



# **NPOESS Preparatory Project (NPP)**

**The Direct Readout Conference  
December 2004**

**Pete Wilczynski  
NPP Program Manager  
NPOESS Integrated Program Office (IPO)**



# Overview

- **NPP Origins & Objectives**
- **Requirements & Mission Segments**
- **Data Products**
- **NPP Direct Broadcast**
- **Summary**





# NPP Origins & Mission Objectives

- **NPP is a joint partnership between NASA's Office of Earth Sciences (OES) and the NPOESS Integrated Program Office (IPO) initiated in 1998.**
  - Feasibility study began in November 1998.
  - Formulation began in November 1999.
- **The partnership provides both organizations with considerable cost savings while achieving their key program objectives:**
  - **Bridge Mission**: To provide NASA with continuation of a group of global change observations initiated by the Earth Observing System (EOS) TERRA, AQUA, and Aura missions.
  - **NPOESS Risk Reduction**: To provide the NPOESS operational community with pre-operational risk reduction demonstration and validation for selected NPOESS instruments, and algorithms, as well as ground processing.



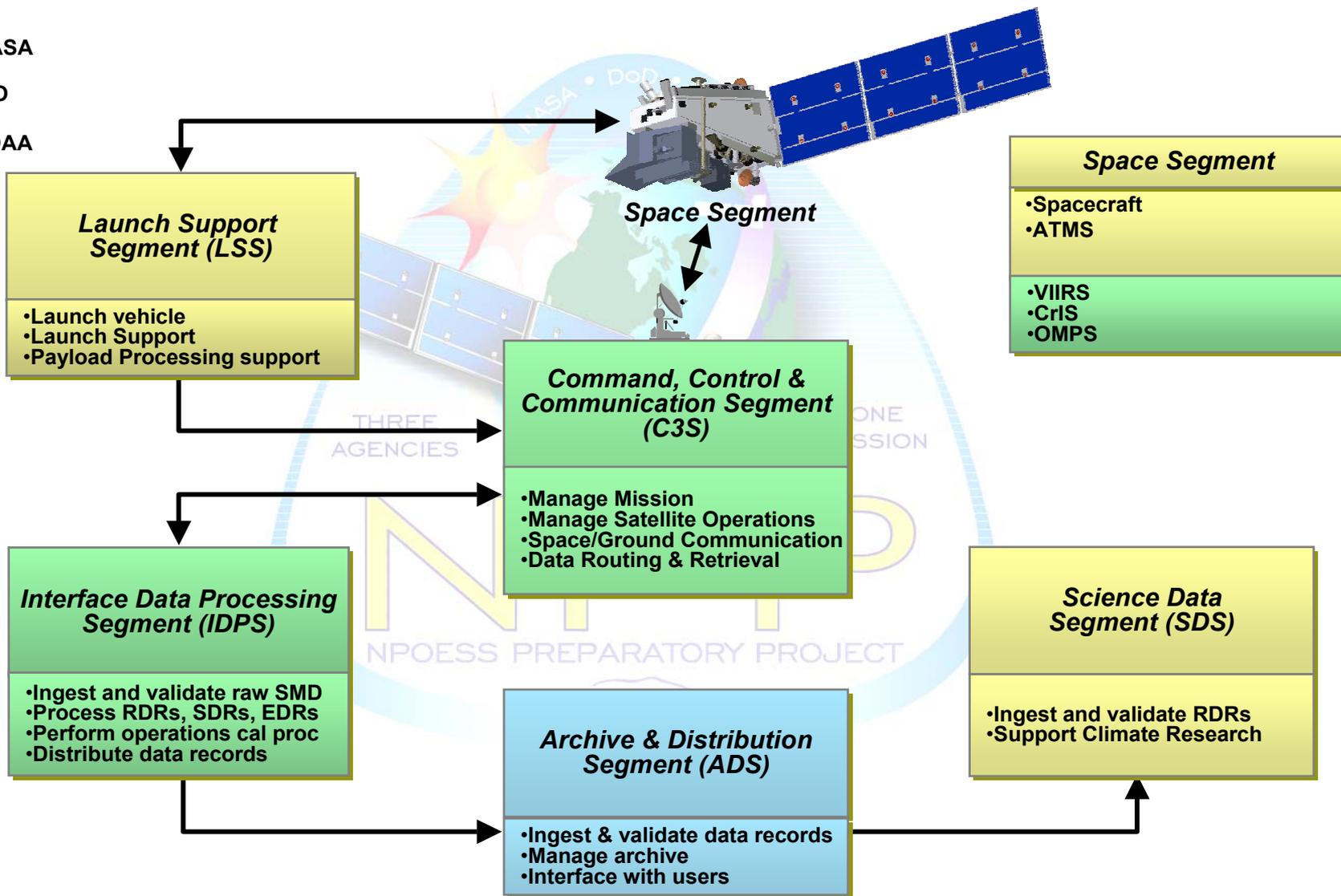
# NPP Requirements Summary

- **NPP programmatic requirements established by NASA Mission Level 1 Requirements document and science performance by NPOESS Integrated Operational Requirements Document (IORD).**
- **Key Level 1 requirements include:**
  - **5 year mission lifetime.**
  - **Accommodation of the ATMS, CrIS, OMPS, and VIIRS instruments.**
  - **Concurrent operations of all instruments.**
  - **Real-time direct broadcast of VIIRS, CrIS, and ATMS instrument data.**
  - **Polar sun-synchronous orbit (824km, 20km ground track repeat, 20 day cycle, and descending equatorial crossing time of 10:30 AM).**
  - **Science Data Segment shall be a research tool (with no operational requirements) used to test the usefulness of NPP EDRs for accomplishing climate research.**
    - > **SDS shall use a fully distributed interoperable architecture with 5 (nominally) independent elements (Climate Analysis Research System or CARS) organized around key EDRs.**
  - **Delta II Launch Vehicle with an October 31, 2006 Launch Readiness Date.**



# NPP Mission Segments

- NASA
- IPO
- NOAA





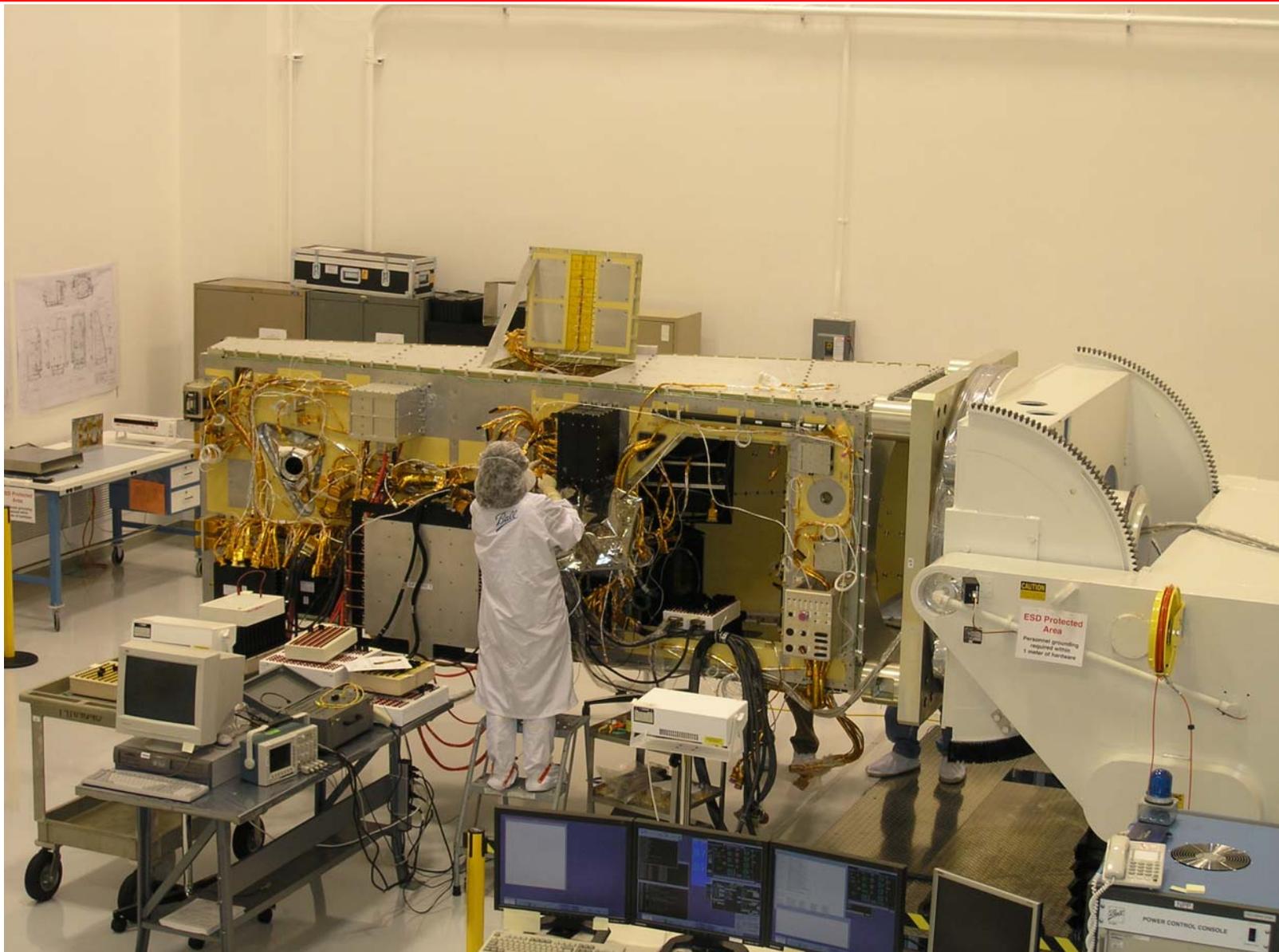
# NPP Satellite



- **LRD:** October 31, 2006
- **Orbit:** 824 km, sun-synchronous, 98° inclination, descending 10:30AM  $\pm$  10 minute local mean time
- **Launch Vehicle:** Delta 7920-10 from VAFB
- **Bus Developer:** Ball Aerospace and Technology Corporation
- **Bus:** BCP-2000
- **Heritage Missions:** ICESat, QuickScat, QuickBird
- **Dimensions:** ~1.35 m x 1.35 m x 4.03 m
- **Mass:** 2,228 kg (including 325 kg of propellant / pressurant)
- **Power:** 2,400 w



# The NPP Spacecraft (as of August 2004)





# ATMS

## ADVANCED TECHNOLOGY MICROWAVE SOUNDER

In conjunction with CrIS, global observations of temperature and moisture profiles at high temporal resolution (~daily).

- **Instrument Developer:** Northrop Grumman Electronic Systems
- **Predecessor Instruments:** AMSU A1 / A2, MHS
- **Approach:** Scanning passive microwave radiometer (22 channels / 23 - 183 GHz)
- **Swath width:** 2,300 km (Co-registered with CrIS)



- **Mass:** 85 kg
- **Power:** 110 w
- **Average Data Rate:** 30 kbps



# CrIS

## CROSS TRACK INFRARED SOUNDER

In conjunction with ATMS, global observations of temperature and moisture profiles at high temporal resolution (~daily)

- **Instrument Developer:** Northrop Grumman Space Technology / ITT
- **Predecessor Instruments:** HIRS, AIRS, IASI
- **Approach:** Michelson interferometer (1142 channels in 3 bands / 3.5  $\mu\text{m}$  to 16  $\mu\text{m}$ )
- **Swath width:** 2,300 km (Co-registered with ATMS)



- **Mass:** 165 kg
- **Power:** 141 w
- **Average Data Rate:** 1.5 mbps



# OMPS

## OZONE MAPPING PROFILER SUITE

Monitors the total column and vertical profile of ozone

- **Instrument Developer:** Northrop Grumman Space Technology / Ball Aerospace and Technology Corporation
- **Predecessor Instruments:** TOMS, SBUV, GOME, OSIRIS, SCHIAMACHY
- **Approach:** Nadir and Limb push broom CCD spectrometers
- **Swath width:** 2,600 km



- **Mass:** 68 kg
- **Power:** 100 w
- **Average Data Rate:** 190 kbps

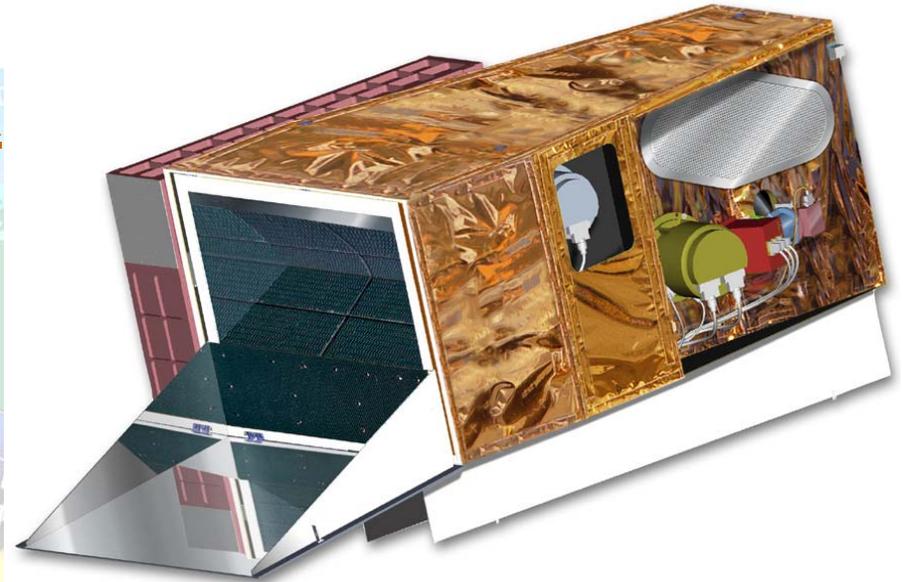


# VIIRS

## VISIBLE INFRARED IMAGING SPECTROMETER

Global observations of land, ocean, & atmosphere parameters at high temporal resolution (~ daily)

- **Instrument Developer:** Northrop Grumman Space Technology / Raytheon Santa Barbara Remote Sensing
- **Predecessor Instruments:** AVHRR, OLS, MODIS, SeaWiFS
- **Approach:** Multi-spectral scanning radiometer (22 bands between 0.4  $\mu\text{m}$  and 12  $\mu\text{m}$ ) 12-bit quantization
- **Swath width:** 3,000 km



- **Mass:** 275 kg
- **Power:** 240 w
- **Average Data Rate:** 8 mbps



# NPP Development Status

- **ATMS, VIIRS, CrIS, and OMPS instruments have Engineering Development Units in process. Flight assembly has started for all the sensors and deliveries are expected through out 2005**
- **Key spacecraft components have been integrated, the spacecraft has been successfully powered-up, and the first command has been successfully sent on August 10, 2004. The spacecraft is on track for an early 2005 completion**
- **All ground system elements are well underway and development schedules support mission readiness testing**
- **In general all NPP mission elements are making good progress, although some technical issues with the sensors are putting pressure on mission schedule reserves**



# Mission Data Products

- **NPP (and later the NPOESS Space Segment) will produce sensor data for processing by the NPOESS Interface Data Processing Segment (IDPS)**
- **The IDPS will produce Environmental Data Records (EDR's) of geophysical products in an operational environment while minimizing data latency**
- **NASA, NOAA, and other agencies will leverage the operational EDR's in performing climate research**
  - **ADS will archive the IDPS EDRs**
  - **SDS is intended to be a research tool in support of NASA's efforts**



# NPP Sensors Contribute 27 of 56 NPOESS Environmental Data Records (EDRs)

|   |                                  |   |                                   |
|---|----------------------------------|---|-----------------------------------|
| ★ | <b>Atm Vert Moist Profile</b>    | Cloud Top Pressure                          | Precipitable Water                |
| ★ | <b>Atm Vert Temp Profile</b>     | Cloud Top Temperature                       | Precipitation Type/Rate           |
| ★ | <b>Imagery</b>                   | Down LW Radiance (Sfc)                      | <b>Pressure (Surface/Profile)</b> |
| ★ | <b>Sea Surface Temperature</b>   | Down SW Radiance (Sfc)                      | <b>Sea Ice Characterization</b>   |
| ★ | <b>Sea Surface Winds</b>         | Electric Fields                             | Sea SFC Height/TOPO               |
| ★ | <b>Soil Moisture</b>             | Electron Density Profile                    | <b>Snow Cover/Depth</b>           |
|   | <b>Aerosol Optical Thickness</b> | Energetic Ions                              | Solar Irradiance                  |
|   | <b>Aerosol Particle Size</b>     | Geomagnetic Field                           | Supra-Therm-Aurora Prop           |
|   | Aerosol Refractive Index         | <b>Ice Surface Temperature</b>              | <b>Surface Type</b>               |
|   | <b>Albedo (Surface)</b>          | In-situ Plasma Fluctuation                  | <b>Active Fires</b>               |
|   | Auroral Boundary                 | In-situ Plasma Temp                         | Surface Wind Stress               |
|   | Auroral Energy Deposition        | Ionospheric Scintillation                   | <b>Suspended Matter</b>           |
|   | Auroral Imagery                  | Med Energy Chgd Parts                       | Total Water Content               |
|   | <b>Cloud Base Height</b>         | <b>Land Surface Temp</b>                    | <b>Vegetative Index</b>           |
|   | <b>Cloud Cover/Layers</b>        | <b>Net Heat Flux</b>                        |                                   |
|   | <b>Cloud Effective Part Size</b> | Net Solar Radiation (TOA)                   |                                   |
|   | Cloud Ice Water Path             | Neutral Density Profile                     |                                   |
|   | Cloud Liquid Water               | <b>Ocean Color/Chlorophyll</b>              |                                   |
|   | <b>Cloud Optical Thickness</b>   | Ocean Wave Character                        |                                   |
|   | Cloud Particle Size/Distrib      | Outgoing LW Rad (TOA)                       |                                   |
|   | <b>Cloud Top Height</b>          | <b>O<sup>3</sup> – Total Column Profile</b> |                                   |

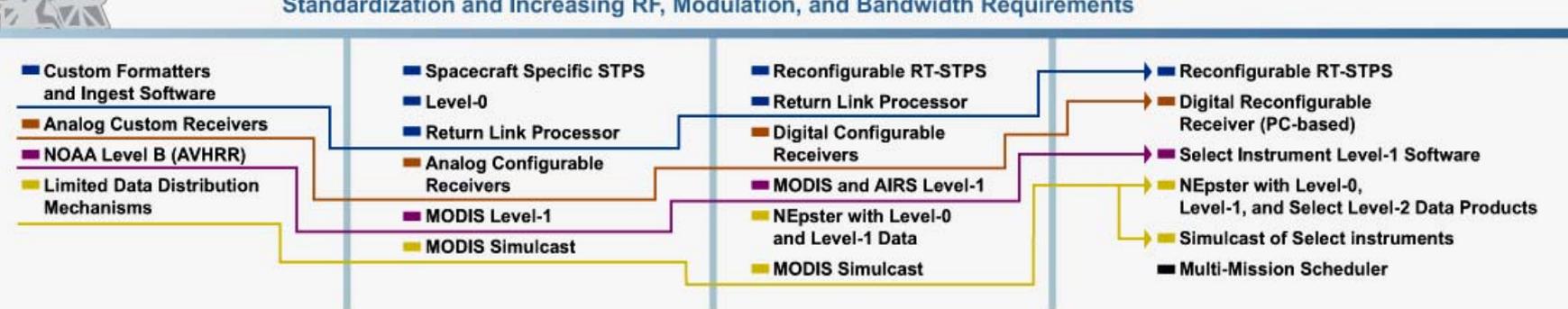
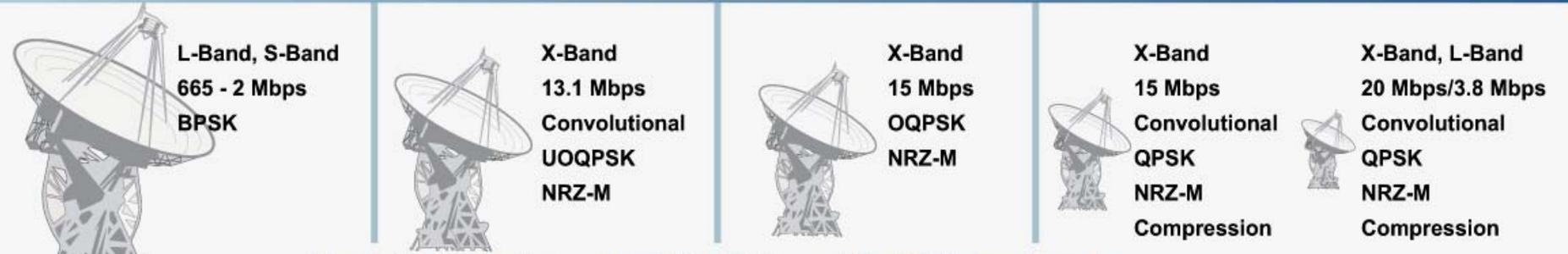
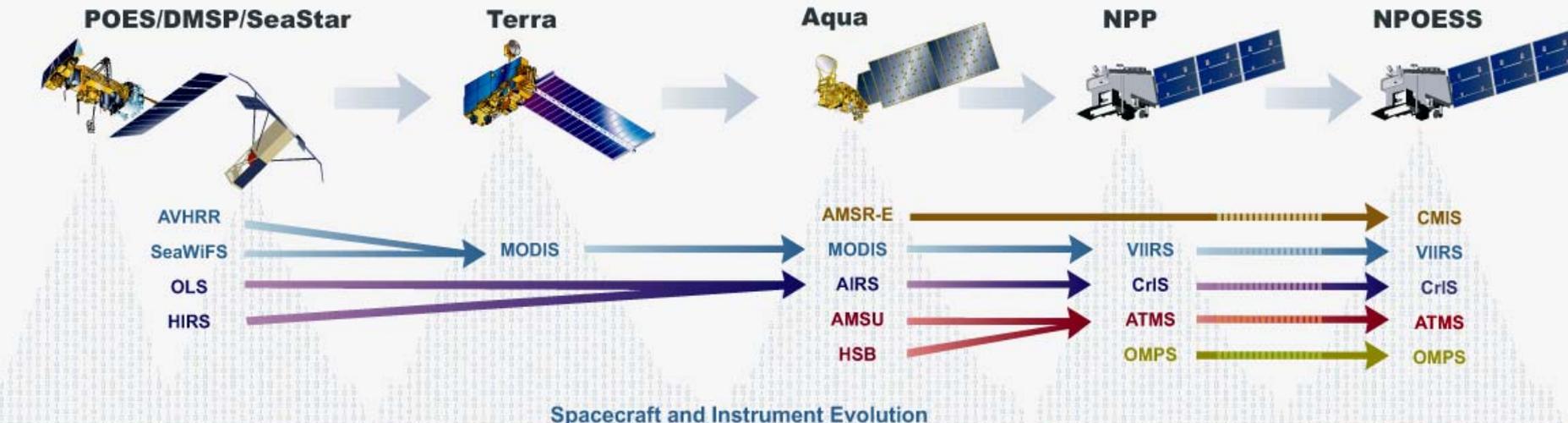
## LEGEND

|                      |           |
|----------------------|-----------|
| VIIRS (24)           | GPSOS (2) |
| CMIS (19)            | ERBS (5)  |
| <b>CrIS/ATMS (3)</b> | TSIS (1)  |
| <b>OMPS (1)</b>      | ALT (3)   |
| SES (13)             | APS (4)   |

★ - NPOESS Key Performance Parameters (KPPs)

NPP EDRs IN BLACK FONT

# Ensuring Direct Broadcast Continuity



Evolution of Concurrent Ground Systems Supporting Technologies and Algorithm Development



# Risk Reduction & Mitigation

- **For NPP, the NASA Direct Readout Laboratory (DRL) provides risk reduction and a roadmap for the NPOESS IDPS system in the Field Terminal Segment (FTS).**
- **The DRL has been, and will continue to do this by providing NPP packet processing and Level-0 algorithms, real-time NPP-specific visualization tools, lessons learned and an environment for testing and validating the FTS processing system.**



# DRL DB User Model – The NPP Example

## Internal Mission Team

### NPP MISSION

- Protocol/Data Interface Compatibility
- Spacecraft I&T for Direct Broadcast
- Direct Broadcast Level-0 and Level-1 Algorithms and Verification
- Working Group Meetings
- System Meetings
- Science Team Meetings

Report the State of the Community

### NISGS

Provide a Roadmap to Future Technology

## External Direct Broadcast Community

- Frequently Asked Questions
- Email
- Technology Transfer
- Technology Enabling
- Public Release Software
- Web Portal Feedback
- Open-door Policy
- Demonstrations
- Presentations
- Conferences

**R&D Organizations**

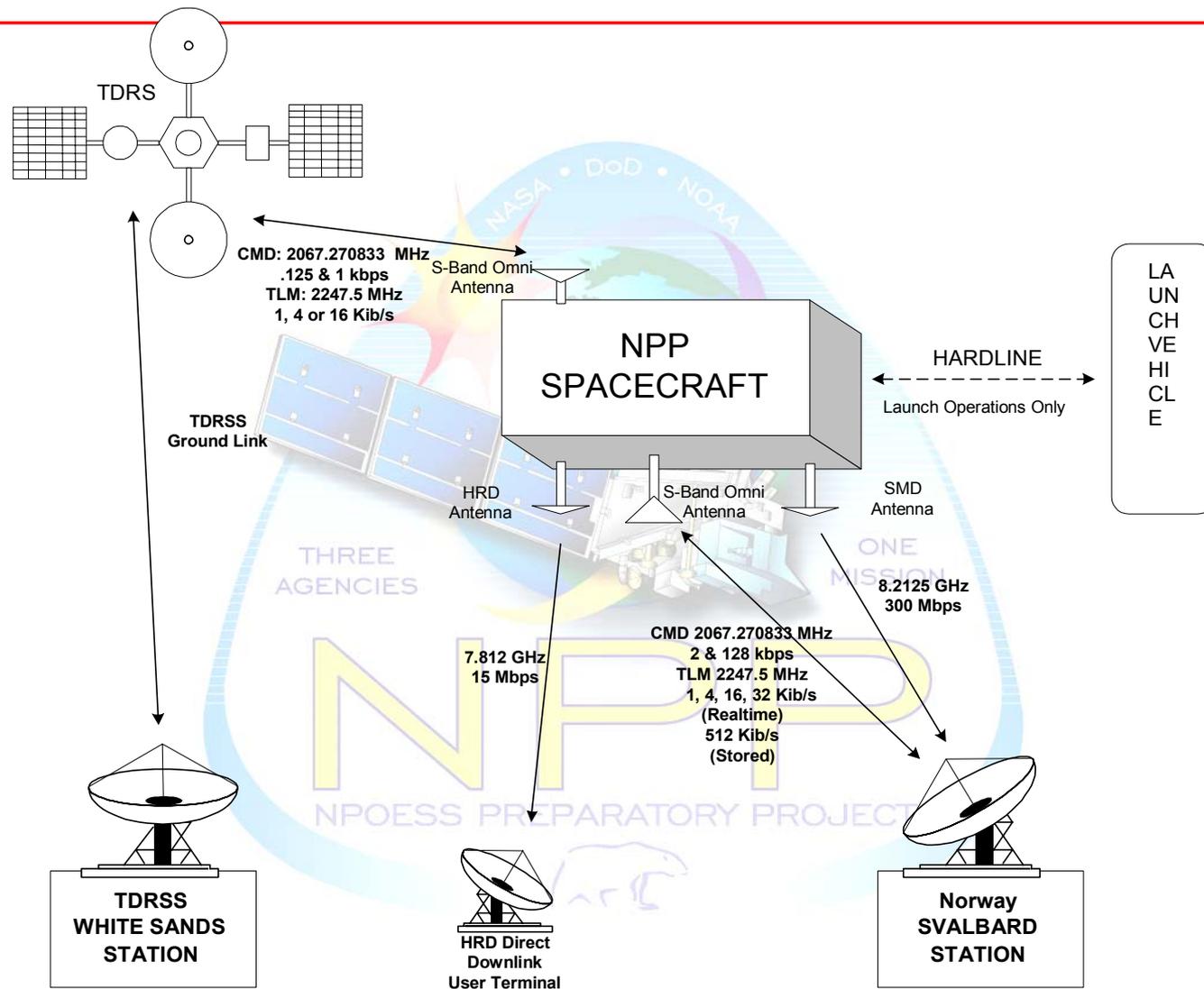
**General Public**

**Commercial Sector**

**Other Government Agencies**



# NPP's Communications





# Summary

- **NPP meeting requirements for EOS Bridge Mission and NPOESS Risk Reduction.**
- **NPP and NPOESS to benefit from close collaboration with NASA and the DRL.**
- **Developing plans to send out a “Future Polar User” survey to Latin American and Caribbean countries that are interested in acquiring NPP/NPOESS direct broadcast data.**
  - **Purpose: To better understand specific localized data needs and uses.**