Landsat 5, LDCM, NPOESS

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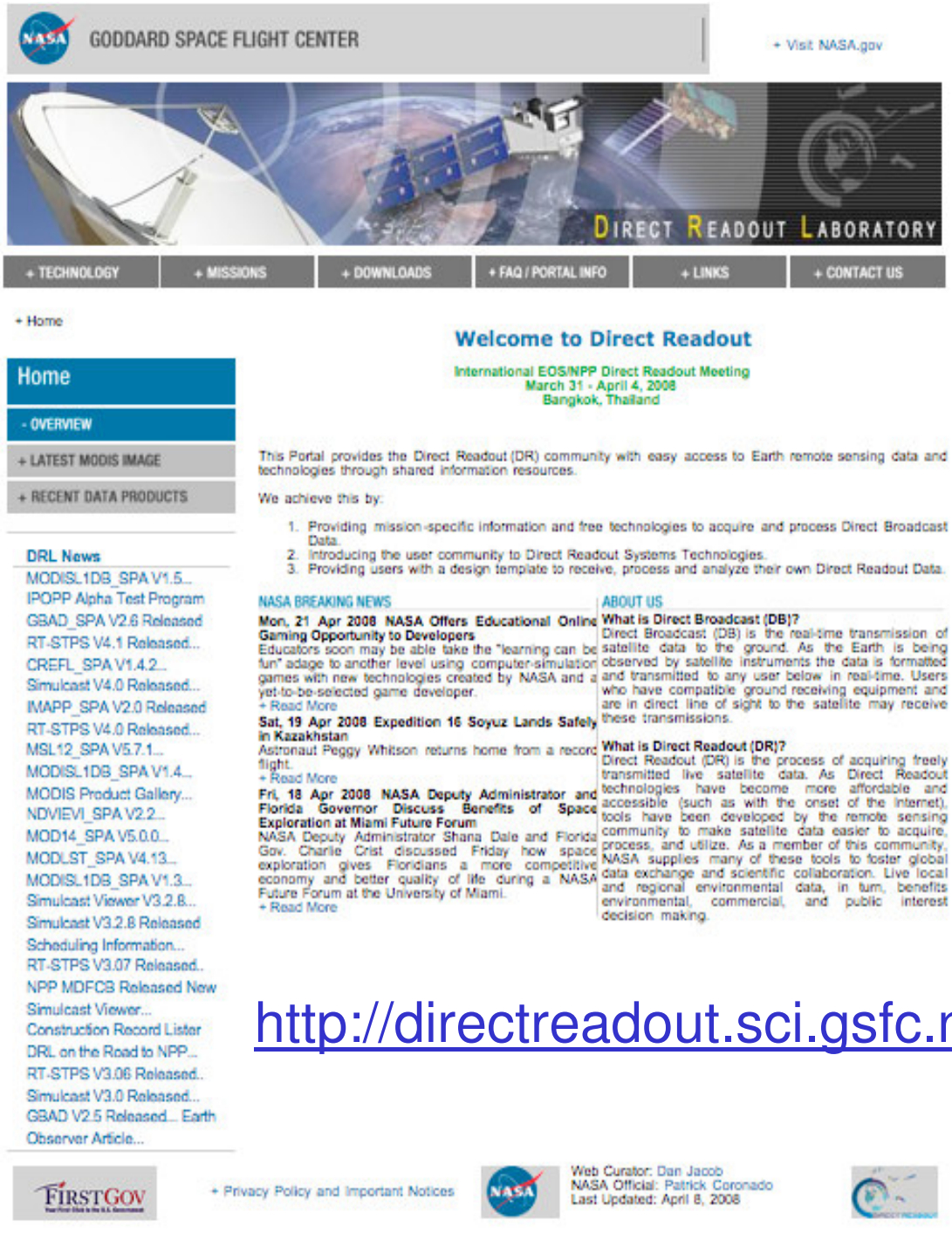
1. MODIS/NPOESS Direct Readout and Direct Readout Web Portal
2. Landsat Data Continuity Mission(LDCM) status



http://directreadout.sci.gsfc.nasa.gov

DIRECT READOUT PROGRAM ROADMAP

AVHRR
SeaWiFS
OLS
HIRS
SSM/I, SSMIS, SSM/T, SSM/T-2

MODIS

MODIS
AIRS
AMSU
HSB
AMSR-E

VIIRS
CrIS
ATMS
OMPS
CMIS
(NPOESS Only)

Spacecraft and Instrument Evolution

L-Band, S-Band
665 - 2 Mbps
BPSK

X-Band
13.1 Mbps
Convolutional
UOQPSK
NRZ-M

X-Band
15 Mbps
OQPSK
NRZ-M

X-Band • X-Band, L-Band
15 Mbps • 20, 3.8 Mbps
Convolutional
QPSK • OQPSK
NRZ-M
Compression

Standardization and Increasing RF, Modulation, and Bandwidth Requirements

- Custom Formatters and Ingest Software
- Analog Custom Receivers
- NOAA Level B (AVHRR)
- Limited Data Distribution Mechanisms

- Spacecraft Specific STPS
- Level-0
- Return Link Processor
- Analog Configurable Receivers
- MODIS Level-1
- MODIS Simulcast

- Reconfigurable RT-STPS
- Return Link Processor
- Digital Configurable Receivers
- MODIS and AIRS Level-1
- NEpster with Level-0 and Level-1 Data
- MODIS Simulcast

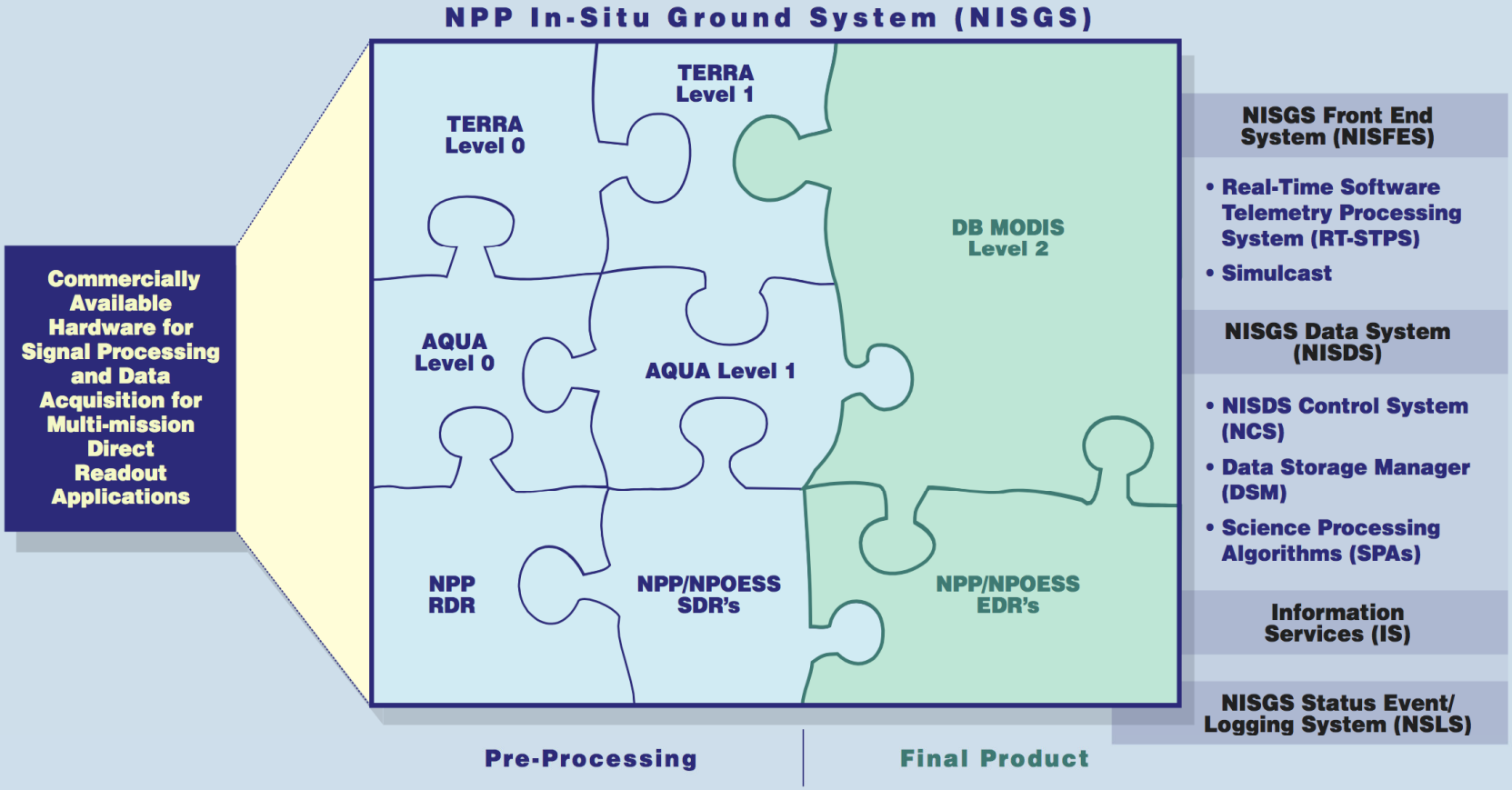
- User Reconfigurable RT-STPS
- Multi-Mission Digital Receiver
- Instrument SDR Software and Select EDR Algorithms
- NEpster with RDR, SDR, and EDR Data Products
- Simulcast of Select Instruments
- Multi-Mission Scheduler and Controller
- Science Processing Algorithm Wrapper
- Real-time Data Management and Processing Tools
- HDF to GIS Data Transport Tools

Evolution of Concurrent Ground Systems Supporting Technologies and Algorithm Development

DIRECT READOUT

National Aeronautics and Space Administration

Modular Components Approach for *Real-Time* Data System Implementation

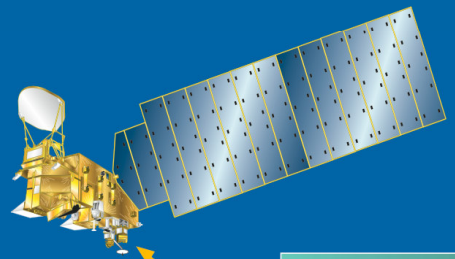


NPOESS Preparatory Project
http://jointmission.gsfc.nasa.gov

DIRECT READOUT

National Aeronautics and Space Administration

International Polar Orbiter Processing Package (IPOPP) Elements for Terra, Aqua, and NPP



IPOPP is the primary processing package that will enable the Direct Broadcast (DB) community to process, visualize, and evaluate NPP Sensor and Environmental Data Records–which is a necessity for the DB community during the transition from the Earth Observing System Era to the NPOESS Era.

L1A/RDRs
- Protocol Processing
- Raw Data
- Formatting

HDFEOS / HDF-5

L1B/SDRs
- MODIS
- AIRS
- VIIRS
- CrIS
- ATMS
- OMPS
- Geo Cal

HDFEOS / HDF-5

Utilities
- GIS
- H_2G
- Analysis
- Visualization
- Ancillary Data

Cal/Val
- Field Campaign
- SDR Intercomparison
- EDR Intercomparison
- SDR/EDR Validation

L2/L3/EDRs

Atmosphere
- AVMP
- AVTP
- AVPP
- Sus Matt
- AOT
- APSP
- CBH
- CC/L
- CEPS
- COT
- CTH/CTP/CTT
- O3 Profile
- O3 Column
- Imagery*

Land
- Active Fires
- Surf Albedo
- LST
- Surface Type
- Vegetation Index
- Snow Cover/Depth
- Imagery*

Water
- SST
- OCC
- NHF
- Sea Ice Char
- IST

Space

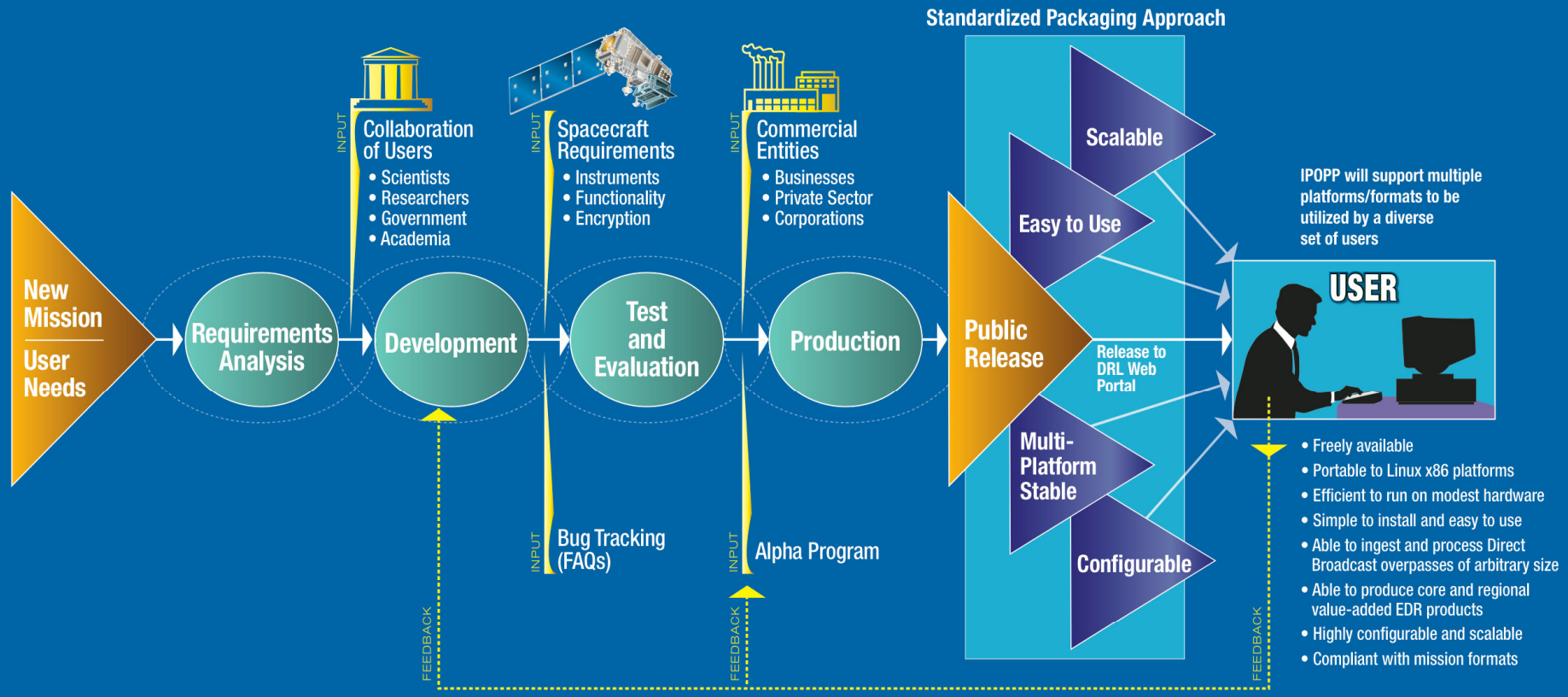
Future NPOESS Era

Information Services - System, Science, Application, Education, and Training

National Aeronautics and Space Administration

International Polar Orbiter Processing Package (IPOPP) Development Process:

An Approach Driven By User Needs



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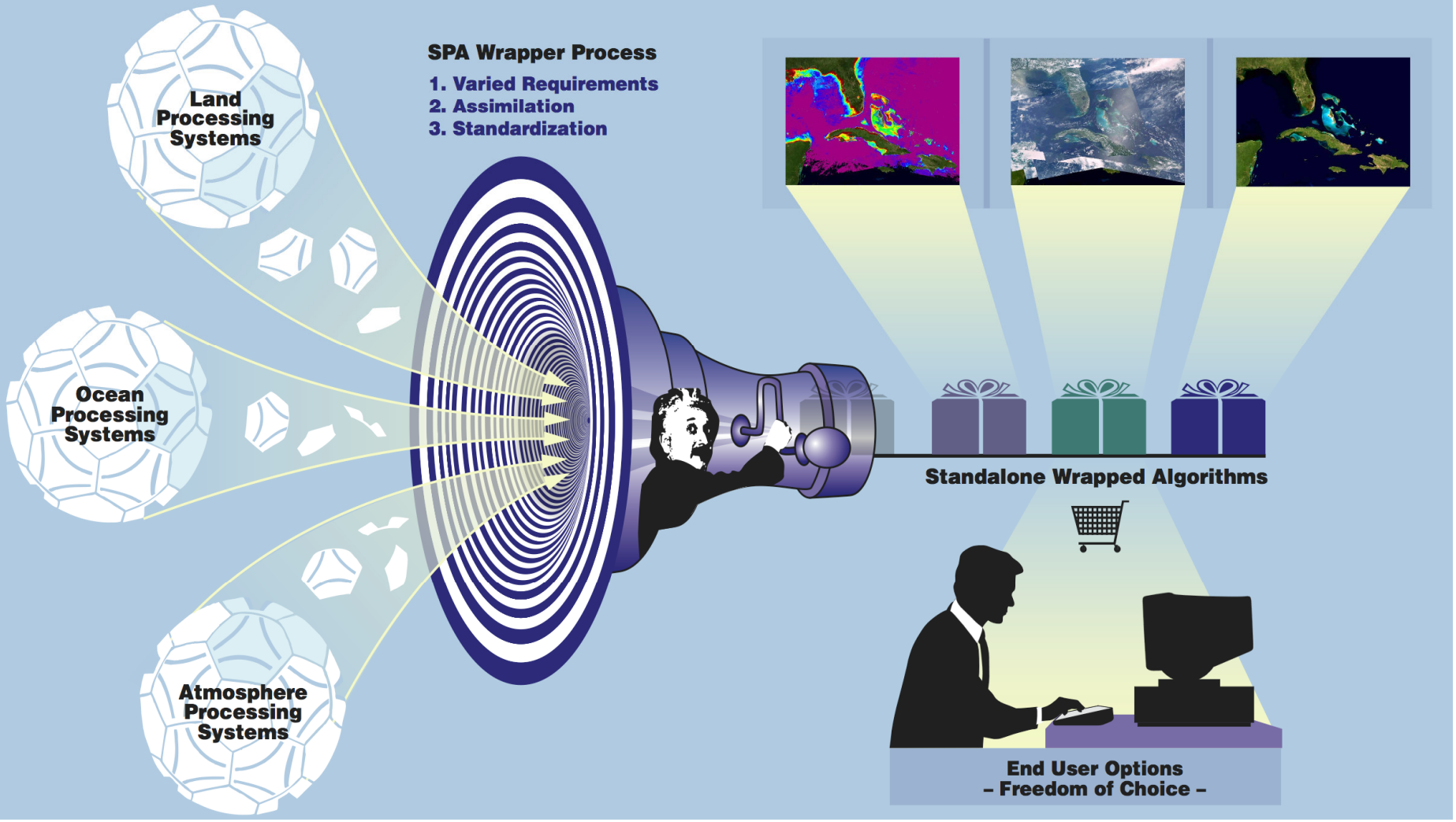
Science Processing Algorithm (SPA) Wrapper



http://directreadout.sci.gsfc.nasa.gov

ALPHA PROGRAM -SCIENCE PROCESSING ALGORITHMS (SPAs) (overview)

The DRL supplies Alpha testers with the following SPAs:

1. MODISL1DB (Ocean Biology Processing Group)
2. Aqua Ground Based Ephemeris and Attitude Data (GBAD) Converter (DRL)
3. Fire Mask (MODIS Land Rapid Response Team)
4. Vegetation Index (Normalized Vegetation Index [NDVI] and Enhanced Vegetation Index [EVI]) (MODIS Land Rapid Response Team)
5. Sea Surface Temperature (SST) (SeaDAS)
6. Chlorophyll-a Concentration (SeaDAS)
7. Cloud mask (IMAPP)
8. Aerosol (IMAPP)
9. Cloud top Properties and Cloud Phase (IMAPP)
10. Atmospheric Profiles (IMAPP)
11. Land Surface Temperature (LST) (MODIS Land Rapid Response Team)
12. Corrected Reflectance (CREFL) (MODIS Land Rapid Response Team)

ALPHA PROGRAM - TECHNOLOGIES (overview)

The DRL supplies Alpha testers following NISGS technologies:

1. Real-time Software Telemetry Processing System (RT-STPS)
2. Simulcast
3. Hierarchical Data Format (HDF) to Georeferenced Tagged Image File Format (GEOTIFF) (H2G) Converter
4. Data Storage Manager (DSM)
5. NISGS Data System (NISDS) Control System (NCS)
6. NISGS Status/Event Logging System (NSLS)
7. Information Services (IS)

Landsat Data Continuity Mission Status

Status, March 31, 2008

NASA / USGS Interagency Partnership

LDCM

- NASA Associate Administrator Alan Stern and the USGS Associate Director of Geography, Barbara Ryan, signed Final Implementation Agreement in April 2007
- NASA Shall
  - Lead, fund, and manage development of Space Segment and Launch Segment
  - Procure on a reimbursable basis the Mission Operations Element (MOE)
  - Lead the LDCM development as the system integrator for all mission segments throughout development, on-orbit checkout, and acceptance
  - Lead, fund, and manage the LDCM pre-launch calibration, validation, and characterization of LDCM data through on-orbit check out
  - Transfer the Space Segment and MOE contracts to USGS following on-orbit acceptance
  - Provide a co-chair for the Landsat Science Team
- USGS shall
  - Lead, fund, and manage development of the Ground System (excluding the MOE) including flight operations and ground data processing
  - Accept the LDCM Space Segment and MOE contracts following on-orbit acceptance
  - Lead, fund, and manage on-orbit performance evaluation of the LDCM system and calibration, validation, and characterization of the LDCM data following on-orbit acceptance
  - Lead, fund, and manage the Landsat Science Team

LDCM Milestones

- **Operational Land Imager (OLI) awarded to Ball Aerospace Technology Corporation (BATC), Boulder, CO on July 16, 2007**
  - **RFP released Jan. 09, 2007**
  - **Cost-plus-award-fee contract, including all options, is for $127.9million**
  - **OLI Instrument Preliminary Design Review held March 03-07 at BATC**
- **Atlas V launch vehicle selected Oct. 03, 2007**
- **Ground System Requirements Review held at USGS EROS on Sept. 26 - 27**
- **Spacecraft Request for Offer (RFO) released Dec. 07, 2007 via RSDO**
  - **Contract award expected by no later than May 01**
- **Mission Operations Element (MOE) RFP released Feb. 28**
  - **Contract award expected in June**

OLI Specifications

Table 1. Required Spectral Bands and Spatial Resolution

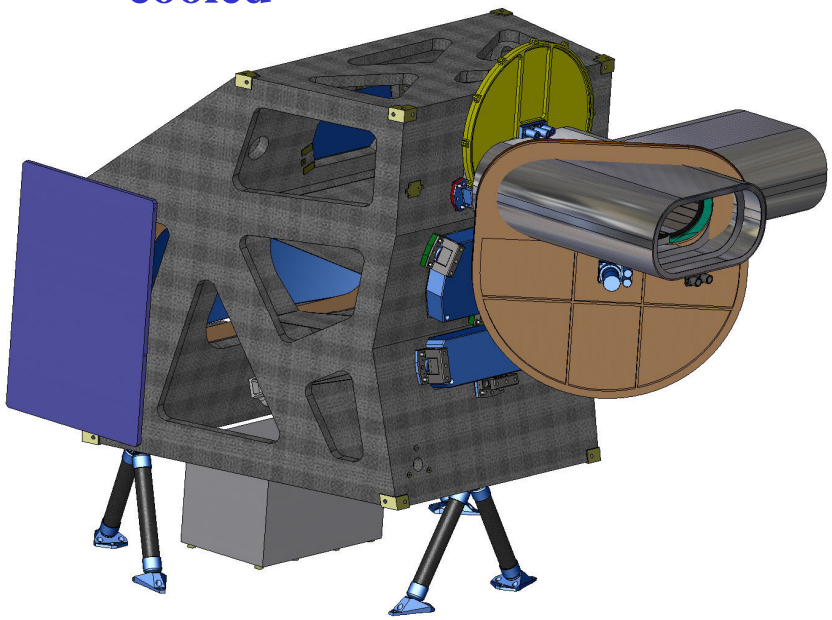
#	Band	Minimum Lower Band Edge (nm)	Maximum Upper Band Edge (nm)	Center Wavelength (nm)	Maximum Spatial Resolution At Nadir (m)
1*	Coastal /Aerosol	433	453	443	30
2	Blue	450	515	482	30
3	Green	525	600	562	30
4	Red	630	680	655	30
5	NIR	845	885	865	30
6	SWIR 1	1560	1660	1610	30
7	SWIR 2	2100	2300	2200	30
8	Panchromatic	500	680	590	15
9*	Cirrus	1360	1390	1375	30

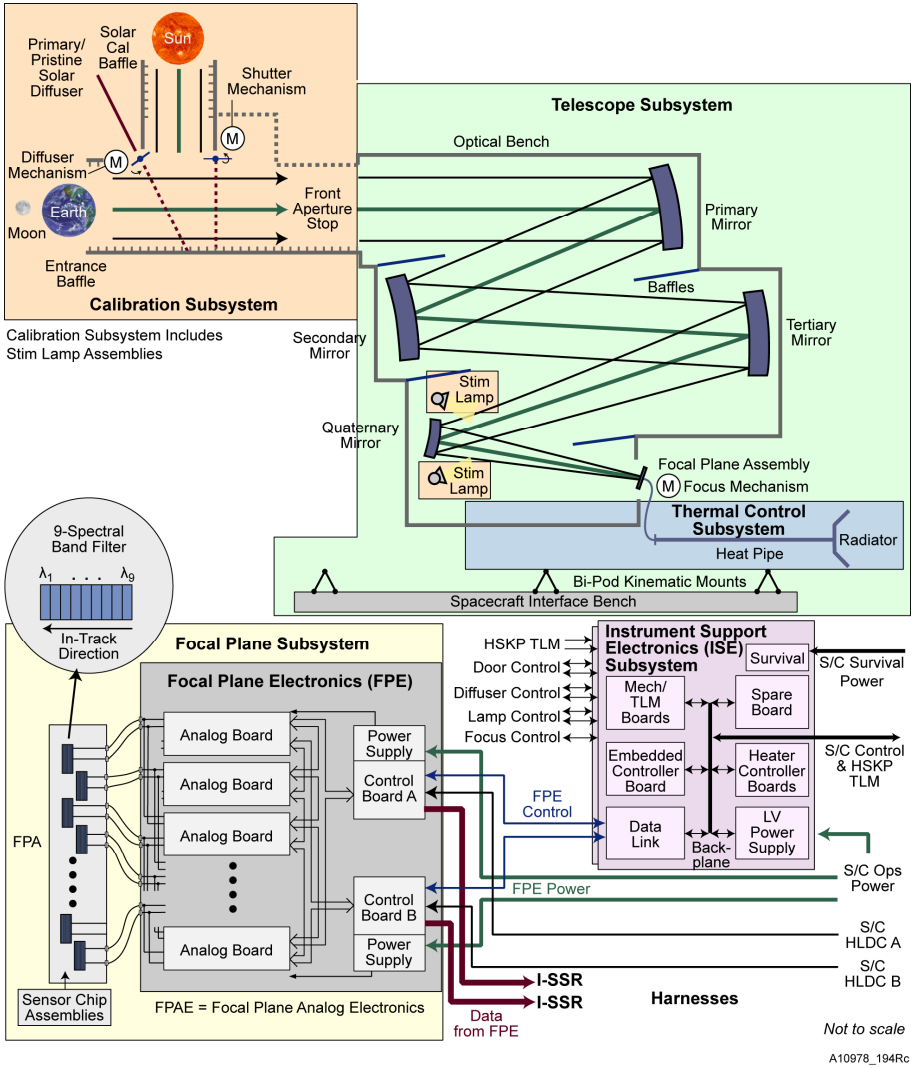
***New bands relative to TM and ETM+ sensors aboard Landsats 4, 5, & 7**

Baseline Design and Descriptive Block Diagram

LDCM

- Pushbroom VIS/SWIR sensor
- Four mirror telescope with front aperture stop
- FPA consisting of 14 sensor chip assemblies, passively cooled





Landsat Science Team

- **USGS convened the first meeting of the USGS-sponsored science team for Jan. 09 - 11, 2007 at USGS EROS in Sioux Falls, SD**
  - **Co-chaired by the USGS Landsat Project Scientist, Tom Loveland, and the NASA LDCM Project Scientist, Jim Irons**
  - **USGS selected 17 science team members in Oct.**
    - 8 PI's from academia and private industry
    - 6 civil servant PI's and 3 international PI's
  - **Team selected Curtis Woodcock, Boston U., as Team Leader**

- **Second meeting held June 12 - 14, 2007 in Corvallis, OR**

- **Third meeting held Jan. 08 - 10, 2008 at USGS EROS**

Future Planning

- National Science and Technology Council (NSTC) Future of Land Imaging - Interagency Working Group (FLI-IWG) have proposed a National Land Imaging Program (NLIP) within Dept. of Interior
  - $2M FY09 funding in President's budget
- International Group on Earth Observations (GEO) and the Global Earth Observing System of Systems (GEOSS)
  - Committee on Earth Observation Satellites (CEOS) and the Land Surface Imaging Constellation
- National Research Council Decadal Survey: Earth Science and Applications from Space: A Community Assessment and Strategy for the Future.

The LDCM needs to serve as a foundation upon which future land imaging systems can be built

Target Launch Date

LDCM

Launch - July, 2011

Operational - March, 2012