of environmental observations**

- **This value model expresses *relative mission value* of performance choices and drives the analysis**

- **Satellite Platform Requirements Working Group (SPRWG) established to support NOAA leadership in developing this model**

EDR Value Model Objectives Overview

Core Capability Objectives
- Regional Real-Time Imaging of CONUS
- Two out of three of: Global IR Sounding, Global MW Sounding, and GNSS-RO

Weather and Ocean Objectives (19 Objectives)
- 3-D and Ocean Surface Winds
- Imagery and Soundings
- Ocean Color
- Lightning
- Chemical Concentration
- SW/LW Radiation

Space Weather Objectives (18 Objectives)
- Coronographs and other Imagery
- *In situ* space measurements

Strategic Objectives (6 Objectives)
- Assurance of core capabilities
- Compatibility with fixed budgets
- Assurance of all (remaining) capabilities
- Programmatic responsiveness and adaptability
- Develop and maintain international partnerships
- Low Risk at Constellation Level

EDR Value Model Objectives

Terrestrial / Ocean Objectives

3-D winds
Real Time (RT) regional Weather imagery
Global GNSS-RO soundings
Global RT imagery
Global Near RT microwave (MW) soundings
Global Near RT IR soundings
Global ocean surface vector winds
Non-RT global Weather imagery
Global ocean color/phytoplankton composition
Microwave imagery
Lightning
Radar-based global precipitation rates
Regional MW soundings
Regional infrared (IR) soundings
Global sea surface height
Global chemical concentration
Ozone
Outgoing Long Wave Radiation - NASA Mission
Incoming solar radiation - NASA Mission

Space Weather Objectives

Coronograph imagery: Off Sun-Earth line
Coronograph imagery: Sun-Earth line
Photospheric magnetogram imagery: Off Sun-Earth line
Heliospheric images
Auroral imaging
Thermospheric O/N2 ratio (height integrated)
Upper thermospheric density
Ionospheric electron density profiles
Interplanetary Solar wind: Off Sun-Earth line
Photospheric magnetogram imagery-Sun-Earth line
Solar X-ray irradiance
Solar EUV imaging
Solar EUV irradiance
Interplanetary Solar wind: Sun-Earth Line
Interplanetary Energetic particles
Geospace Energetic particles
Geomagnetic field
Interplanetary Magnetic Field

EDR Value Model Objectives

Strategic Objectives

Assurance of Core Capabilities
Compatibility with stable budgets
Assurance of all capabilities
Programmatic Responsiveness and Adaptability
Develop and Maintain International Partnerships
Low Risk at Constellation Level

NSOSA Value Model Case Study

Assess (and trade) building a sustained off-Earth-Sun-Axis observation platform into the next generation architecture

- **EVM has 5 off-axis-observations, mostly associated with CME warning**
- **Supplying these observations requires a continuous presence off the Earth-Sun-Axis (sustained flights)**
- **A dollar spent on this is a dollar not spent on terrestrial weather function improvement (e.g., spectral and spatial resolution enhancement for Real-Time Regional Weather Imagery)**
- **If cost is equal, which is preferred?**
- **EVM can answer that question**

Space Weather Objectives

Coronograph imagery: Off Sun-Earth line
Coronograph imagery: Sun-Earth line
Photospheric magnetogram imagery: Off Sun-Earth line
Heliospheric images
Auroral imaging
Thermospheric O/N2 ratio (height integrated)
Upper thermospheric density
Ionospheric electron density profiles
Interplanetary Solar wind: Off Sun-Earth line
Photospheric magnetogram imagery-Sun-Earth line
Solar X-ray irradiance
Solar EUV imaging
Solar EUV irradiance
Interplanetary Solar wind: Sun-Earth Line
Interplanetary Energetic particles
Geospace Energetic particles
Geomagnetic field
Interplanetary Magnetic Field

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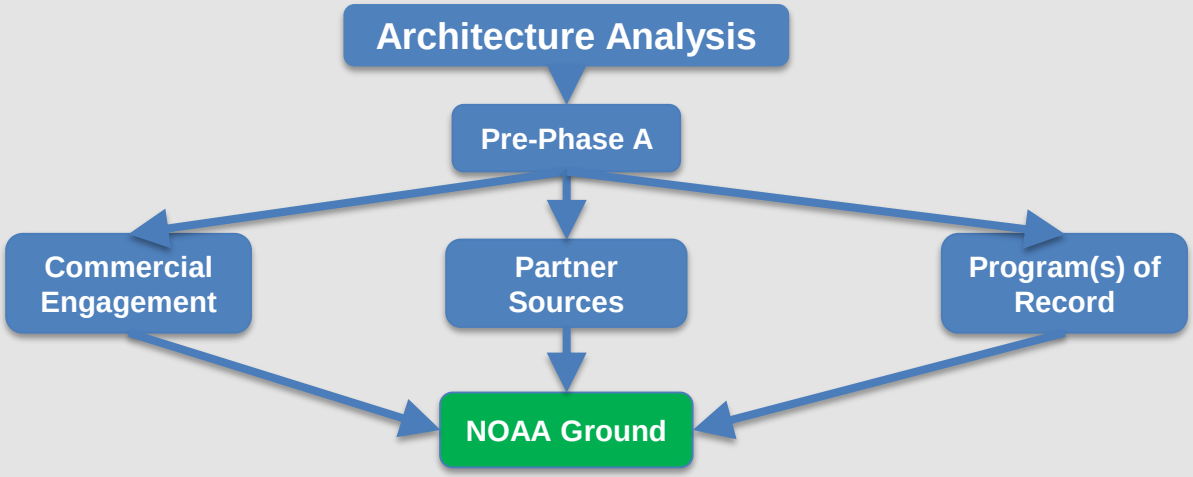
After the Study

- **NSOSA will inform NOAA's selection of a future architecture**
  - ➢ NSOSA will recommend an allocation of functions to orbits in high value, cost-effective configuration(s), along with roadmaps
  - ➢NSOSA will identify key cost and value driving instruments and associated technologies
  - ➢NSOSA will not recommend any particular instrument vendor or data service provider.



Pre-Formulation

- Pre-Formulation bridges the gap between tech development (typically NASA, National Labs, FFRDCs) & operational system acquisition
- Reduces costs thru design concept studies and tech demos
- Detailed activities will be based on Architecture Study results

Architecture Element	Pre-Formulation Activity	Acquisition Activity	Potential Examples
Commercial Service	▪ Sample Data Buy for System Engineering and Quality Evaluation	▪ Operational Mission Data Buy	▪ Radio Occultation Data ▪ Communication Services
New Technology insertion (e.g. Lab-developed)	▪ Technology transition, producibility & manufacturability ▪ Concept competition	▪ System Procurement	▪ EON to mature Small Microwave Sounder to TRL 7 for operational system following NASA-funded MIRADA
Heritage Instrument	▪ Obsolescence Mitigation	▪ System Procurement	▪ EO Focal Planes
Use-driven Data Product	▪ Algorithm transition/development	▪ Operational Data Exploitation Algorithm, End-to-End Validation	▪ Urgent data products (e.g. volcanic eruptions, oil spills)