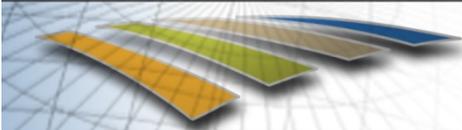




Landsat Data Continuity Mission (LDCM) USGS Project Status Report

January 20, 2010

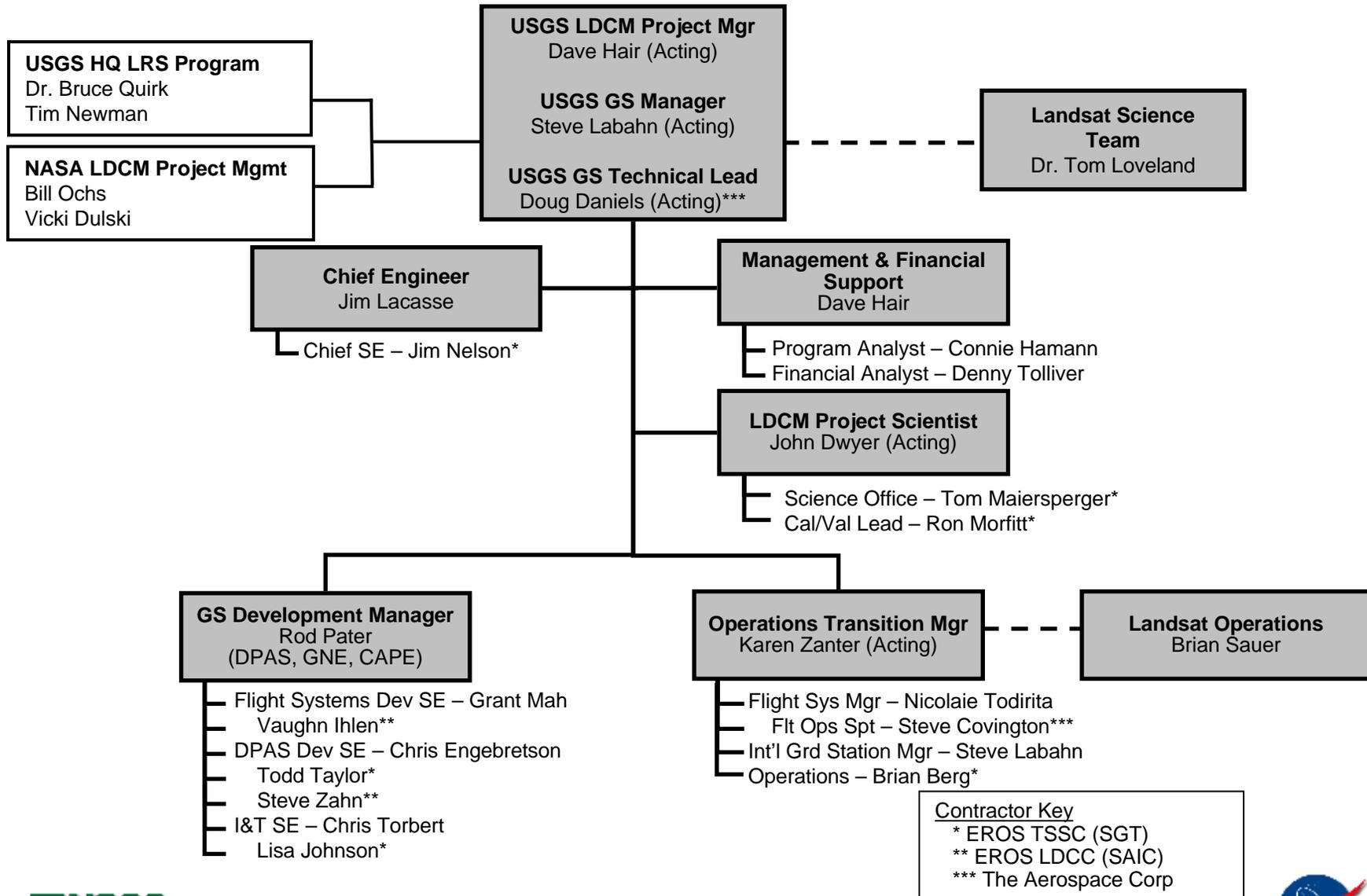
Dave Hair
USGS LDCM Project Manager
hair@usgs.gov

 Topics**LDCM**

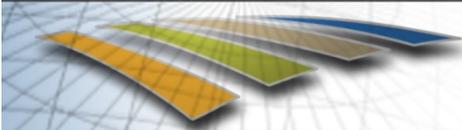
- ◆ USGS LDCM Project Team Update
- ◆ Current Status Highlights
- ◆ Ground System Reviews
- ◆ Schedule & Ground System Builds
- ◆ TIRS Development Strategy Update
- ◆ Algorithm Status
- ◆ Summary

USGS LDCM Project Organization

LDCM



Contractor Key
 * EROS TSSC (SGT)
 ** EROS LDCC (SAIC)
 *** The Aerospace Corp



Current Status Highlights

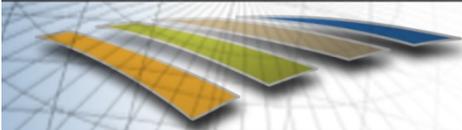
LDCM

- ◆ The Data Processing and Archive System (DPAS) architecture was modified to reuse, to the greatest extent possible, the existing Landsat Operations system
- ◆ The DPAS Preliminary Design Review (PDR) was completed in September 2009 and received zero Requests for Action (RFA)
- ◆ The Ground System PDR was completed in September 2009 and received six Advisories and zero RFA's
- ◆ The first delivery of the Collection Activity Planning Element (CAPE 1.0) accomplished its Pre-Ship Review in January 2010
 - ◆ This release of the CAPE addresses the majority of functionality associated with scheduling science data acquisitions via implementation of the Long Term Acquisition Plan (LTAP)

Current Status Highlights (cont'd.)

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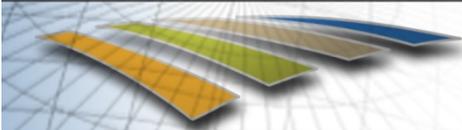
- ◆ The LDCM Ground System is approaching two major milestones pertaining directly to achieving LDCM Science Data Processing objectives
 - ◆ The Data Processing and Archive System (DPAS) Critical Design Review (CDR)
 - Critical design associated with functionality and performance requirements for all aspects of DPAS including science data ingest, storage and archive, Level 1 production, user portal (interface), and image assessment will be presented to an independent panel of experts
 - February 22-23, 2010 in Sioux Falls
 - ◆ The Ground System CDR
 - Critical design associated with functionality and performance requirements for all aspects of the Ground System including mission operations, ground networks, science data collection and activity planning, and DPAS will be presented to an independent panel of experts
 - Additional key items of information include continuous risk management, systems engineering, integration and test, networks, IT security, and facilities planning
 - Several milestones precede this review including: trade studies, multiple subsystem and element engineering peer reviews and critical design reviews, OLI and TIRS algorithm deliveries, and element build definition and mapping to integration and test activities
 - March 16-17, 2010 in Sioux Falls

A graphic showing several overlapping, curved bands of color (yellow, green, blue) representing satellite data or orbits, set against a grid background.

Current Status Highlights (cont'd.)

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- ◆ Following Ground System CDR, the Team will participate in a Mission CDR this Spring and a Mission Operations Review this Fall
- ◆ Ground Readiness Testing begins in the Summer of 2010 and concludes with final DPAS readiness testing in the Summer of 2012



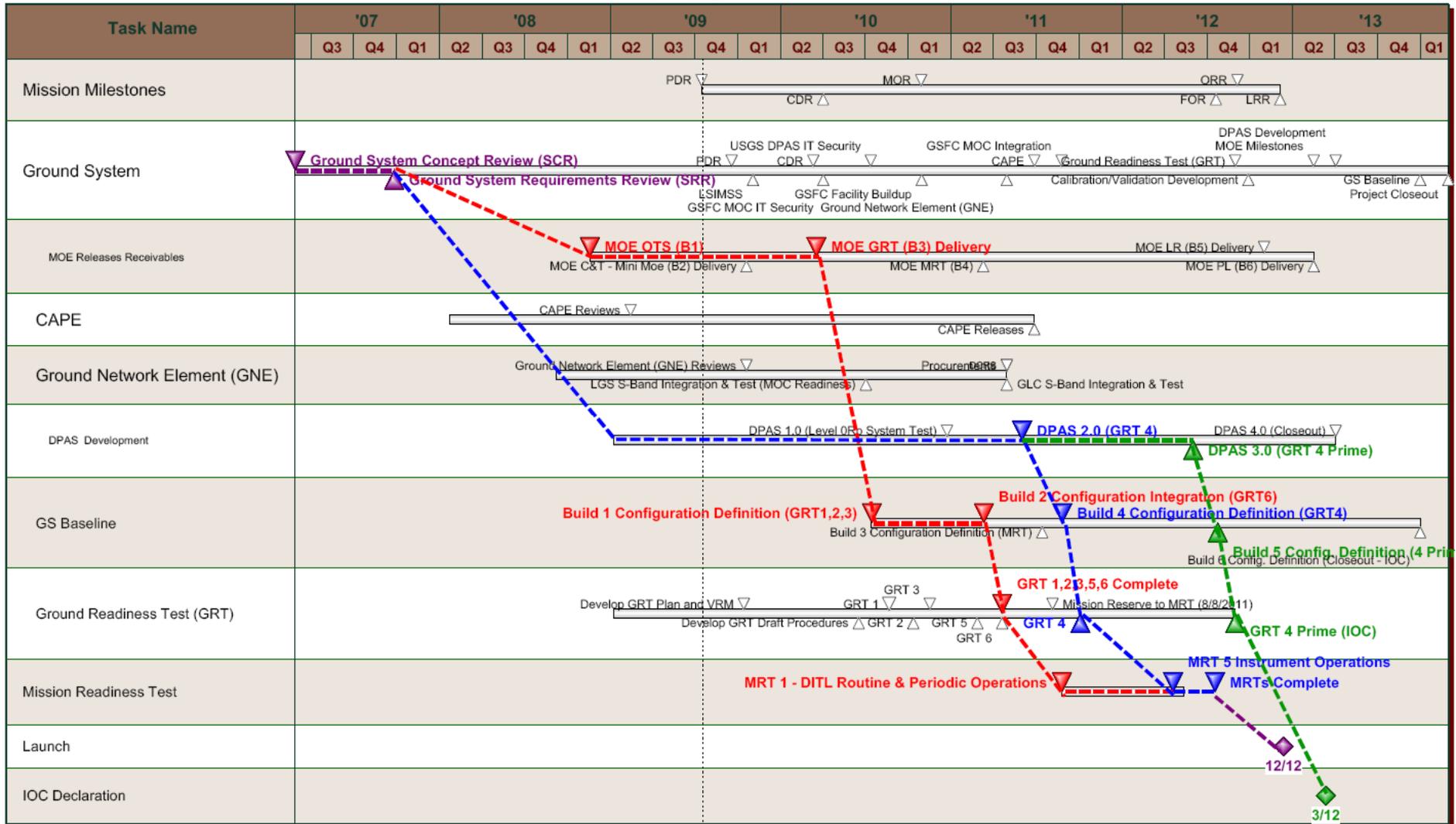
Ground System Reviews

LDCM

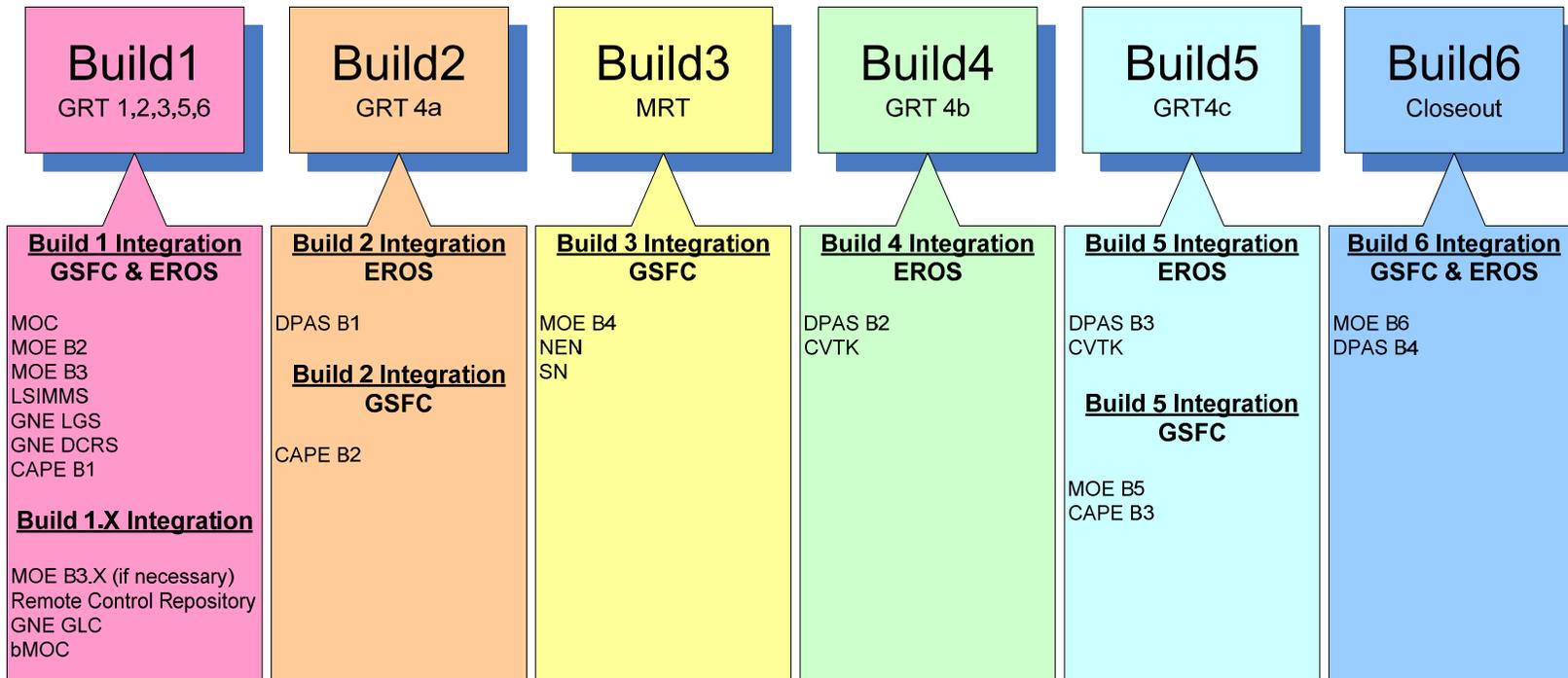
Critical Design Reviews (CDRs)	Date
Collection Activity Planning Element (CAPE)	✓ Jan 2009
Mission Operations Element (MOE)	✓ Nov 2009
Ground Network Element (GNE)	Feb 2010
Data Processing and Archive System (DPAS)	Feb 2010
Ground System (GS)	Mar 2010

Test Readiness Reviews (TRRs)	Date
Collection Activity Planning Element (CAPE)	✓ Dec 2009
Ground Readiness Test 1 (GRT 1)	Jul 2010
Ground Readiness Test 2 (GRT 2)	Sep 2010
Ground Readiness Test 3 (GRT 3)	Oct 2010
Ground Readiness Test 5 (GRT 5)	Jan 2011
Ground Readiness Test 6 (GRT 6)	Mar 2011
Ground Readiness Test 4 (GRT 4)	Aug 2011
Ground Readiness Test 4' (GRT 4')	Jul 2012

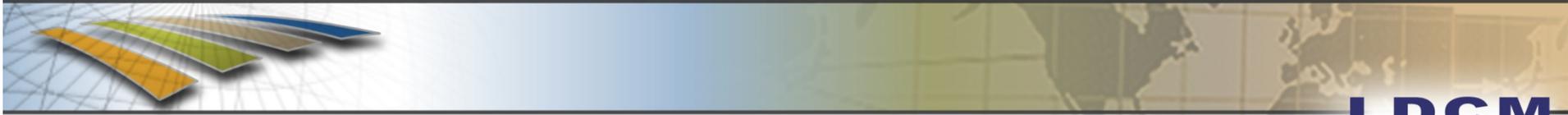
Schedule & Critical Path



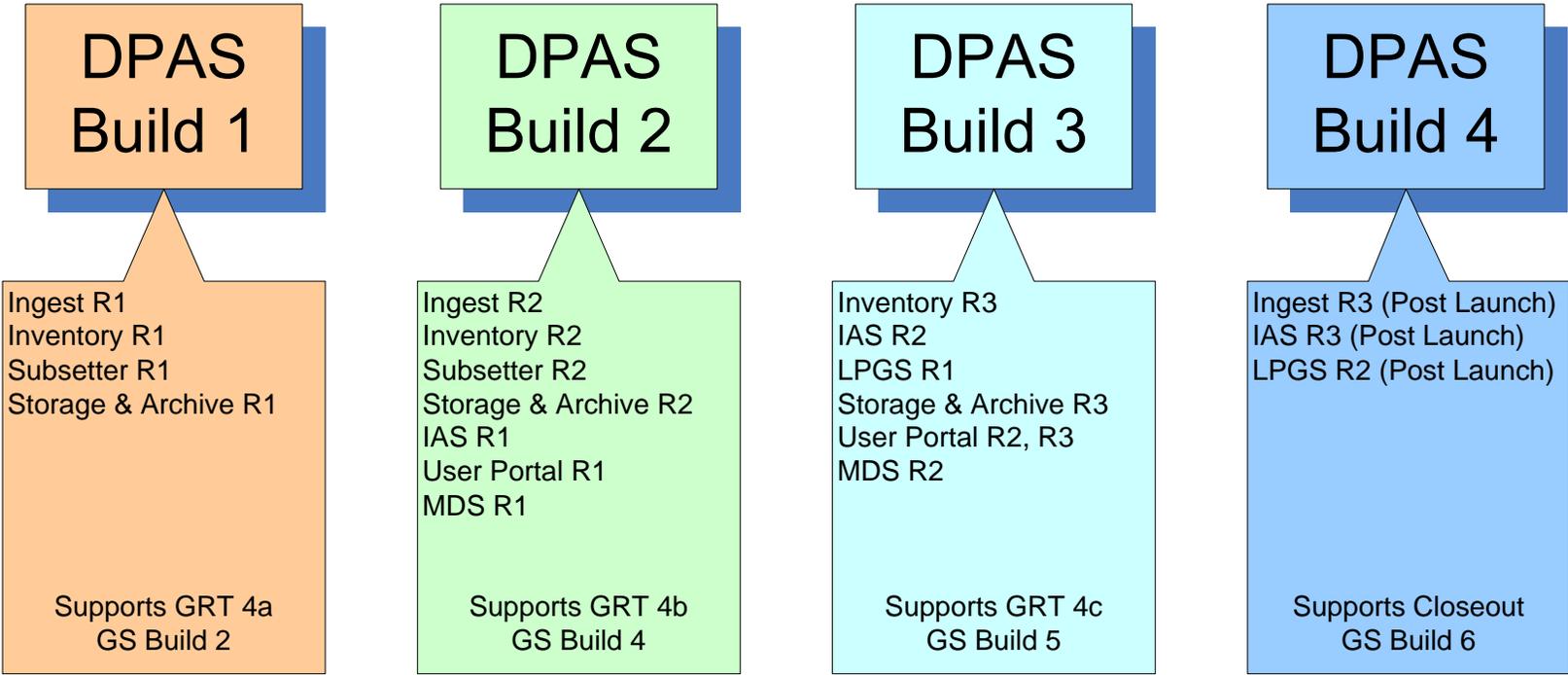
LDCM Ground System Build Sequence & Scope

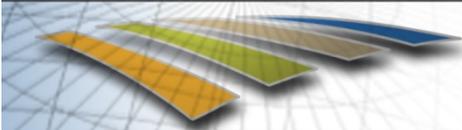


Key:
 Build = Mechanism for configuring Ground System functionality available for test and operations. Also known as Build Configuration Definition.
 GRT = Ground Readiness Test
 B = Build (ex. B2)
 R = Release (ex. R3)



DPAS Build Sequence & Scope





Ground System Schedule

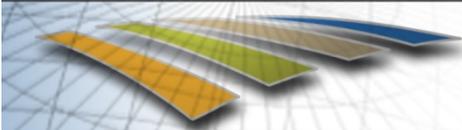
LDCM

- ◆ Key Schedule Reserve Metrics (working days) – Availability for Integration

- ◆ Launch Critical Functionality
 - ◆ MOE Build 3 – 20 days to MOC integration (required for GRT 1)
 - ◆ CAPE R1 – 16 days to MOC integration (required for GRT 2)
 - ◆ GNE LGS – 155 days to MOC integration (required for GRT 1)
 - ◆ GNE GLC – 246 days to MOC integration (required for GRT 5)
 - ◆ GNE Demod – 212 days to GNE integration (required for GRT 6)
 - Will change approximately 110 days if aligned to GRT 2
 - ◆ GNE DCRS – 158 days to GNE integration (required for GRT 6)
 - Will change to approximately 65 days if aligned to GRT 2

- ◆ OIV Functionality
 - ◆ Ingest R2 – 16 days to DPAS integration (required for GRT 4)
 - ◆ Subsetter R2 – 17 days to DPAS integration (required for GRT 4)
 - ◆ Storage & Archive R2 – 30 days to DPAS integration (required for GRT 4)
 - ◆ IAS R2 – 11 days to DPAS integration (required for GRT 4)

- ◆ IOC Functionality
 - ◆ LPGS R1 – 40 days to DPAS integration (required for GRT 4 Prime)
 - ◆ UP R3 – 75 days to DPAS integration (required for GRT 4 Prime)

 TIRS Development Strategy Update**LDCM**

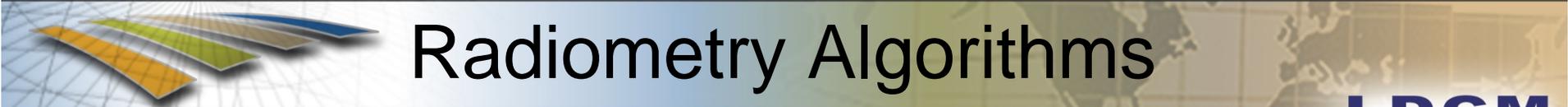
- ◆ USGS evaluated alternatives that would enable us to proceed, while not yet funded to support TIRS
- ◆ We chose a strategy that would minimize risk to the LDCM Mission
- ◆ Modified the Final Implementation Agreement (FIA) with NASA
- ◆ Ground System/DPAS architecture changes implemented last spring, enabled USGS to initiate support for the TIRS instrument within the current budget profile
- ◆ LDCM implemented Landsat Data Continuity Contract (LDCC) and Technical Support Services Contract (TSSC) modifications to support TIRS requirements
- ◆ Contractors have augmented staff to support TIRS
- ◆ Phase 2 OLI and TIRS algorithms have been delivered to enable DPAS design
- ◆ Phase 3 OLI and TIRS algorithms are being delivered incrementally for DPAS development, paced by instrument development, algorithm maturity, and available test data
- ◆ Full support for TIRS, through launch and initial operations, requires additional funding
- ◆ Continue to work on funding for FY'11 through launch



Geometry Algorithms

LDCM

Algorithm Name	Status	Instrument	Subsystem	Phase 3 Delivery
Ground Control Point Correlation/Mensuration		TIRS	LPGS/IAS	
Redundant Detector Row Replacement		TIRS	LPGS/IAS	
Off-Nadir Scene Framing		both	IS	
Lunar Precision		OLI	CVTK	
Ground Control Point Correlation/Mensuration	delivered	OLI	LPGS/IAS	11/30/09
Terrain Occlusion	delivered	OLI	LPGS/IAS	12/30/09
Geodetic Accuracy Assessment (L1Gs)		OLI	IAS	01/29/10
Resampling	delivered	OLI	LPGS/IAS	02/26/10
Geometric Accuracy Assessment (L1T)	delivered	OLI	IAS	03/31/10
Image Registration Accuracy Assessment		OLI	IAS	03/31/10
Band Registration Accuracy Assessment		OLI	IAS	03/31/10
Line of Sight Model Creation		OLI	LPGS/IAS	04/30/10
Band Alignment Calibration		OLI	IAS	04/30/10
Resampling		TIRS	LPGS/IAS	05/07/10
Focal Plane Alignment Calibration		OLI	IAS	05/31/10
Line of Sight Projection Ellipsoid & Terrain		OLI	LPGS/IAS	06/30/10
Line of Sight Model Creation		TIRS	LPGS/IAS	07/09/10
Line of Sight Model Correction		both	LPGS/IAS	07/30/10
Line of Sight Projection Ellipsoid & Terrain		TIRS	LPGS/IAS	08/06/10
Ancillary Data Preprocessing		both	LPGS/IAS	08/31/10
Band Registration Accuracy Assessment		TIRS	IAS	09/10/10
TIRS Band Alignment Calibration		TIRS	IAS	09/10/10
Sensor Alignment Calibration		OLI	IAS	09/30/10
TIRS Alignment Calibration		TIRS	IAS	11/05/10
MTF Lunar Characterization		OLI	CVTK	11/30/10
MTF Bridge Characterization		OLI	CVTK	11/30/10



Radiometry Algorithms

LDCM

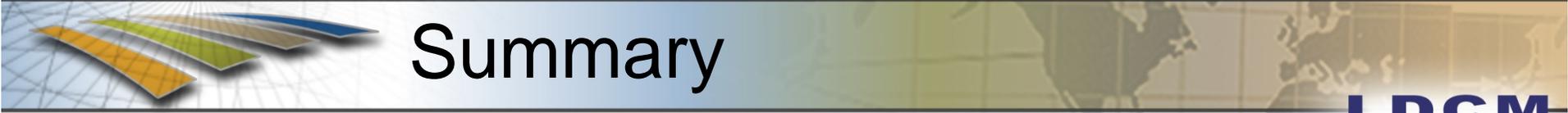
Algorithm Name	Status	Instrument	Subsystem	Phase 3 Delivery
Temperature Conversion		TIRS	CVTK	
Cloud Cover Assessment - temporal		independent	LPGS/IAS	
Cloud Cover Assessment - Parallax		independent	LPGS/IAS	
Relative Gain Characterization (90-degree Yaw)		TIRS	CVTK	
Stray Light Characterization		TIRS	CVTK	
Contamination Characterization		TIRS	CVTK	
Contamination Correction		TIRS	CVTK	
Nonlinear Response Characterization		TIRS	CVTK	
Dropped Frame Characterization	delivered	both	LPGS/IAS	04/30/09
Cloud Cover Assessment - control	delivered	independent	LPGS/IAS	07/31/09
Cloud Cover Assessment - AT-ACCA	delivered	independent	LPGS/IAS	07/31/09
Cloud Cover Assessment - See5	delivered	independent	LPGS/IAS	07/31/09
Non-uniformity Characterization	delivered	both	IAS	09/01/09
Temperature Sensitivity Correction	delivered	both	LPGS/IAS	09/01/09
Impulse Noise Characterization	delivered	both	LPGS/IAS	09/01/09
L1R SCA Stitching	delivered	both	IAS	09/29/09
Gain Application	delivered	both	LPGS/IAS	09/30/09
Histogram Statistics Characterization	delivered	both	LPGS/IAS	09/30/09
Detector Response Characterization (Solar Diffuser)	delivered	OLI	IAS	10/30/09
Saturated Pixel Characterization	delivered	both	LPGS/IAS	11/06/09
SCA Overlap Statistics Characterization	delivered	both	LPGS/IAS	11/06/09
Reflectance Conversion	delivered	OLI	LPGS/IAS	11/30/09
60s Radiometric Stability Characterization	review	OLI	IAS	01/11/10
Saturated Pixel Replacement	review	both	LPGS/IAS	01/15/10
Radiance Rescaling	review	both	LPGS/IAS	01/15/10
SCA Discontinuity Correction	review	both	LPGS/IAS	01/22/10



Radiometry Algorithms (cont'd)

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Algorithm Name	Status	Instrument	Subsystem	Phase 3 Delivery
Detector Response Characterization (Lamp)	review	OLI	IAS	01/29/10
Inoperable Detectors Fill		both	LPGS/IAS	01/29/10
Striping Characterization		both	LPGS/IAS	01/29/10
Residual Striping Correction	review	both	LPGS/IAS	01/29/10
Bias Removal		OLI	LPGS/IAS	02/26/10
Response Linearization		OLI	LPGS/IAS	02/26/10
Bias Determination		OLI	LPGS/IAS	02/26/10
Bias Model Calibration		OLI	IS	02/26/10
Lunar Irradiance Characterization		OLI	CVTK	03/31/10
Bias Removal		TIRS	LPGS/IAS	05/07/10
Response Linearization		TIRS	LPGS/IAS	05/07/10
White Noise Characterization		both	CVTK	05/31/10
Detector Operability Characterization		both	CVTK	05/31/10
SNR Characterization		OLI	CVTK	05/31/10
Contamination Characterization		OLI	CVTK	05/31/10
Dark Response Determination		TIRS	IAS	06/11/10
Radiometric Response Determination		TIRS	IAS	06/11/10
NEdL Characterization		TIRS	CVTK	06/30/10
Nonlinear Response Characterization		OLI	CVTK	06/30/10
Radiometric Stability Characterization		TIRS	CVTK	06/30/10
Stray Light Characterization		OLI	CVTK	07/31/10
Gain Trending		both	CVTK	08/31/10
Temperature Sensitivity Characterization		both	CVTK	08/31/10
Relative Gain Characterization (90-degree Yaw)		OLI	CVTK	08/31/10
Performance Trending		both	CVTK	08/31/10
Coherent Noise Characterization		both	CVTK	10/29/10
Relative Gain Characterization (Histogram Method)		both	CVTK	10/29/10
1/f Noise Characterization		both	CVTK	11/26/10
Contamination Correction		OLI	CVTK	11/26/10



Summary

LDCM

- ◆ Significant progress has been made on the Ground System
- ◆ Ground System approach and architecture continues to take advantage of existing capabilities to the greatest extent possible
- ◆ Ground System critical design is proceeding and accommodates TIRS
- ◆ Budget shortfall has been mitigated to the greatest extent possible and additional funding is being actively worked by the USGS and Department of the Interior (DOI)
- ◆ On track to complete DPAS and Ground System critical design reviews in February and March respectively