Vera C. Rubin Observatory
Systems Engineering

Integration Milestones

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SITCOMTN-006

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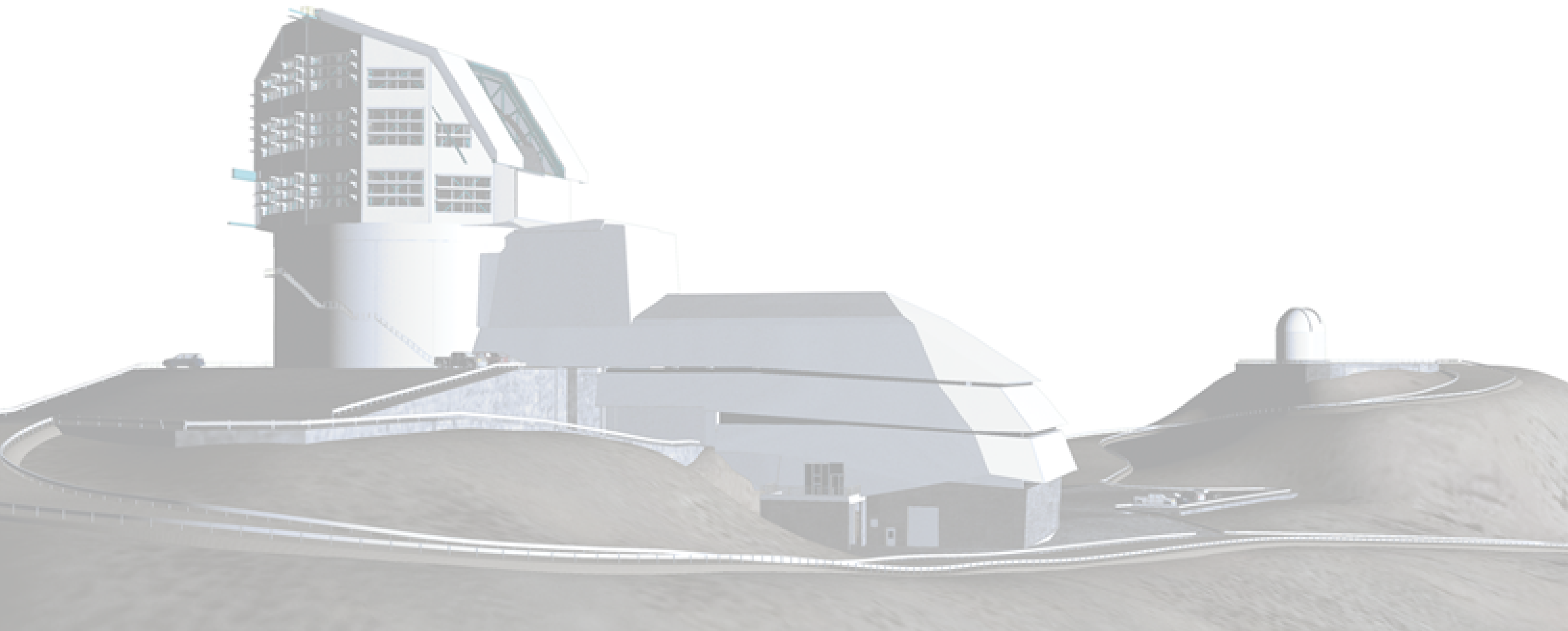

Abstract

A proposal for ways to work on predominantly software subsystem commissioning, building on the Rubin AuxTel (née auxTel) experience

Change Record

Version	Date	Description	Owner name
1	YYYY-MM-DD	Unreleased.	Robert Lupton

Document source location: `https://github.com/lsst-sitcom/sitcomtn-006`

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Integration Milestones

1 Introduction

The Rubin construction project is composed of three main subsystems: DM, Camera, and T&S.[1] but in operations there is only one survey. The task of merging the projects is not easy, especially when some of the interfaces are underspecified, or turn out to need modification based on experience. This is primarily a problem for the software — the hardware interfaces, specified in mm and screw threads, are generally well defined.

Once we accept that the only way to complete the integration of the subsystems is to actually integrate them, while expecting that the interfaces and requirements will evolve, we recognise that our situation is analogous to the way that software development has moved from waterfall to agile development models.

This technote proposes that we introduce the concept of an IM which defines a specified set of functionalities that are available to the Rubin project. This is slightly different from DM's current OR concept which tests the state of DM systems at a certain time rather than guaranteeing continued cross-subsystem functionality. I envisage that an IM would be followed by an OR to test the deliverable, and to carry out an internal ORR for the functionality delivered by the IM.

[1] And also EPO, but this is probably not relevant here.

2 IM$_A$: ComCam Image Capture and Archive (2020-XX-YY)

Executive Summary:

Run ComCam from notebooks, with generation and certification of ComCam calibrations

2.1 Goals of IM

- Taking ComCam images in Chile using nublado
- Taking calibration and other images using the scriptQueue
- Automatic ingestion into a gen3 butler in Chile
- Transfer over pDBB and the LHN to NCSA, followed by gen3 ingest
- Human generation and availability of master calibrations in Chile

2.2 Prerequisites

- ComCam on summit
  - cold and functional
  - integrating sphere and filters (expected to be available by 2020-12-01)
- gen3 butler ingestion for comCam
- Nublado running in Chile

3 IM_B: ComCam Image Capture and Archive (2021-XX-YY)

Executive Summary:

Run ComCam from notebooks and the scriptQueue, with automated generation and certification of ComCam calibrations

3.1 Goals of IM

- Triggering OCPS processing from nublado/scriptQueue
- Automated generation and availability of ComCam master calibrations in Chile
- Use of RLS and LOVE
    - including monitoring of data transfer to NCSA
- Demonstration that the operator can cycle through states, bring the system up from `STANDBY`, and take data without any intervention from developers
- Monitor the health of the CCS from the observatory environment (e.g. Chronograph/LOVE)
- Explore relationship between EFD and Camera trending databases
- TAP/ADQL access to EFD from RSP

3.2 Prerequisites

- IM_A

4 $\mathrm{IM_C}$: Rubin AuxTel Standard Star Campaign (2021-XX-YY)

Executive Summary:

Demonstrates ability to take and reduce AuxTel data using the scriptQueue

4.1 Goals of IM

- Automated generation and availability of AuxTel master calibrations in Chile (cf. $\mathrm{IM_B}$)
- Annotate exposures using RLS
- Take data in a standard star field, including interactive re-centering
- Run AuxTel data analysis package in Chile and NCSA, triggered by OCPS
  - push results to EFD (maybe??)

4.2 Prerequisites

- $\mathrm{IM_B}$
- AuxTel functional
- Available staff for night time operations
- User commenting in RLS available

5 IM_D: MT Full Slew (2021-XX-YY)

Executive Summary:

Demonstrates ability to slew the MT with Group 2 systems running

5.1 Goals of IM

- Slew MT to a field using a nublado notebook
- Status displays using LOVE
- Create observing log using RLS

5.2 Prerequisites

- IM_B
  - RLS, LOVE
- Group 2 hardware and CSCs all online and enabled
  - RHL which of these will be real hardware on 2021-01-15?
  - Not required for fully simulated exercise at NCSA, but CSCs must be simulated, however, no low-level M2-type simulators required
- User commenting in RLS available

6 IM$_E$: Rubin AuxTel Standard Star Campaign (2021-XX-YY)

Executive Summary:

Demonstrates ability to carry out sustained AuxTel observing using the scriptQueue

6.1 Goals of IM

- Display images using Camera Image Visualization Tool
- Take pointing model using the script queue + OCPS, possibly including interactive re-centering
- Take standard set of standard star fields using the script queue
- Visualise the reduced data

6.2 Prerequisites

- IM$_C$
- Camera Image Visualisation Tool or other equivalent tooling

7 IM$_F$: Corner raft AOS (2021-XX-YY)

Executive Summary:

Use a notebook to process corner raft `SW0/1` simulated data, publishing wavefront error events

7.1 Goals of IM

Demonstrate ability to:

- Slew to a field (only needed to provide ra, dec, rotator telemetry)
  - Question: does AOS need anything from the scheduler about the next field?
- Command exposure (or pair, if that's required by AOS) from ComCam
- have MTAOS process images, triggered by appropriate events, and publish `{{camera,m2}Hexapod,{m1m3,` events

7.2 Prerequisites

- Recover PhoSim images with donuts from ComCam
  - we may need to fake something here, if ComCam cannot play back corner raft data
- Pointing component generating telemetry

8 IM$_{\text{pre-G}}$: Standalone ComCam AOS (2021-XX-YY)

Executive Summary: Process phosim Intra/Extra simulated ComCam images with the MTAOS. Assuming that the images where acquired and ingested previously, drive the MTAOS through the data processing steps and produce corrections.

8.1 Goals of IM

Demonstrate ability to:

- Have MTAOS process images, triggered by appropriate commands, and publish `{{camera,m2}Hexapod,{m1m3,m2}}Correction` events

8.2 Prerequisites

- PhoSim images with donuts from ComCam ingested into a butler repo.
- Working version of MTAOS with access to a butler repo containing simulated ingested data.
- Working version of wavefront estimation pipeline (wep).

8.3 Procedure

- Generate and ingest simulated images with desired pistons (e.g. $[0, -10, 0, 10, 0]$) and appropriate metadata
- Manually issue commands to AOS system to process the data; in IM$_{\text{G}}$ we will generate these commands from the scriptQueue, triggered by OODS events. *N.b.* we may need an extra config file for this IM providing information which will come from SAL in IM$_{\text{G}}$
- Check that desired events are in the EFD

9 IM_{G}: ComCam AOS (2021-XX-YY)

Executive Summary:

Perform wave-front sensing using ComCam and a notebook

9.1 Goals of IM

Demonstrate:

- Slew to field, generating telemetry (*cf.* IM_{F})
- piston camera (e.g. in, -out, in, +out, in)
- take data using ComCam in playback mode
- uses OCPS to reduce data on commissioning cluster
- load Zernikes into EFD

9.2 Prerequisites

- ability to control camera hexapod
- $\mathrm{IM}_{\text{pre-G}}$
- IM_{F}
  - No need for replaying corner raft data
- notebook/script to perform pistoning of camera hexapod with image acquisition
- OCPS

9.3 Procedure

- Generate simulated images with desired pistons (e.g. $[0, -10, 0, 10, 0]$) and appropriate metadata and load into comCam

- Use scriptQueue to issue slew and camera commands, sending commands to OCPS to process the data. *N.b.* will require the AOS to synchronise the piston values with the OCPS exposure numbers (`seqNum`).
- Check that desired events are in the EFD

10 IM$_H$: Active Optics System (2021-XX-YY)

Executive Summary:

Simulate AOS in regular operations

Outstanding questions:

- Are we verifying anything here?
- Should this be split into two IMs?

10.1 Goals of IM

Demonstrate running full AOS functionality script at 3 elevations

- scriptQueue runs SAL script
  - slew to field
  - take an exposure (or snap pair)
  - MTAOS processes data and broadcasts events
    - before starting next field

10.2 Prerequisites

- IM$_D$
- IM$_F$

11 IM$_I$: Commission Active Optics System (2021-XX-YY)

Executive Summary:

Simulate AOS commissioning, including building LUTs

Outstanding questions:

- Are we verifying anything here?
- Should this be split into two IMs?

11.1 Goals of IM

Demonstrate running full AOS functionality script at 3 elevations

- scriptQueue runs SAL script
  - pistons camera (in, -out, in, +out, in)
  - uses OCPS to reduce data on commissioning cluster
    - Returns Zernikes
  - Script awaits on OCPS reduction finishing
  - AOS uses returned Zernikes to calculate mirror offsets as part of loop
  - Applies offsets and repeat
  - in-focus images get sent off via OCPS for reduction

- Build LUT for each mirror and hexapod
- Load the LUTs into components
  - Ideally would use new configuration handling tstn-017
- Repeat elevation testing with new LUTs
  - results should show zero WFE
- Analysis should be repeated at NCSA

11.2 Prerequisites

- IM_f

12 IM$_J$: Start/End of Night (with AuxTel) (2021-XX-YY)

Executive Summary:

Exercise handoffs between day crew and night crew. Perform afternoon calibrations. Perform observatory opening/closing. Requires definition of opening/closing procedures and appropriate observing conditions. Also requires mechanism to get knowledge from night crew into Jira tickets which are then subsequently. How do we use LOVE/EUI/notebooks to troubleshoot/resolve faults?

12.1 Goals of IM

- Have observing specialist run the AuxTel, including
  - Perform nighttime hand off sequence
- Run afternoon calibrations, reduce them using OCPS, run QA, and possibly certify for use
- Test Camera Image Visualization Tool
  - This is a camera deliverable and I'm completely unaware of it's status.
- Verify current environmental conditions against acceptable conditions (Where are these hosted?)
  - Winds, seeing, humidity, windshake conditions (shutter/vent gate configurations), temperature
- Run opening script
  - Functionality requires review to ensure component safety etc.
  - When do we start observing?
- Perform several standard (spectroscopic) AuxTel visits
  - Simulate a fault, have pre-derived written instructions to ”reset”
    - Instructions must not include syntax!
      - e.g. unwrap rotator, manually close vent gates 1-3, put down and push up mirror, home hexapod and re-position etc,

  - Use logger to record important information
  - Create Jira ticket(s)
  - Run pre-derived commands
- Recover, Perform more visits
  - Simulate weather event requiring closure of observatories
- Recover, perform more visits
- Sun rising, Close observatory, publish night report
- Perform daytime handoff, including the procedure to getting the JIRA tickets filtered and addressed accordingly

12.2 Prerequisites

- AuxTel system fully functional
- LOVE screens should be operational for mount/dome/mirrors(?)
- RLS system with fault reporting
- EAS

13 IM_K: LSSTCam Image Capture and Archive (2021-XX-YY)

Executive Summary:

Run LSSTCam from the scriptQueue, with automated generation and certification of LSSTCam calibrations

13.1 Goals of IM

- Taking complete set of LSSTCam calibration data using the scriptQueue
- Reduce the data using OCPS:
  - generating a set of LSSTCam master calibrations
  - characterizing the detectors (noise, gain, tearing)

13.2 Prerequisites

- IM_b
- Remote OCPS, if necessary

14 Milestone Activity backlog

Activities that need to be included in an IM

14.1 Have operators bring system up from power-off

14.2 Test software deployment (daytime) and rollback (nighttime) scenarios.

- Also create a test of setting up individual environments (custom packages/modifications),
- how to run a script that uses a modification to a function.
- How can someone else run someone's code from a previous night if they used a modified environment?

14.3 Alert Processing using AuxTel Imaging Data

14.4 Restart from power-loss on the Mountain

14.5 Promote any remaining CCS functionality needed by observers to OCS

14.6 Write data from the CCS, DMTN-143

- Including ComCam, AuxTel

14.7 Use PPI to transfer data from Chile

A References

B Glossary

AOS Active Optics System.

CCS Camera Control System.

CSC Commandable SAL Component.

DM Data Management.

EFD Engineering and Facility Database.

IM Integration Milestone.

LHN Long Haul Network.

LOVE LSST Operations Visualization Environment.

MT Main Telescope.

MTAOS Main Telescope Active Optics System.

OCPS OCS Controlled Processing System.

OODS Observatory Operations Data Service.

OR Operation Rehearsal.

ORR Operations Readiness Review.

pDBB prototype Data BackBone.

RLS Rubin Observatory Logging (may be equivalent to OWL).

RSP Rubin Science Platform.

SAL Service Abstraction Layer.

scriptQueue The observatory facility for running sequences of commands and interact with OCPS.