



# LDCM Ground System Update

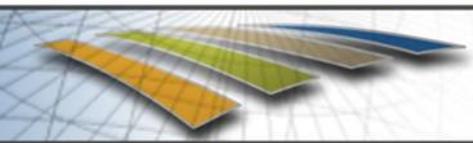
Jim Nelson

*U.S. Geological Survey – LDCM Ground System Manager*

August 16, 2011

L A N D S A T

Data Continuity Mission



**LDCM**



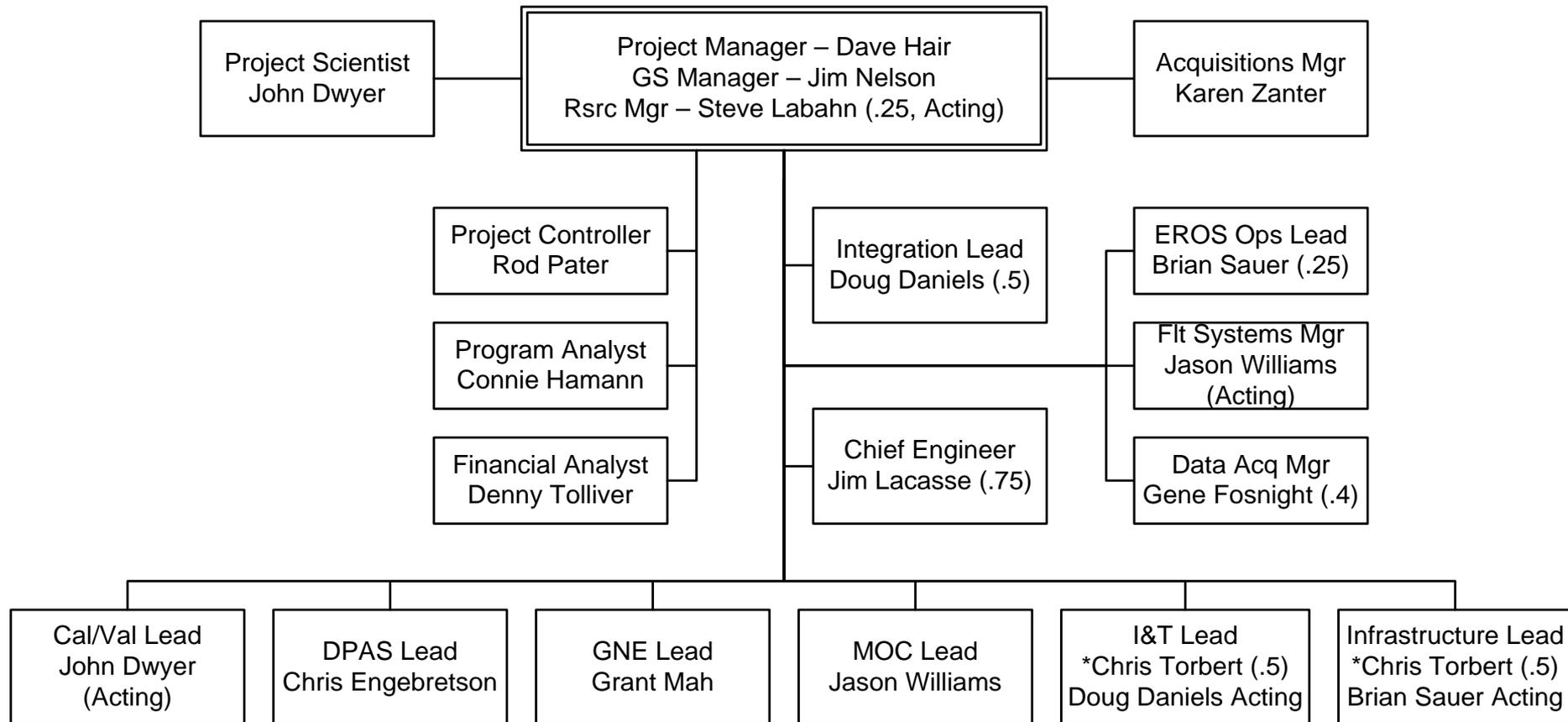
# Agenda

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- ◆ USGS and GS/Ops Organization
- ◆ GS Operational Architecture
- ◆ GS Schedule
- ◆ GS Development Progress
- ◆ GS I&T Progress
- ◆ End to End Science Data Testing
- ◆ Mission Operations Progress

# USGS LDCM Project Organization

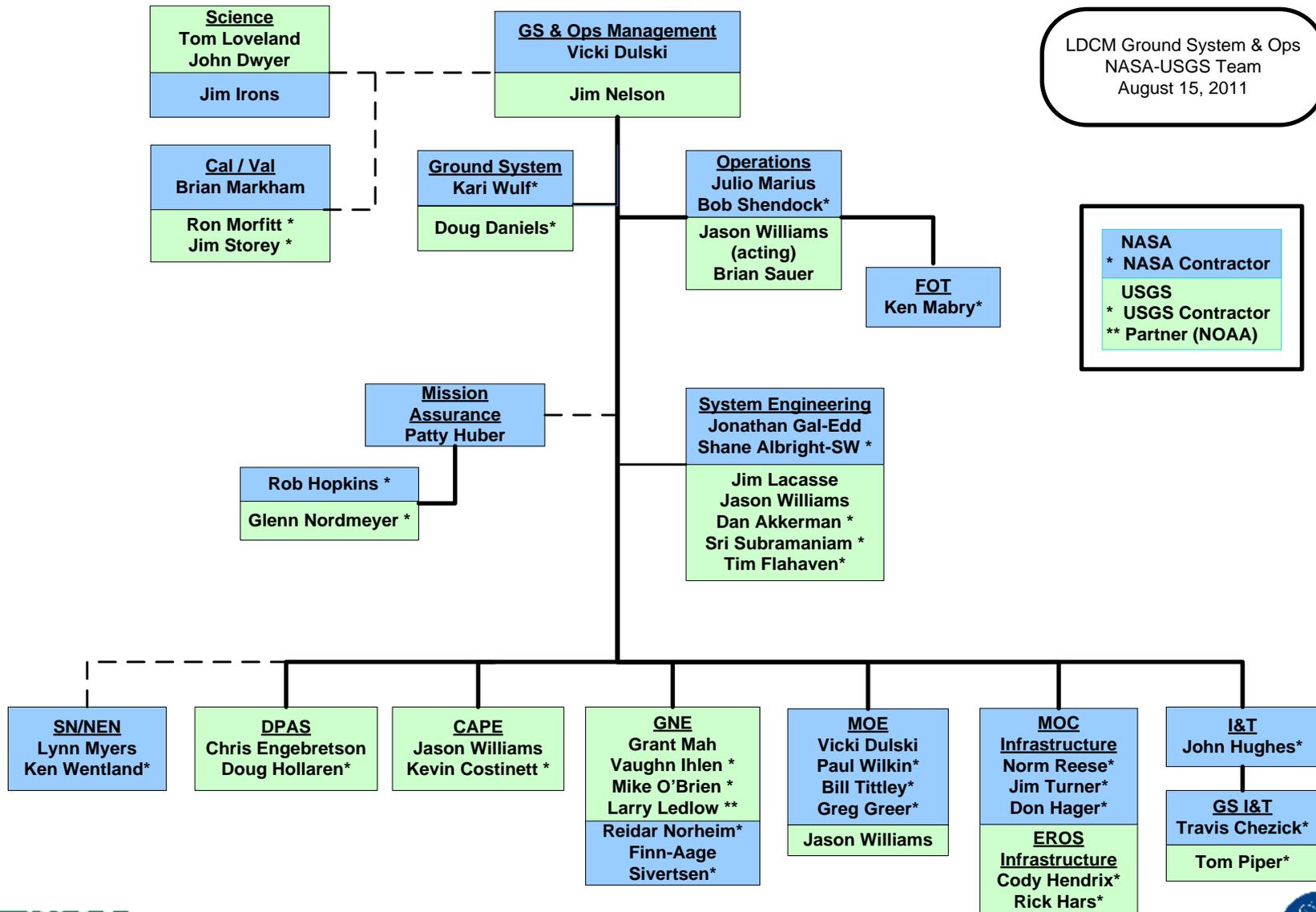
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\*Chris Torbert on detail to Land Carbon project

# Integrated NASA/USGS GS/Ops Team

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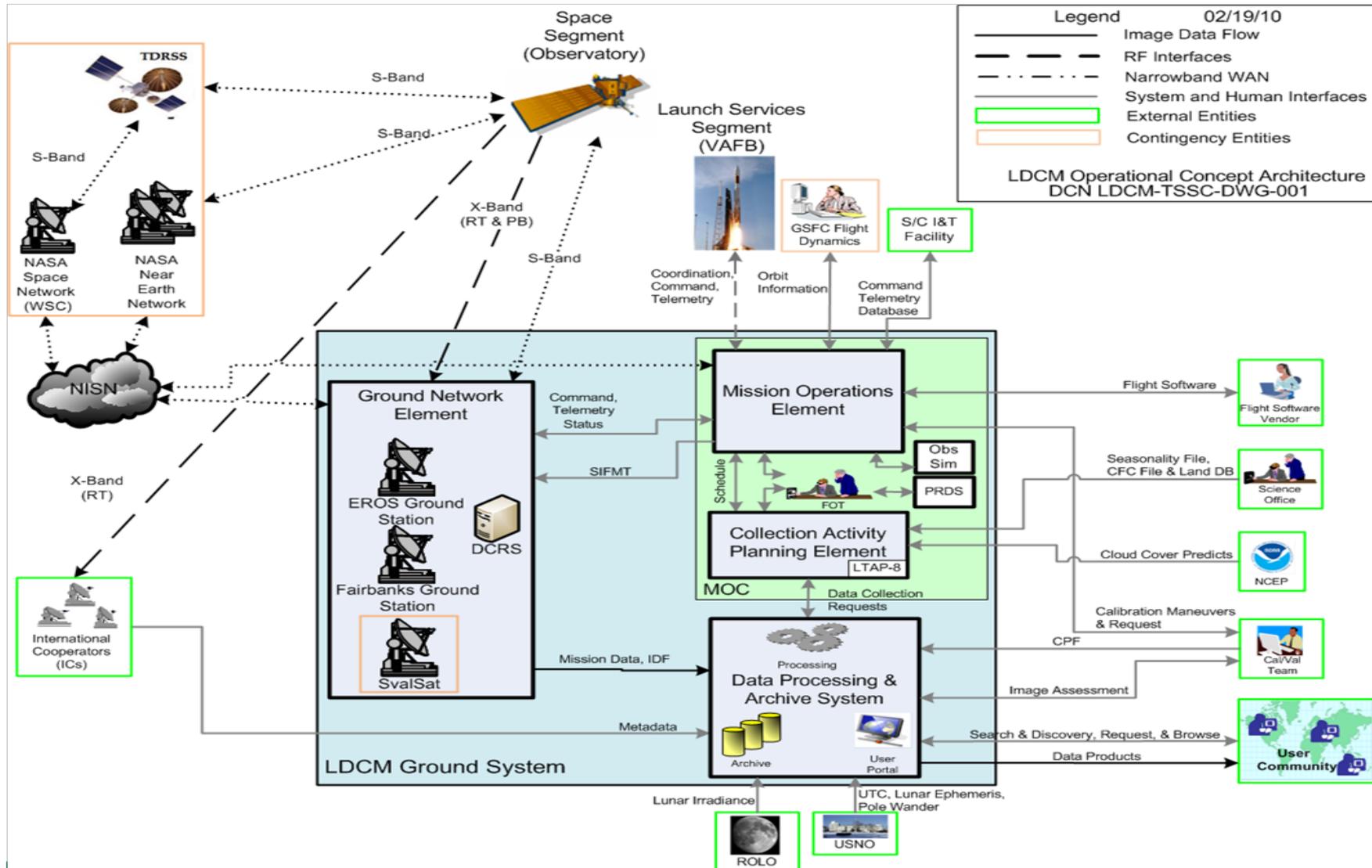


LDCM Ground System & Ops  
NASA-USGS Team  
August 15, 2011

NASA  
\* NASA Contractor  
USGS  
\* USGS Contractor  
\*\* Partner (NOAA)

# GS Operational Architecture

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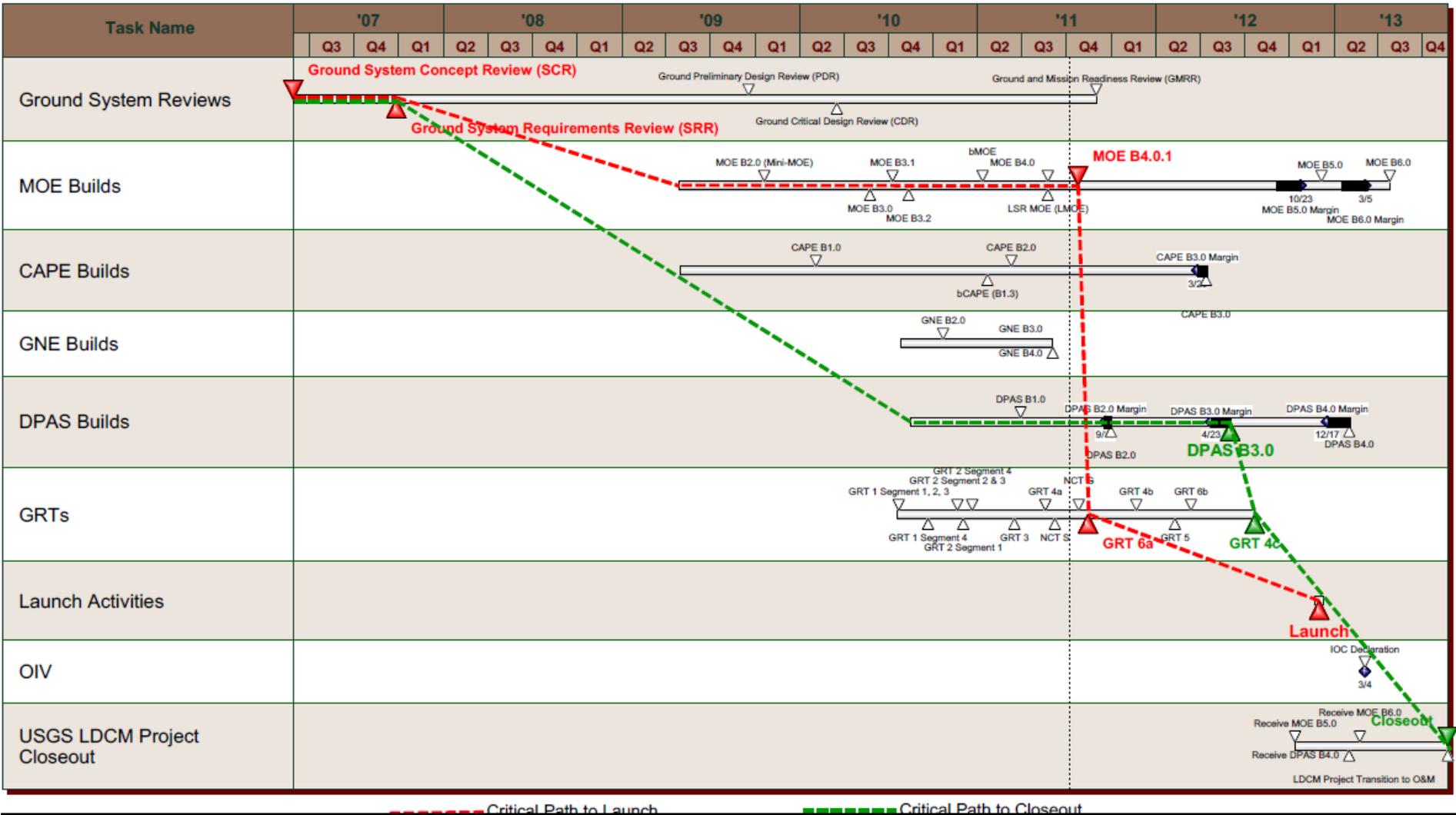
# Ground System Development Approach

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| Element  | Capability  | Agency / Developer           | Approach  |
|--|---|------------------------------|---|
| Mission Ops Center                               | <ul style="list-style-type: none"> <li>•Serves as control center for mission operations performed by the FOT</li> <li>•Hosts the MOE, CAPE, and other operations tools</li> </ul>   | NASA / MOMS                  | Minor mods to HSM MOC, GSFC B3/14                   |
| Mission Ops Element                              | <ul style="list-style-type: none"> <li>•Performs command encryption and commanding, RT telemetry monitoring, mission planning and scheduling, monitoring and analysis, flight dynamics, and onboard memory management and mission data accounting</li> </ul>                            | NASA / The Hammers Co., Inc. | COTS customization                                  |
| Collection Activity Planning Element             | <ul style="list-style-type: none"> <li>•Generates instrument image collection schedules based on science priorities</li> </ul>  | USGS / SGT                   | GOTS customization                                  |
| Ground Network Element                           | <ul style="list-style-type: none"> <li>•Performs S-band communication for S/C commanding and HK telemetry receipt</li> <li>•Receives S/C mission data via X-band</li> <li>•Routes HK telemetry to MOC and mission data to the DPAS</li> </ul>   | USGS / SGT, NOAA, KSAT       | Modification of existing stations                   |
| Data Processing and Archive System               | <ul style="list-style-type: none"> <li>•Performs mission data ingest, product generation, and image assessment</li> <li>•Provides storage and archive services</li> <li>•Provides web interface for data discovery, product selection and ordering, and product distribution</li> </ul> | USGS / SGT                   | Customization of heritage systems                   |
| NASA institutional services (SN, NEN, NISN, FDF) | <ul style="list-style-type: none"> <li>•Performs S-band communication for S/C commanding and HK telemetry receipt</li> <li>•Provides network connectivity across GS</li> <li>•Supports post-launch FD</li> </ul>  | NASA                         | Existing systems and services acquired through PSLA |

# Ground System Schedule

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--- Critical Path to Launch

--- Critical Path to Closeout



# MOC Progress

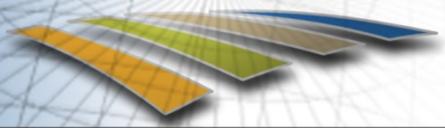
- ◆ MOE Status
  - ◆ MOE Build 4.0 site verification testing is underway (last major delivery)
    - Adding software patches to support ground system and mission-level testing as well as address issues found during development
  - ◆ MOE Build 4.0.1 delivered and installation underway in MOC
  - ◆ MOE team developing/delivering emergency patches to resolve problems identified in testing as needed
  - ◆ Backup MOE will be integrated into the backup MOC (BMOC) in the fall of 2011
  - ◆ Launch Support Room (LSR) equipment was delivered in May
- ◆ CAPE Status
  - ◆ Build 2.2 delivered; install in the MOC planned for next week (last major delivery)
  - ◆ Build 3.0 in work (upgrades to modeling and schedule engine)
- ◆ MOC Integration Status
  - ◆ S/OS delivery and installation in the MOC completed
  - ◆ Network connections between MOC and stations complete
  - ◆ Establishing connectivity and interfaces with Launch Site
  - ◆ BMOC facility in place (shared location with L5/L7 MOC)
  - ◆ LSR facility being prepared for integration in the fall of 2011



# GNE / RF Progress

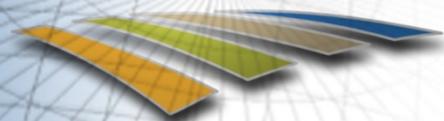
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- ◆ DCRS 2.1.2 completed and installed at all stations (last major release)
- ◆ LGS (Sioux Falls, SD)
  - ◆ Operational
- ◆ SvalSat (Svalbard, Norway)
  - ◆ All station and GNE testing complete
  - ◆ Station accepted June 2011
- ◆ GLC (Fairbanks, Alaska)
  - ◆ Integration and unit test complete
  - ◆ Lingering issues with NOAA acceptance of station due to building move
  - ◆ Level 3 testing with the MOC has been delayed until November, following MRT 1
- ◆ RF compat test planned for September 2011
  - ◆ Verification of S-band and X-band RF interfaces with the spacecraft
  - ◆ Will be using ground station RF equipment in the NASA Compatibility Test Van (CTV) at Orbital facility
    - GLC receivers only remaining equipment to integrate into the CTV



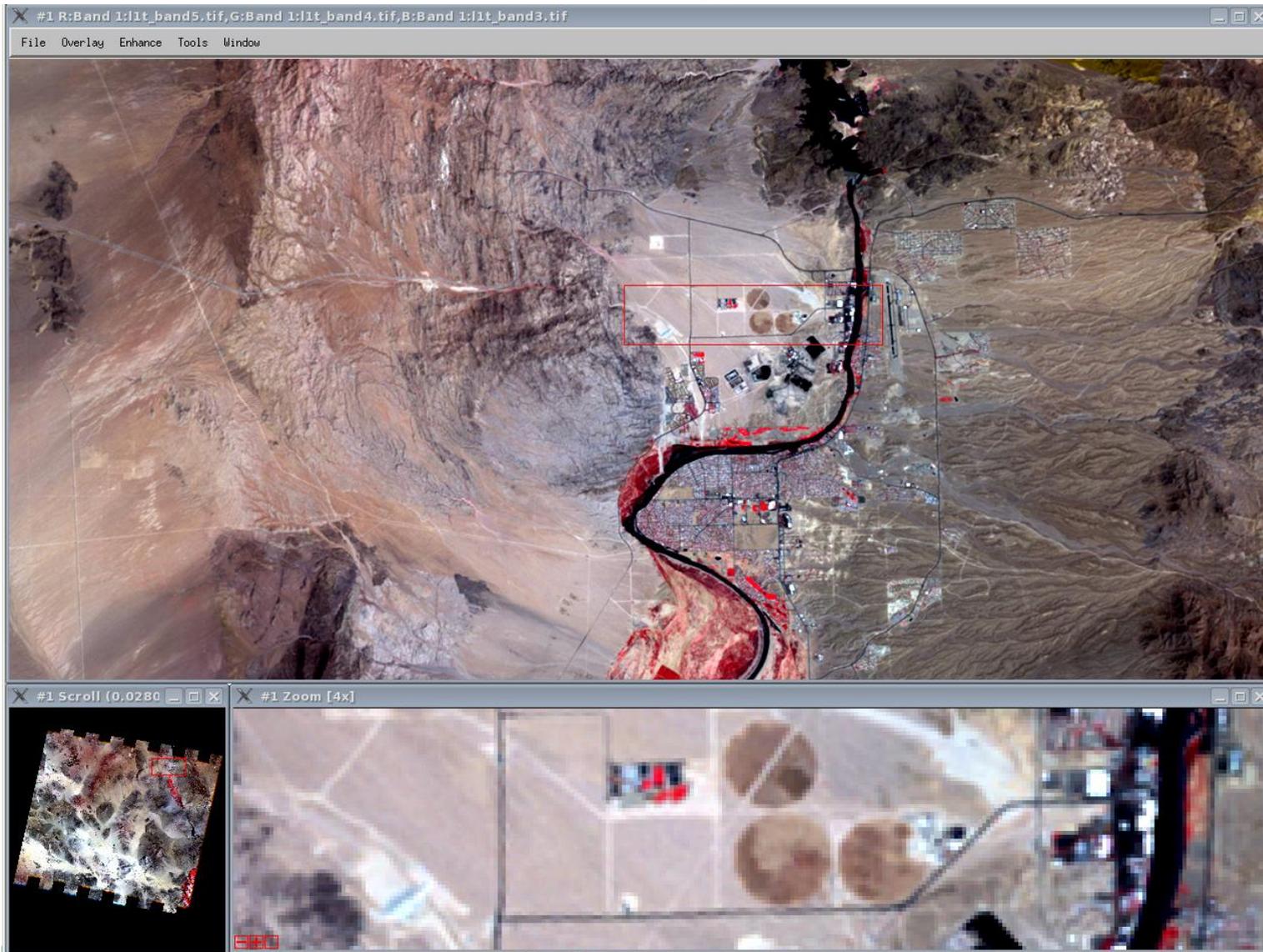
# DPAS Progress

- ◆ DPAS B1.0 (safeguard mission data)
  - ◆ Complete and installed in operations environment
- ◆ DPAS B2.0 (generate L1 data)
  - ◆ Data format based on simulation test using spacecraft engineering model hardware
  - ◆ All subsystems delivered and installed in DPAS test environment
    - User Portal R2.0 (browse and quality band generation)
    - Image Assessment Subsystem (IAS) R1.0 (L1 product generation, image cal/val)
    - Ingest R2.0 (LORa generation, BPF generation)
    - Subsetter R2.0 (LORp data generation, user interface)
    - Inventory R2.1 (inventory for mission data, LOR, and L1 data)
    - MDS R1.0 (metrics gathering and reporting for volume, latency, and throughput)
    - Storage & Archive R2.1 (permanent archive of mission data, internal/online caches for L0/L1)
  - ◆ DPAS B2.0 TRR scheduled for August 22<sup>nd</sup>
  - ◆ DPAS B2.0 on schedule for September 2011 delivery to GS testing
- ◆ DPAS B3.0 (full production)
  - ◆ Adds LPGS to the DPAS and IC interfaces to the User Portal
  - ◆ Data format includes TIRS data format updates and final ancillary data definition
  - ◆ Delivery to GS testing in late May 2012
- ◆ DPAS B4.0 (post-launch closeout release)
  - ◆ Final release of DPAS for capabilities not required for launch or commissioning
  - ◆ Delivery to GS testing in January 2013



# First L1T Out of DPAS

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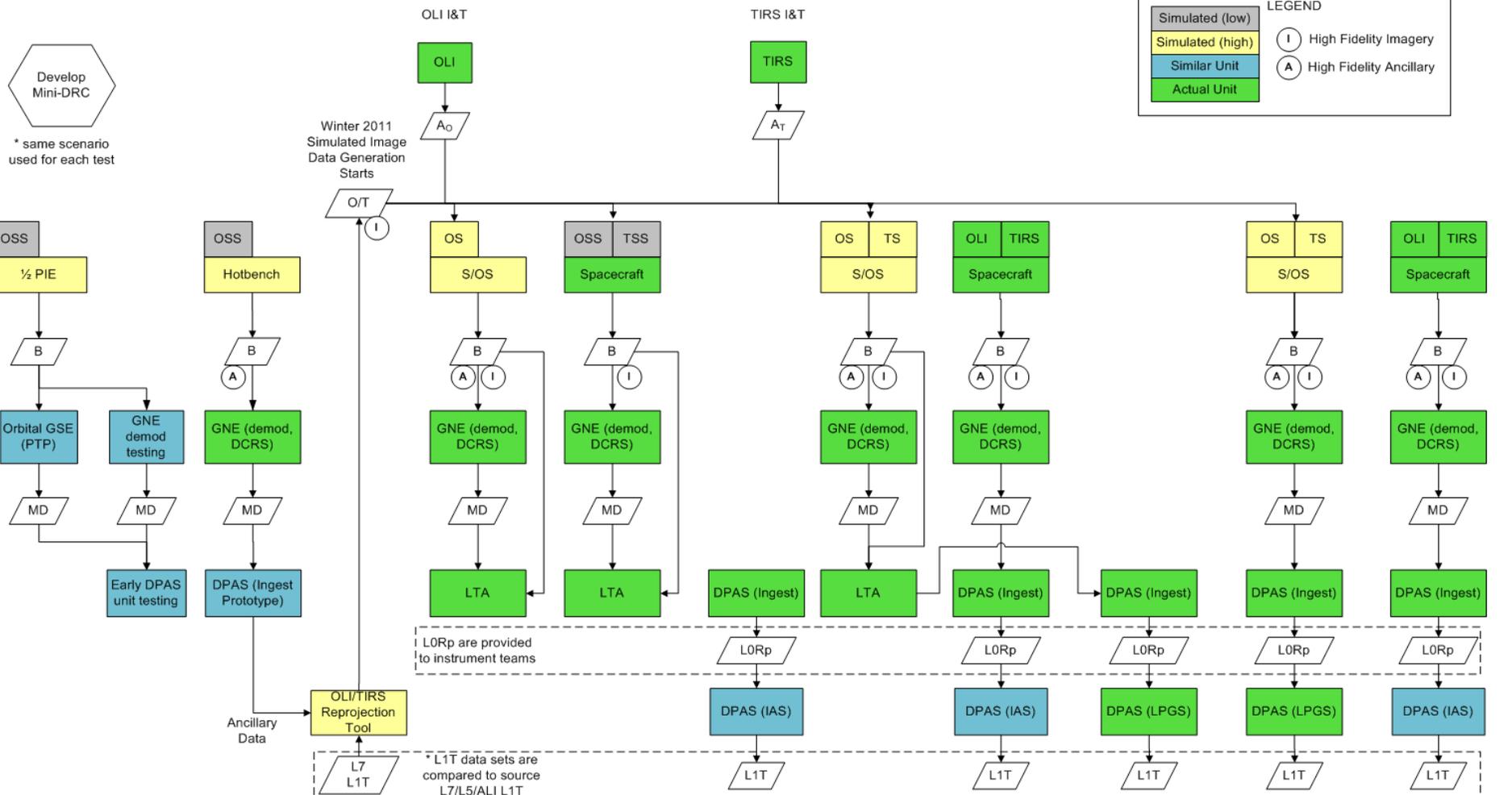
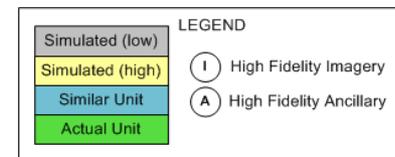


# End-to-End Science Data Testing

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Develop Mini-DRC

\* same scenario used for each test



EM PIE Tests

CADU Test

GRT6a

MRT1

GRT4b

GRT6b

MRT5

GRT4c

MOS4/5

Commissioning

# Ground Readiness Test (GRT) Status

## LDCM

| GRT#          | Date     | Description  | Configuration   |
|---------------|----------|--|---|
| <b>GRT 1</b>  | 7-9/10   | TLM/CMD (S-band)                                       | 1) MOC with LSIMSS<br>2) MOC to EROS station CTP across NISN interface  |
| <b>GRT 2</b>  | 11-12/10 | Planning, Scheduling and Mission Data Management (MDM) | 1) MOC with LSIMSS<br>2/3) MOC with remote access to Orbital hotbench and integrated X-band demodulator.<br>4) MOC with LGS |
| <b>GRT 3</b>  | 3/11     | Maneuvers and Special Events                           | MOC with softbench/FSW 4.0  |
| <b>GRT 4a</b> | 5/11     | Safeguard Mission Data                                 | DPAS, GNE/DCRS  |
| <b>NCT-S</b>  | 6/11     | Repeat GRT 1&2 portions for GLC                        | MOC to SGS station CTP across NISN  |
| <b>GRT 6a</b> | 8/11     | MOC & Station Capstone/Clean-up                        | MOC with S/OS (no TIRS simulator) <sup>1</sup> , LGS <sup>2</sup>   |
| <b>GRT 4b</b> | 11/11    | DPAS Level 1 Processing                                | DPAS, MOC, GNE/DCRS   |
| <b>NCT-G</b>  | 11/11    | Repeat GRT 1&2 portions for GLC                        | MOC to GLC station CTP across NISN  |
| <b>GRT 5</b>  | 2/12     | Contingency Operations                                 | MOC and bMOC failovers, rescheduling of contacts  |
| <b>GRT 6b</b> | 3/12     | MOC & Station Capstone/Clean-up                        | MOC with full S/OS <sup>1</sup>   |
| <b>AVT</b>    | 3/12     | Science Algorithm Verification                         | DPAS and Cal/Val Toolkit  |
| <b>GRT 4c</b> | 6/12     | DPAS Capstone  | DPAS, MOC, GNE/DCRS   |

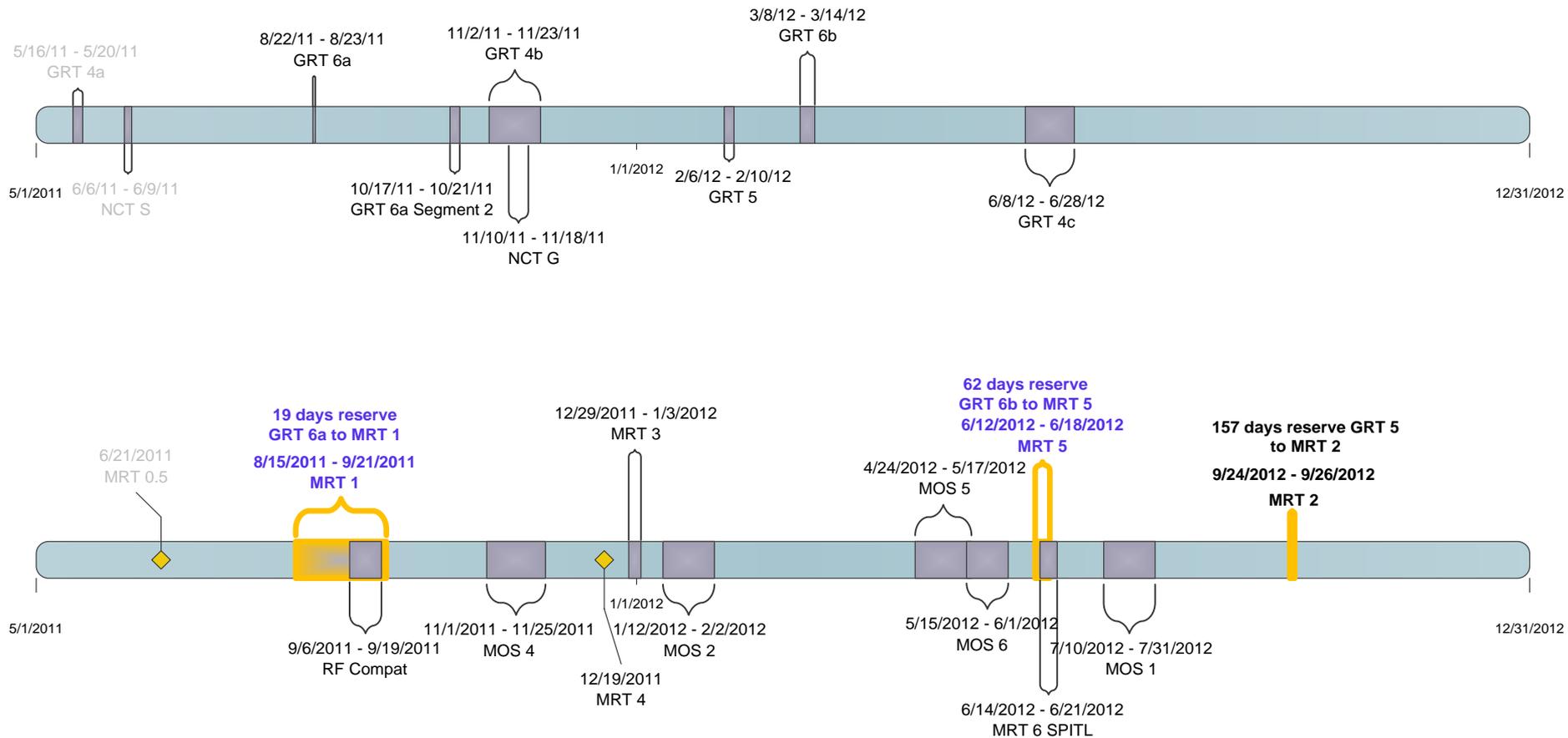
|             |
|-------------|
| complete    |
| in progress |
| future      |

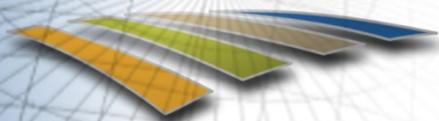
<sup>1</sup>TIRS Sim to be integrated at MOC in winter 2011, GS testing will be completed then.

<sup>2</sup>GRT 6a testing run in conjunction with MRT 1 dry run, but will delay MOC-station testing until after MRT 1

# GS/Ops Testing Schedule

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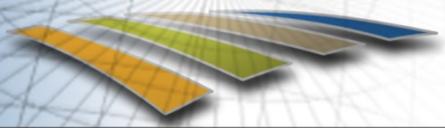


# Technical Performance Measures

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- ◆ Ground System performance is monitored through a set of TPMs
  - ◆ TPMs are monitored on a regular basis

| TPM                              | Requirement     | Performance      | Margin |
|----------------------------------|-----------------|------------------|--------|
| LGN Contact Time                 | 98 min/day      | 133 min/day      | +36%   |
| Ingest and Processing Throughput | 400 scenes/day  | 890 scenes/day   | +123%  |
| Distribution Capacity Years 1-2  | 1250 scenes/day | 4,700 scenes/day | +276%  |
| Distribution Capacity Years 3-5  | 3500 scenes/day | 4,725 scenes/day | +35%   |
| End to End Latency               | 85% in 48 hrs   | 85% in 12 hrs    | +75%   |
| Receiver Implementation Loss     | 3 dB            | 2.3 dB           | +23%   |



# Mission Operations Progress

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- ◆ Completed execution of MRT 0.5 on July 8
  - ◆ Final of the mission readiness interface tests (MRT 0.x)
  - ◆ Primary and Secondary Objectives met over a period of 12 hours
- ◆ Full court press for MRT 1
  - ◆ Multiple TIMs held with the NASA/USGS/Orbital operations teams to iron out objectives
  - ◆ Dry runs each week for the next three weeks
  - ◆ Progress monitored with daily standups and weekly tag-ups with project
  - ◆ Procedure development closely coordinated with Orbital
- ◆ MOC Day In The Life (DITL) preparations for use in GRT 6 and MRT 1
  - ◆ Also provides a routine, automated method of exercising the ground system prior to tests with spacecraft
  - ◆ FDS product generation now live
  - ◆ Getting other products, particularly mission data management, to work with the S/OS
- ◆ Mission Simulations planning ongoing
  - ◆ Testing with simulators (S/OS & softbench) that can't be performed on the spacecraft
  - ◆ Day in the life scenarios, operator training and certification
  - ◆ MOS plan in draft
- ◆ Launch & Activation Timeline
  - ◆ Timeline updates with L&EO sequences defined in Spacecraft User's Guide
  - ◆ Timeline Tool in procurement cycle



# Summary and Next Steps

- ◆ Ground System development is on track
  
- ◆ Entering Observatory I&T and mission readiness test phase
  - ◆ RF compat testing in September 2011
  - ◆ GRT 6a/MRT 1 in August/September 2011
  - ◆ MOSs begin in Winter 2011
  
- ◆ Focus turning to mission data testing and L1 production
  - ◆ DPAS B2.0/GRT 4b provides L1 processing capability
  - ◆ End to end image data testing using a combination of tests with flight hardware and simulators