Rubin Observatory

Verification Elements Details for the Network Component in DM Subsystem

2020-05-15

1   Introduction

This plan governs only tests of the network infrastructure, not the applications and services that use the network. To be specific, this plan governs tests of the network only up to ISO OSI Layer 3: `https://en.wikipedia.org/wiki/OSI_model`.

As such, all of the tests governed by this plan and defined in the Rubin Observatory Verification and Validation JIRA project are defined as Lower Level (LL). LL corresponded to Data Management Subsystem Integration Test. Where appropriate, additional comments regarding Same Level (SL) which corresponds to Rubin Observatory Sytem Integration, and Higher Level (HL), which corresponds to Rubin Observatory Commissioning, are provided as comments in JIRA.

Note that significant testing of the networks occurs during subsystem and system integration, prior to verification, as documented in document-14789 LSST LHN End-to-End Plan.

Finally, note that the Summit Network is not a DM deliverable and as such is not contained within this plan, except in terms of connections between these networks and the Summit Network. As a Telescope and Site Deliverable, the Summit Network is covered more fully in the Telescope and Site V&V plans.

1.1   Scope

This is a detailed overview of the Verification Elements and relevant associated information, the Network component in DM subsystem. It is provided for convenience as a working document. The information presented here is officially baselined in LDM-732 – the Verification Elements baseline document – available at `https://LDM-732.lsst.io`. Test case information is baselined in the LDM-639 test specification, available at `https://LDM-639.lsst.io`. Official releases of both documents are also available in Docushare. Please always use LDM-732 and LDM-639 official releases for reference.

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This report is updated together with the the verification elements baseline document, LDM-732. Therefore, verification elements information will be always up-to-date. Test cases information instead may be outdated, since test cases may be subject to changes during future phases of the V&V activities.

2 Summary Overview

Requirements		Verification Elements	Test Cases
DMS-REQ-0168	3.1	LVV-71(Gregory Dubois-Felsmann)	LVV-T1097 (Jeff Kantor)
DMS-REQ-0171	3.2	LVV-73(Robert Gruendl)	LVV-T1168 (Jeff Kantor)
			LVV-T1612 (Jeff Kantor)
DMS-REQ-0172	3.3	LVV-74(Robert Gruendl)	LVV-T185 (Jeff Kantor)
DMS-REQ-0173	3.4	LVV-75(Robert Gruendl)	LVV-T186 (Jeff Kantor)
DMS-REQ-0174	3.5	LVV-76(Robert Gruendl)	LVV-T187 (Jeff Kantor)
DMS-REQ-0175	3.6	LVV-77(Robert Gruendl)	LVV-T188 (Jeff Kantor)
DMS-REQ-0180	3.7	LVV-81(Robert Gruendl)	LVV-T193 (Jeff Kantor)
DMS-REQ-0181	3.8	LVV-82(Robert Gruendl)	LVV-T194 (Jeff Kantor)
DMS-REQ-0182	3.9	LVV-83(Robert Gruendl)	LVV-T195 (Jeff Kantor)
DMS-REQ-0183	3.10	LVV-84(Robert Gruendl)	LVV-T196 (Jeff Kantor)
DMS-REQ-0188	3.11	LVV-88(Robert Gruendl)	LVV-T200 (Jeff Kantor)
DMS-REQ-0189	3.12	LVV-89(Robert Gruendl)	LVV-T201 (Jeff Kantor)
DMS-REQ-0190	3.13	LVV-90(Robert Gruendl)	LVV-T202 (Jeff Kantor)
DMS-REQ-0191	3.14	LVV-91(Robert Gruendl)	LVV-T203 (Kian-Tat Lim)
DMS-REQ-0352	3.15	LVV-183(Robert Gruendl)	LVV-T192 (Jeff Kantor)
	3.16	LVV-18491(Robert Gruendl)	LVV-T181 (Jeff Kantor)

3 Verification Elements Details

The following is the list of verification elements defined in the context of the Network component of the DM subsystem.

3.1 [LVV-71] DMS-REQ-0168-V-01: Summit Facility Data Communications

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Jira Link	Assignee	Status	Priority	Test Cases
LVV-71	Gregory Dubois-Felsmann	Not Covered	1a	LVV-T1097

Verification Element Description:

Verify that:

- Summit - Base Network has been properly implemented in Summit and Base facilities
- Summit - Base Network is properly integrated with Summit Control Network and DAQ/-Camera Data Backbone

Verify that OCS/DMCS triggers read-out from DAQ and queries EFD. verify that data from EFD and camera are accepted and transferred to the Summit DWDM. Requirement does not include data transfer to base (LVV-73) or from base to archive center (LVV-81, LVV-82, LVV-83).

Upstream Requirements	
Requirement ID	DMS-REQ-0168
Requirement Description	**Specification:** The DMS shall provide data communications infrastructure to accept science data and associated metadata read-outs, and the collection of ancillary and engineering data, for transfer to the base facility.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0002 The Summit Facility

3.1.1   [LVV-T1097] Verify Summit Facility Network Implementation

Test Case Summary					
Jira Link	Owner	Status	Version	Critical Event	Verification Type
LVV-T1097	Jeff Kantor	Draft	1	false	Test

Objective:

Verify that data acquired by a AuxTel DAQ can be transferred to Summit DWDM and loaded in the EFD without problems.

Precondition:

1. Summit Control Network and Camera Data Backbone installed and operating properly.
2. Summit - Base Network installed and operating properly.
3. AuxTel hardware and control systems are functional with LATISS. AuxTel TCS, AuxTel EFD, AuxTel CCS, AuxTel DAQ are connected via Control Network on Summit to Rubin Observatory DWDM (with at least 2 x 10 Gbps ethernet port client cards).
4. AuxTel Archiver/forwarders installed in Summit and operating properly.
5. As-built documentation for all of the above is available.

Predecessors:
PMCS DMTC-7400-2400 Complete
PMCS T&SC-2600-1545 Complete

Test Personnel:
Ron Lambert (Rubin Observatory), Kian-Tat Lim (Rubin Observatory), Matt Kollross (NCSA), Tony Johnson (SLAC), Gregg Thayer (SLAC)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Verify the pre-conditions have been satisfied
	Test Data	NA
	Expected Result	Pre-conditions are satisfied.
2	Description	Control the AuxTel through a night of Observing. While observing, read out LATISS data and transfer to Rubin Observatory Summit DWDM while monitoring latency.
	Test Data	LATISS images and metadata
	Expected Result	Data is fed to DWDM without delays or errors.
3	Description	Verify that data acquired by a AuxTel DAQ can be transferred and loaded in EFD without problems.
	Test Data	LATISS images and metadata
	Expected Result	Examine the EFD to ensure that the data has been loaded properly.

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3.2   [LVV-73] DMS-REQ-0171-V-01: Summit to Base Network

Jira Link	Assignee	Status	Priority	Test Cases
LVV-73	Robert Gruendl	Not Covered	1a	LVV-T1168 LVV-T1612

Verification Element Description:

This requirement must be tested in sequence and collect performance metrics (both DAQ and Control sides unless noted):

1. ISO OSI Layer 1 Physical (fibers with test data from OTDR, AURA does test)
2. ISO OSI Layer 2 Data Link (DWDM equipment, line cards, with test data from multi-channel/lightwave/channel analyzer, Installer does test, AURA certify)
3. ISO Layer 3 minimal (DWDM with 2 x 10 Gbps ethernet port client cards with test data from 4 windows test boxes, 2 on each side, Installer does test, AURA certify, can repeat as part of #4 with DAQ)
4. ISO Layer 3 full (22 x 10 Gbps ethernet ports on DAQ side with test data from DAQ test stand, AURA, Camera DAQ team do test). Transfer data between summit and base over uninterrupted 1 day period. Â Demonstrate transfer of data at or exceeding rates specified in LDM-142.

Upstream Requirements	
Requirement ID	DMS-REQ-0171
Requirement Description	**Specification:** The DMS shall provide communications infrastructure between the Summit Facility and the Base Facility sufficient to carry scientific data and associated metadata for each image in no more than time **summToBaseMaxTransferTime**.
Requirement Parameters	**summToBaseMaxTransferTime = 2[second]** Maximum time interval to transfer a full Crosstalk Corrected Exposure and all related metadata from the Summit Facility to the Base facility.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0003 The Base Facility OSS-REQ-0127 Level 1 Data Product Availability

3.2.1   [LVV-T1168] Verify Summit - Base Network Integration

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Test Case Summary					
Jira Link	**Owner**	**Status**	**Version**	**Critical Event**	**Verification Type**
LVV-T1168	Jeff Kantor	Approved	1	false	Inspection

Objective:

Verify the integration of the summit to base network by demonstrating a sustained and unin-terrupted transfer of data between summit and base over 1 day period at or exceeding rates specified in LDM-142. Done in 3 phases in collaboration with equipment/installation vendors (see test procedure).

Precondition:

PMCS DMTC-7400-2330 COMPLETE

By phase:

1. Posts from Cerro Pachon to AURA Gatehouse repaired/improved. Fiber installed on posts from Cerro Pachon to AURA Gatehouse. Fiber installed from AURA Gatehouse to AURA compound in La Serena. OTDR purchased.
2. AURA DWDM installed in caseta on Cerro Pachon and in existing computer room in La Serena. DTN installed in La Serena. DTN loaded with software and test data staged.
3. Base Data Center (BDC) ready for installation of LSST DWDM. Fiber connecting existing computer room to BDC. LSST DWDM equipment installed in Summit Computer Room and BDC.

Predecessors:

See pre-conditions by phase above.

Test Personnel:

Ron Lambert (LSST), Albert Astudillo (REUNA), Mauricio Rojas (CTIO/CISS), Raylex, Coriant, Telefonica contractors

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Test optical fiber with OTDR: Installation of fiber optic cables and Optical Time Domain Reflector (OTDR) fiber testing (completed 20170602 REUNA deliverable RD10)
	Test Data	OTDR generated optical data
	Expected Result	Fiber tested to within acceptable Db.
2	Description	Test AURA DWDM: Installation of AURA DWDM and Data Transfer Node (DTN) (completed 20171218 DMTR-82)
	Test Data	DTN perfSonar generated data
	Expected Result	Summit - Base bandwidth and latency within specifications
3	Description	Test LSST DWDM: Installation of LSST DWDM and Bit Error Rate Tester (BERT) data (completed 20190505 collection-7743, 20191108 DAQ DWDM Connection Tests)
	Test Data	BERT generated data
	Expected Result	Summit - Base bandwidth, latency, bit error rate within specifications

3.2.2 [LVV-T1612] Verify Summit - Base Network Integration (System Level)

Test Case Summary					
Jira Link	Owner	Status	Version	Critical Event	Verification Type
LVV-T1612	Jeff Kantor	Draft	1	false	Inspection

Objective:

Verify ISO Layer 3 full (22 x 10 Gbps ethernet ports on DAQ side with test data from DAQ test stand, AURA, Camera DAQ team do test). Demonstrate transfer of data at or exceeding rates specified in LDM-142.

Precondition:

PMCS DMTC-7400-2400 COMPLETE

LVV-T1168 Passed

Full Camera DAQ installed on summit and loaded with data.

Archiver/forwarders installed at Base.

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As-built documentation for all of the above is available.

Predecessors:

See pre-conditions.

Test Personnel:

Ron Lambert (LSST), Greg Thayer (SLAC)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Verify Pre-conditions are satisfied.
	Test Data	NA
	Expected Result	Pre-conditions are satisfied.
2	Description	Transfer data between summit and base over uninterrupted 1 day period. Monitor transfer of data at or exceeding rates specified in LDM-142.
	Test Data	DAQ pre-loaded data
	Expected Result	Data transfers at or exceeding rates specified in LDM-142.

3.3 [LVV-74] DMS-REQ-0172-V-01: Summit to Base Network Availability

Jira Link	Assignee	Status	Priority	Test Cases
LVV-74	Robert Gruendl	Not Covered	1a	LVV-T185

Verification Element Description:

This requirement needs the network link to be active for a calculated amount of time (at least 1 week) without failure. Will require extrapolating from test and historical data as failures are rare. Monthly operating statistics will be acquired during commissioning. Demonstrate transfer of data at or exceeding rates specified in LDM-142, verify achieved average and peak throughput and latency.

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Upstream Requirements	
Requirement ID	DMS-REQ-0172
Requirement Description	**Specification:** The Summit to Base communications shall be highly available, with Mean Time Between Failures (MTBF) > **summToBaseNetMTBF**.
Requirement Parameters	**summToBaseNetMTBF = 90[day]** Mean time between failures, measured over a 1-yr period.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0373 Unscheduled Downtime Subsystem Allocations DMS-REQ-0161 Optimization of Cost, Reliability and Availability in Order

3.3.1   [LVV-T185] Verify implementation of Summit to Base Network Availability

Test Case Summary					
Jira Link	**Owner**	**Status**	**Version**	**Critical Event**	**Verification Type**
LVV-T185	Jeff Kantor	Draft	1	false	Inspection

Objective:

Verify the availability of Summit to Base Network by demonstrating that the mean time between failures is less than summToBaseNetMTBF (90 days) over 1 year.

Precondition:

PMCS DMTC-7400-2400 Complete.

6 months of historical availability data for this link is available.

perSonar installed in Summit and publishing statistics to MadDash.

As-built documentation for all of the above is available.

Predecessors:

See pre-conditions.

Test Personnel:

Ron Lambert (LSST)

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Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Monitor summit to base networking for at least 1 week
	Test Data	LATISS, ComCAM, and/or Full Camera data.
	Expected Result	Summit - base network is operational for 1 week and monitoring data is collected.
2	Description	Extrapolate annual availability, compare with at least 6 months of historical data on the link.
	Test Data	Historical and current logs
	Expected Result	The mean time between failures (MTBF) is projected to be less than summToBaseNetMTBF (90 days) over 1 year.

3.4 [LVV-75] DMS-REQ-0173-V-01: Summit to Base Network Reliability

Jira Link	Assignee	Status	Priority	Test Cases
LVV-75	Robert Gruendl	Not Covered	1a	LVV-T186

Verification Element Description:

Disconnect, reconnect and recover transfer of data between summit and base. After disconnecting fiber at an intermediate location between summit and base, demonstrate reconnection and recovery to transfer of data at or exceeding rates specified in LDM-142 within MTTR specification. Â Network operator will provide MTTR data on links during commissioning and operations.

Upstream Requirements	
Requirement ID	DMS-REQ-0173
Requirement Description	**Specification:** The Summit to Base communications shall be highly reliable, with Mean Time to Repair (MTTR) < **summToBaseNetMTTR**.
Requirement Parameters	**summToBaseNetMTTR = 24[hour]** Mean time to repair, measured over a 1-yr period.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0373 Unscheduled Downtime Subsystem Allocations DMS-REQ-0161 Optimization of Cost, Reliability and Availability in Order

3.4.1 [LVV-T186] Verify implementation of Summit to Base Network Reliability

Test Case Summary					
Jira Link	**Owner**	**Status**	**Version**	**Critical Event**	**Verification Type**
LVV-T186	Jeff Kantor	Draft	1	false	Demonstration

Objective:

Verify the reliability of the summit to base network by demonstrating reconnection and recovery to transfer of data at or exceeding rates specified in LDM-142 following a cut in network connection, within MTTR specification. The network operator will provide MTTR data on links during commissioning and operations.

Precondition:

PMCS DMTC-7400-2400 Complete

As-built documentation for Summit - Base Network is available.

Predecessors:

See pre-conditions.

Test Personnel:

Ron Lambert (LSST), Guido Maulen (LSST)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Disconnect fiber cable at an endpoint location on the base side of the Summit - Base fiber.
	Test Data	LATISS, ComCAM, or FullCam data
	Expected Result	Fiber is disconnected and the fault is detected by the network monitoring system.
2	Description	Measure the cable with the OTDR to locate the distance from the end point. Diagnose that it is a break.
	Test Data	NA

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Step	Description, Input Data and Expected Result	
	Expected Result	OTDR shows the fiber is disconnected (break).
3	Description	Elapse time to simulate the following: • Go to the most inaccessible place which would mean carrying all the tools/splicer/generator/-tent equipment some metres. • Erect a tent to make the splice • Start the generator • Do a splice on some random piece of cable • At an end point measure the cable again to ensure it is break free. • Take down and reinstall an isolated pole (not in the actual fiber path) • Put the cable on the pole.
	Test Data	NA
	Expected Result	Wall clock advances by 24 hours.
4	Description	Clean fiber connections. Restore connection (e.g. reconnect cable). Cycle equipment as necessary to confirm fiber is connected.
	Test Data	NA
	Expected Result	Network recovers and resumes sending data.
5	Description	Measure with OTDR to ensure back to normal state.
	Test Data	NA
	Expected Result	OTDR indicates normal state.

3.5   [LVV-76] DMS-REQ-0174-V-01: Summit to Base Network Secondary Link

Jira Link	Assignee	Status	Priority	Test Cases
LVV-76	Robert Gruendl	Not Covered	1a	LVV-T187

Verification Element Description:

This requirement is verified by demonstrating use of a secondary transfer method (redundant fiber network, microwave link, or transportable medium) between Summit and Base capable of transferring 1 night of raw data (nCalibExpDay + nRawExpNightMax = 450 + 2800 = 3250

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exposures) within summToBaseNet2TransMax (72 hours).

Upstream Requirements	
Requirement ID	DMS-REQ-0174
Requirement De-scription	**Specification:** The Summit to Base communications shall provide at least one secondary link or transport mechanism for minimal operations support in the event of extended outage. This link may include redundant fiber optics, microwaves, or transportable media. It shall be capable of transferring one night's worth of raw data in **summTo-BaseNet2TransMax** or less.
Requirement Parameters	**summToBaseNet2TransMax = 72[hour]** Maximum time to transfer one night of data via the network secondary link.
Requirement Priority	1b
Upper Level Requirement	DMS-REQ-0173 Summit to Base Network Reliability OSS-REQ-0049 Degraded Operational States DMS-REQ-0172 Summit to Base Network Availability

3.5.1   [LVV-T187] Verify implementation of Summit to Base Network Secondary Link

Test Case Summary					
Jira Link	**Owner**	**Status**	**Version**	**Critical Event**	**Verification Type**
LVV-T187	Jeff Kantor	Draft	1	false	Test

Objective:

Verify automated fail-over from primary to secondary equipment in Rubin Observatory DWDM on simulated failure of primary. Verify bandwidth sufficiency on secondary. Verify automated recovery to primary equipment on simulated restoration of primary. Repeat for failure of Rubin Observatory fiber and fail-over to AURA fiber and DWDM. Demonstrate use of secondary in "catch-up" mode.

Precondition:

PMCS DMTC-7400-2400 complete.
As-built documentation for Summit - Base Network is available.

Predecessors:

See pre-conditions.

Test Personnel:

Ron Lambert (LSST)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Transfer data between summit and base on primary equipment (LSST Summit - Base) over uninterrupted 1 day period.
	Test Data	LATISS, ComCAM, or FullCAM data.
	Expected Result	Normal operations.
2	Description	Simulate equipment outage by disconnecting power card from primary DWDM equipment on base side of Summit - Base Fiber.
	Test Data	NA
	Expected Result	Network fails over to secondary equipment in <=60s.
3	Description	Transfer data between summit and base over secondary equipment uninterrupted 1 day period while monitoring network.
	Test Data	NA
	Expected Result	Verify that secondary equipment is capable of transferring 1 night of raw data (nCalibExpDay + nRawExpNightMax = 450 + 2800 = 3250 exposures) within summmToBaseNet2TransMax (72 hours), i.e. at or exceeding rates specified in LDM-142.
4	Description	Restore primary equipment (i.e. reconnect power card to primary equipment.)
	Test Data	NA
	Expected Result	Network recovers to primary in <= 60s.
5	Description	Simulate fiber outage by disconnecting fiber from primary DWDM equipment on base side of Summit - Base Fiber.
	Test Data	NA
	Expected Result	Network fails over to AURA DWDM and fiber.
6	Description	Transfer data between summit and base over AURA fiber and equipment uninterrupted 1 day period while monitoring network.
	Test Data	LATISS, ComCAM, or FullCAM data.
	Expected Result	Verify that AURA fiber and equipment is capable of transferring 1 night of raw data (nCalibExpDay + nRawExpNightMax = 450 + 2800 = 3250 exposures) within summmToBaseNet2TransMax (72 hours), i.e. at or exceeding rates specified in LDM-142.
7	Description	Restore primary fiber (i.e. reconnect fiber to Rubin Observatory DWDM equipment.)
	Test Data	

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Step	Description, Input Data and Expected Result	
	Expected Result	Network recovers to Rubin Observatory fiber and DWDM.
8	Description	Demonstrate use of secondary in "catch-up" mode.
	Test Data	DAQ data buffer full of images and associated meta-data
	Expected Result	Images from DAQ buffer and associated metadata are retrievable over secondary path while current observing data is being transferred over primary path.

3.6   [LVV-77] DMS-REQ-0175-V-01: Summit to Base Network Ownership and Operation

Jira Link	Assignee	Status	Priority	Test Cases
LVV-77	Robert Gruendl	Not Covered	1a	LVV-T188

Verification Element Description:

This requirement is verified by inspecting construction and operations contracts and Indefeasible Rights to Use (IRUs).

Upstream Requirements		
Requirement ID	DMS-REQ-0175	
Requirement Description	**Specification:** The Summit to Base communications link shall be owned and operated by LSST and/or the operations entity to ensure responsiveness of support.	
Requirement Priority	1b	
Upper Level Requirement	DMS-REQ-0173	Summit to Base Network Reliability
	OSS-REQ-0036	Local Autonomous Administration of System Sites
	DMS-REQ-0172	Summit to Base Network Availability

3.6.1   [LVV-T188] Verify implementation of Summit to Base Network Ownership and Operation

Test Case Summary					
Jira Link	Owner	Status	Version	Critical Event	Verification Type
LVV-T188	Jeff Kantor	Draft	1	false	Inspection

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Objective:

Verify Summit to Base Network Ownership and Operation by LSST and/or the operations entity by inspection of construction and operations contracts and Indefeasible Rights.

Precondition:

As-built documentation for all of the above contracts and IRUs is available.

Predecessors:

PMCS DMTC-7400-2140, -2240, -2330 Complete

Test Personnel:

Jeff Kantor (LSST)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Examine contracts with REUNA and telefonica for fiber ownership and maintenance terms.
	Test Data	
	Expected Result	Rubin Observatory is owner of fibers on AURA property and Summit - Base DWDM and has 15-year IRU for use of fibers on all segments. REUNA is owner of LS - SCL DWDM on AURA property and in Santiago, and is operator on all fibers and DWDM. Telefonica is contracted to maintain fibers not on AURA property.

3.7   [LVV-81] DMS-REQ-0180-V-01: Base to Archive Network

Jira Link	Assignee	Status	Priority	Test Cases
LVV-81	Robert Gruendl	Not Covered	1a	LVV-T193

Verification Element Description:

This requirement is verified by transferring simulated or pre-cursor image data and metadata between base and archive over an uninterrupted 1 day period. Â Analyze the network performance and show that data can be transferred by DAQ within the required time.

Upstream Requirements	
Requirement ID	DMS-REQ-0180

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Requirement De-scription	**Specification:** The DMS shall provide communications infrastructure between the Base Facility and the Archive Center sufficient to carry scientific data and associated metadata for each image in no more than time **baseToArchiveMaxTransferTime**.	
Requirement Pa-rameters	**baseToArchiveMaxTransferTime = 5[second]** Maximum time interval to transfer a full Crosstalk Corrected Exposure and all related metadata from the Base Facility to the Archive Center.	
Requirement Prior-ity	1b	
Upper Level Re-quirement	OSS-REQ-0053	Base-Archive Connectivity Loss
	OSS-REQ-0055	Base Updating from Archive
	DMS-REQ-0162	Pipeline Throughput

3.7.1 [LVV-T193] Verify implementation of Base to Archive Network

Test Case Summary					
Jira Link	**Owner**	**Status**	**Version**	**Critical Event**	**Verification Type**
LVV-T193	Jeff Kantor	Draft	1	false	Test

Objective:
Verify that the data acquired by a DAQ can be transferred within the required time, i.e. verify that link is capable of transferring image for prompt processing in oArchiveMaxTransferTime = 5[second], i.e. at or exceeding rates specified in LDM-142.

Precondition:
Archiver/Forwarders are configured at Base, connected to REUNA DWDM, loaded with simu-lated or pre-cursor data.
Archiver/Forwarder receivers or other capability is on configured at LDF, connected to Base - Archive Network.
As-built documentation for all of the above is available.

Predecessors:
PMCS DM-Net-5 Complete

Test Personnel:
Ron Lambert (LSST)

Test Procedure

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Step	Description, Input Data and Expected Result	
1	Description	Transfer data between base and archive while monitoring the network over uninterrupted 1 day period (with repeated transfers on normal observing cadence).
	Test Data	LATISS, ComCAM, or FullCAM data.
	Expected Result	Data transfers occur without significant delay or frequent latency spikes.
2	Description	Analyze the network logs and monitoring system to determine average and peak latency and packet loss statistics.
	Test Data	
	Expected Result	Data can be transferred within the required time, i.e. verify that link is capable of transferring image for prompt processing in oArchiveMaxTransferTime = 5[second]. Verify transfer of data at or exceeding rates specified in LDM-142 at least 98% of the time.

3.8   [LVV-82] DMS-REQ-0181-V-01: Base to Archive Network Availability

Jira Link	Assignee	Status	Priority	Test Cases
LVV-82	Robert Gruendl	Not Covered	1a	LVV-T194

Verification Element Description:

This requirement is verified by transferring data between base and archive over uninterrupted 1 week period, modeling to extrapolate to an annual failure rate, and verifying that is within the requirement.

Upstream Requirements		
Requirement ID	DMS-REQ-0181	
Requirement Description	**Specification:** The Base to Archive communications shall be highly available, with MTBF > **baseToArchNetMTBF**.	
Requirement Parameters	**baseToArchNetMTBF = 180[day]** Mean time between failures, measured over a 1-yr period.	
Requirement Priority	1b	
Upper Level Requirement	OSS-REQ-0053	Base-Archive Connectivity Loss
	DMS-REQ-0162	Pipeline Throughput
	DMS-REQ-0161	Optimization of Cost, Reliability and Availability in Order

3.8.1   [LVV-T194] Verify implementation of Base to Archive Network Availability

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Test Case Summary

Jira Link	Owner	Status	Version	Critical Event	Verification Type
LVV-T194	Jeff Kantor	Draft	1	false	Test

Objective:

Verify the availability of the Base to Archive Network communications by demonstrating that it meets or exceeds a mean time between failures, measured over a 1-yr period of MTBF > baseToArchNetMTBF (180[day])

Precondition:

Archiver/Forwarders are configured at Base, connected to REUNA DWDM, loaded with simulated or pre-cursor data.

Archiver/Forwarder receivers or other capability is on configured at LDF, connected to Base - Archive Network.

At least 6 months of historical monitoring data on this link is available.

As-built documentation for all of the above is available.

Predecessors:

PMCS DMTC-7400-2130 Complete

Test Personnel:

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Transfer data between base and archive over uninterrupted 1 week period.
	Test Data	LATISS, ComCAM, or FullCAM data.
	Expected Result	Data is successfully transferred during the entire week.
2	Description	Analyze monitoring/performance data, compare to historical data, and extrapolate to a full year, average and peak throughput and latency.
	Test Data	NA
	Expected Result	Extrapolated network availability meets baseToArchNetMTBF = 180[day]. Note that this is for complete loss of transfer service (all paths), not a single path failure with successful fail-over.

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3.9 [LVV-83] DMS-REQ-0182-V-01: Base to Archive Network Reliability

Jira Link	Assignee	Status	Priority	Test Cases
LVV-83	Robert Gruendl	Not Covered	1a	LVV-T195

Verification Element Description:

Disconnect, reconnect and recover transfer of data between summit and base, after disconnecting fiber at an intermediate location between base and archive

Upstream Requirements	
Requirement ID	DMS-REQ-0182
Requirement Description	**Specification:** The Base to Archive communications shall be highly reliable, with MTTR < **baseToArchNetMTTR**.
Requirement Parameters	**baseToArchNetMTTR = 48[hour]** Mean time to repair, measured over a 1-yr period.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0053 Base-Archive Connectivity Loss DMS-REQ-0161 Optimization of Cost, Reliability and Availability in Order

3.9.1 [LVV-T195] Verify implementation of Base to Archive Network Reliability

Test Case Summary					
Jira Link	Owner	Status	Version	Critical Event	Verification Type
LVV-T195	Jeff Kantor	Draft	1	false	Test

Objective:

Verify Base to Archive Network Reliability by demonstrating that the network can recover from outages within baseToArchNetMTTR = 48[hour].

Precondition:

Archiver/Forwarders are configured at Base, connected to REUNA DWDM, loaded with simulated or pre-cursor data.

Archiver/Forwarder receivers or other capability is on configured at LDF, connected to Base - Archive Network.

At least 6 months of monitoring data for this link is available.

As-built documentation for all of the above is available.

Predecessors:

PMCS DM-NET-5 Complete

Test Personnel:

Ron Lambert (LSST), Albert Astudillo (REUNA), Jeronimo Bezerra (FIU/AmLight), Matt Kollross (NCSA)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Disconnect primary fiber on base side of Base - Archive network.
	Test Data	LATISS, ComCAM, or FullCAM data.
	Expected Result	Network fails over to secondary path.
2	Description	Simulate diagnosis and repair by elapsed time.
	Test Data	NA
	Expected Result	Wall clock advances by 48 hours. Data is successfully transferred over secondary path.
3	Description	Reconnect primary fiber on base side of Base - Archive network.
	Test Data	NA
	Expected Result	Network recovers to primary path.
4	Description	Analyze fail-over and recovery times. Compare to historical data and extrapolate to MTTR.
	Test Data	
	Expected Result	Verify recovery can occur within baseToArchNetMTTR = 48[hour]. Demonstrate reconnection and recovery to transfer of data at or exceeding rates specified in LDM-142.

3.10 [LVV-84] DMS-REQ-0183-V-01: Base to Archive Network Secondary Link

Jira Link	Assignee	Status	Priority	Test Cases

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LVV-84	Robert Gruendl	Not Covered	1a	LVV-T196

Verification Element Description:

This requirement is verified by disconnecting the primary link, failing over to the secondary link, reconnecting primary link, and failing back to primary link, while verifying data is transferred within required times.

Upstream Requirements	
Requirement ID	DMS-REQ-0183
Requirement Description	**Specification:** The Base to Archive communications shall provide a secondary link or transport mechanism (e.g. protected circuit) for operations support and "catch up" in the event of extended outage which is capable of transferring data at least the same rate as the required minimum capacity of the primary link.
Requirement Priority	1b
Upper Level Requirement	DMS-REQ-0181 Base to Archive Network Availability DMS-REQ-0182 Base to Archive Network Reliability OSS-REQ-0049 Degraded Operational States

3.10.1 [LVV-T196] Verify implementation of Base to Archive Network Secondary Link

Test Case Summary					
Jira Link	**Owner**	**Status**	**Version**	**Critical Event**	**Verification Type**
LVV-T196	Jeff Kantor	Draft	1	false	Test

Objective:

Verify Base to Archive Network Secondary Link failover and capacity, and subsequent recovery primary. Demonstrate the use of the secondary path in "catch-up" mode.

Precondition:

Archiver/Forwarders are configured at Base, connected to REUNA DWDM, loaded with simulated or pre-cursor data.
Archiver/Forwarder receivers or other capability is on configured at LDF, connected to Base - Archive Network.
As-built documentation for all of the above is available.

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Predecessors:

PMCS DM-NET-5 Complete

PMCS DMTC-8000-0990 Complete

PMCS DMTC-8100-2130 Complete

PMCS DMTC-8100-2530 Complete

PMCS DMTC-8200-0600 Complete

Test Personnel:

Ron Lambert (LSST), Albert Astudillo (REUNA), Jeronimo Bezerra (FIU/AmLight), Matt Kollross (NCSA)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Transfer data between base and archive on primary links over uninterrupted 1 day period.
	Test Data	LATISS, ComCAM, or FullCAM data.
	Expected Result	Data is successfully transferred over primary link at or exceeding rates specified in LDM-142 through-out period.
2	Description	Simulate outage by disconnecting fiber on primary fiber on Base side of Base - Archive Network.
	Test Data	NA
	Expected Result	Network fails over to secondary links in <=60s
3	Description	Transfer data between base and archive over secondary equipment uninterrupted 1 day period.
	Test Data	LATISS, ComCAM, or FullCAM data.
	Expected Result	Data is successfully transferred over secondary link at or exceeding rates specified in LDM-142 throughout period.
4	Description	Restore connection on primary link by reconnecting fiber.
	Test Data	NA
	Expected Result	Network recovers to primary.
5	Description	Demonstrate use of secondary in catch-up mode.
	Test Data	DAQ buffer full of images and associated metadata.

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Step	Description, Input Data and Expected Result	
Expected Result	Images from DAQ buffer and associated metadata are retrievable over secondary path while current observing data is being transferred over primary path.	

3.11   [LVV-88] DMS-REQ-0188-V-01: Archive to Data Access Center Network

Jira Link	Assignee	Status	Priority	Test Cases
LVV-88	Robert Gruendl	Not Covered	1a	LVV-T200

Verification Element Description:

This requirement is verified by transferring data between archive and both DACs over uninterrupted 1 day period, analyzing the network performance, and verifying that data can be transferred within the required time.

Upstream Requirements	
Requirement ID	DMS-REQ-0188
Requirement Description	**Specification:** The DMS shall provide communications infrastructure between the Archive Center and Data Access Centers sufficient to carry scientific data and associated metadata in support of community and EPO access. Aggregate bandwidth for data transfers from the Archive Center to Data Centers shall be at least **archToDacBandwidth**.
Requirement Parameters	**archToDacBandwidth = 10000[megabit per second]** Aggregate bandwidth capacity for data transfers between the Archive and Data Access Centers.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0004 The Archive Facility

3.11.1   [LVV-T200] Verify implementation of Archive to Data Access Center Network

Test Case Summary					
Jira Link	Owner	Status	Version	Critical Event	Verification Type
LVV-T200	Jeff Kantor	Draft	1	false	Test

Objective:

Verify archiving of data to Data Access Center Network at or exceeding rates specified in LDM-

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142, i.e at archToDacBandwidth = 10000[megabit per second].

Precondition:

Data is staged in LDF and data transfer capabilities to US DAC and Chilean DAC are in place.
At least 6 months of historical monitoring data is available on these network links.
As-built documentation for all of the above is available.

Predecessors:

PMCS DMTC-8100-2550 Complete

Test Personnel:

Ron Lambert (LSST), Albert Astudillo (REUNA), Jeronimo Bezerra (FIU/AmLight), Matt Kollross (NCSA)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Transfer data from Data Facility to US and Chilean DACs over an uninterrupted 1 week period.
	Test Data	Data Release
	Expected Result	Data transfers without significant failures or extended latency spikes
2	Description	Analyze network logs and compare with historical data on the links.
	Test Data	NA
	Expected Result	The networks can transfer data at archToDacBandwidth = 10000[megabit per second], i.e. at or exceeding rates specified in LDM-142.

3.12 [LVV-89] DMS-REQ-0189-V-01: Archive to Data Access Center Network Availability

Jira Link	Assignee	Status	Priority	Test Cases
LVV-89	Robert Gruendl	Not Covered	1a	LVV-T201

Verification Element Description:

This requirement needs the network link to be active for a calculated amount of time (at least 1 week) without failure. This will require modeling as failures are rare, so an annual MTBF will be estimated from test results.

Upstream Requirements	
Requirement ID	DMS-REQ-0189
Requirement Description	**Specification:** The Archive to Data Access Center communications shall be highly available, with MTBF > **archToDacNetMTBF**.
Requirement Parameters	**archToDacNetMTBF = 180[day]** Mean Time Between Failures for data service between Archive and DACs, averaged over a one-year period.
Requirement Priority	1b
Upper Level Requirement	DMS-REQ-0161 Optimization of Cost, Reliability and Availability in Order

3.12.1 [LVV-T201] Verify implementation of Archive to Data Access Center Network Availability

Test Case Summary					
Jira Link	**Owner**	**Status**	**Version**	**Critical Event**	**Verification Type**
LVV-T201	Jeff Kantor	Draft	1	false	Test

Objective:

Verify availability of archiving to Data Access Center Network using test and historical data of or exceeding archToDacNetMTBF= 180[day].

Precondition:

Data is staged in LDF and data transfer capabilities to US DAC and Chilean DAC are in place.
At least 6 months of historical monitoring data is available on these network links.
As-built documentation for all of the above is available.

Predecessors:

PMCS DMTC-8100-2550 Complete

Test Personnel:

Ron Lambert (LSST), Albert Astudillo (REUNA), Jeronimo Bezerra (FIU/AmLight), Matt Kollross

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Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Transfer data between archive and DACs over uninterrupted 1 week period.
	Test Data	Data Release or petabyte-scale test data set
	Expected Result	Data transfers without failures or extended latency spikes
2	Description	Analyze test data and compare to historical data. Extrapolate to 1 year testimate of MTBF.
	Test Data	NA
	Expected Result	Networks can meet archToDacNetMTBF = 180[day] at or exceeding rates specified in LDM-142.

3.13 [LVV-90] DMS-REQ-0190-V-01: Archive to Data Access Center Network Reliability

Jira Link	Assignee	Status	Priority	Test Cases
LVV-90	Robert Gruendl	Not Covered	1a	LVV-T202

Verification Element Description:

This requirement is verified by reconnecting and recovering transfer of data between archive and DACs, after disconnecting fiber at an intermediate location between archive and DACs.

Upstream Requirements	
Requirement ID	DMS-REQ-0190
Requirement Description	**Specification:** The Archive to Data Access Center communications shall be highly reliable, with MTTR < **archToDacNetMTTR**.
Requirement Parameters	**archToDacNetMTTR = 48[hour]** Mean time to repair, measured over a 1-yr period.
Requirement Priority	1b
Upper Level Requirement	DMS-REQ-0161 Optimization of Cost, Reliability and Availability in Order

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3.13.1 [LVV-T202] Verify implementation of Archive to Data Access Center Network Reliability

Test Case Summary					
Jira Link	**Owner**	**Status**	**Version**	**Critical Event**	**Verification Type**
LVV-T202	Jeff Kantor	Draft	1	false	Test

Objective:

Verify the reliability of Archive to Data Access Center Network by demonstrating successful failover and capacity to the secondary part and subsequent recovery to primary within or exceeding chToDacNetMTTR = 48[hour].

Precondition:

Data is staged in LDF and data transfer capabilities to US DAC and Chilean DAC are in place. As-built documentation for all of the above is available.

Predecessors:

PMCS DMTC-8100-2550 Complete

Test Personnel:

Ron Lambert (LSST), Albert Astudillo (REUNA), Jeronimo Bezerra (FIU/AmLight), Matt Kollross (NCSA)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Simulate failure on primary paths by disconnecting fiber at an endpoint location in the archive on the Archive - DACs network.
	Test Data	NA
	Expected Result	Networks fail over to secondary paths.
2	Description	Monitor transfers on secondary paths for 1 day.
	Test Data	
	Expected Result	Transfers occur without extended failures or extended latency spikes. Data transfers on secondary at rates at or above those specified in LDM-142.

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Step	Description, Input Data and Expected Result	
3	Description	Simulate repair and recovery period by leaving primary fiber disconnected for at least 1 day, then reconnecting primary fiber.
	Test Data	NA
	Expected Result	Wall clock advances by 1 day. Network recovers to primary path. Verify entire process meets chTo-DacNetMTTR = 48[hour].

3.14   [LVV-91] DMS-REQ-0191-V-01: Archive to Data Access Center Network Secondary Link

Jira Link	Assignee	Status	Priority	Test Cases
LVV-91	Robert Gruendl	Not Covered	1a	LVV-T203

Verification Element Description:

This requirement is verified by reconnecting and recovering transfer of data between archive and DACs, after disconnecting fiber at an intermediate location between archive and DACs.

Upstream Requirements	
Requirement ID	DMS-REQ-0191
Requirement Description	**Specification:** The Archive to Data Access Center communications shall provide secondary link or transport mechanism (e.g. protected circuit) for operations support and "catch up" in the event of extended outage.
Requirement Priority	1b
Upper Level Requirement	DMS-REQ-0189 Archive to Data Access Center Network Availability DMS-REQ-0190 Archive to Data Access Center Network Reliability

3.14.1   [LVV-T203] Verify implementation of Archive to Data Access Center Network Secondary Link

Test Case Summary					
Jira Link	Owner	Status	Version	Critical Event	Verification Type
LVV-T203	Kian-Tat Lim	Draft	1	false	Test

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Objective:

Verify the Archive to Data Access Center Network via Secondary Link by simulating a failure on the primary path and capacity on the secondary path.

Precondition:

Data is staged in LDF and data transfer capabilities to US DAC and Chilean DAC are in place. As-built documentation for all of the above is available.

Predecessors:

PMCS DMTC-8100-2550 Complete

Test Personnel:

Ron Lambert (LSST), Albert Astudillo (REUNA), Jeronimo Bezerra (FIU/AmLight), Matt Kollross (NCSA)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Transfer data between Archive and DACs on primary path over uninterrupted 1 week period.
	Test Data	Data Release or other petabyte-scale test data set.
	Expected Result	Data transfers without failures or extended latency spikes, at or exceeding rates specified in LDM-142 throughout fail-over period.
2	Description	Simulate outage on primary path by disconnecting fiber on primary on Archive side of Archive - DACs networks.
	Test Data	NA
	Expected Result	Network fails over to secondary links in <= 60s.
3	Description	Transfer data between base and archive over secondary equipment uninterrupted 1 day period.
	Test Data	Data Release or other petabyte-scale test data set.
	Expected Result	Data transfers without failures or extended latency spikes, at or exceeding rates specified in LDM-142 throughout fail-over period.
4	Description	Restore connection on primary link (reconnect fiber).
	Test Data	NA
	Expected Result	Network recovers to primary in <= 60s.

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Step	Description, Input Data and Expected Result

3.15   [LVV-183] DMS-REQ-0352-V-01: Base Wireless LAN (WiFi)

Jira Link	Assignee	Status	Priority	Test Cases
LVV-183	Robert Gruendl	Not Covered	1a	LVV-T192

Verification Element Description:

At Base Facility, connect to WiFi, test connection speed, i.e. send email, browse web, and retrieve files from the Internet.

Upstream Requirements	
Requirement ID	DMS-REQ-0352
Requirement Description	**Specification:** The Base LAN shall provide **minBaseWiFi** Wireless LAN (WiFi) and Wireless Access Points in the Base Facility to support connectivity of individual user's computers to the network backbones.
Requirement Parameters	**minBaseWifi = 1000[megabit per second]** Maximum allowable outage of active DM production.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0003 The Base Facility

3.15.1   [LVV-T192] Verify implementation of Base Wireless LAN (WiFi)

Test Case Summary					
Jira Link	Owner	Status	Version	Critical Event	Verification Type
LVV-T192	Jeff Kantor	Draft	1	false	Test

Objective:

Verify as-built wireless network at the Base Facility supports minBaseWiFi bandwidth (1000 Mbs).

Precondition:

Base Wireless LAN is installed/configured and Test Personnel have accounts for email, inter-

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net access.

As-built documentation for all of the above is available.

Predecessors:

PMCS DLP-465 Complete.

Test Personnel:

Heinrich Reinking (LSST)

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Test internet web browsing and file download, email at summit and base over wireless.
	Test Data	NA
	Expected Result	Verify as-built wireless network at the Base Facility supports minBaseWiFi bandwidth (1000 Mbs). Verify wireless signal strength meets or exceeds typical, and average and peak bandwidths meet or exceed minBaseWiFI bandwidth.

3.16   [LVV-18491] DMS-REQ-0352-V-02: Base Voice Over IP (VOIP)

Jira Link	Assignee	Status	Priority	Test Cases
LVV-18491	Robert Gruendl	Not Covered	2	LVV-T181

Verification Element Description:

Verify (a) plannned and (b) as-built VOIP at the Base Facility is operational and performs as expected (i.e. sufficient number of extensions allocated properly, no frequent drop-outs, no frequent jaggies on video, etc.). Test voice calls and videoconferening.

Upstream Requirements	
Requirement ID	DMS-REQ-0352
Requirement Description	**Specification:** The Base LAN shall provide **minBaseWiFi** Wireless LAN (WiFi) and Wireless Access Points in the Base Facility to support connectivity of individual user's computers to the network backbones.
Requirement Parameters	**minBaseWifi = 1000[megabit per second]** Maximum allowable outage of active DM production.
Requirement Priority	2

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Upper Level Requirement	OSS-REQ-0003	The Base Facility

3.16.1   [LVV-T181] Verify Base Voice Over IP (VOIP)

Test Case Summary					
Jira Link	**Owner**	**Status**	**Version**	**Critical Event**	**Verification Type**
LVV-T181	Jeff Kantor	Draft	1	false	Test

Objective:

Verify as-built VOIP at the Base Facility is operational and performs as expected (i.e. sufficient number of extensions allocated properly, no frequent drop-outs, no frequent jaggies on video, etc.) on both voice calls and videoconferening.

Precondition:

Base VOIP is installed/configured and Test Personnel have phone sets. Base Videoconference system is installed/configured. Summit, Headquarters, and/or LDF Videoconference system is installed/configured.
As-built documentation for all of the above is available.

Predecessors:

PMCS DLP-465 Complete
PMCS IT-702 Complete

Test Personnel:

Heinrich Reinking (LSST), another LSST DM Person at Summit, Headquarters, or LDF

Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Test voice calls over VOIP system from Base Facility to locations in Base and to other Rubin Observatory facilities.
	Test Data	
	Expected Result	As-built VOIP at the Base Facility is operational and performs as expected (i.e. sufficient number of extensions allocated properly, no frequent drop-outs, etc.).

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Step	Description, Input Data and Expected Result	
2	Description	Test video conferences over system from Base Facility to locations in Base and to other Rubin Observatory facilities.
	Test Data	
	Expected Result	Verify (a) plannned and (b) as-built VOIP at the Base Facility is operational and performs as expected (i.e. no frequent drop-outs, no frequent audio glitches, no frequent jaggies on video, etc.).

A   References

[1] **[LSE-61]**, Dubois-Felsmann, G., Jenness, T., 2018, *LSST Data Management Subsystem Requirements*, LSE-61, URL `https://ls.st/LSE-61`

[2] **[document-14789]**, Kantor, J., 2014, *LSST Long-Haul Networks (LHN) End-to-end Test Plan*, document-14789, URL `https://ls.st/document-14789`

[3] **[LDM-142]**, Kantor, J., 2017, *Network Sizing Model*, LDM-142, URL `https://ls.st/LDM-142`

B   Acronyms

Acronym	Description
BDC	Base Data Center
BERT	Bit Error Rate Tester
CCB	Change Control Board
CCS	Camera Control System
CISS	Computer Infrastructure Services South (part of the former NOAO Cerro Tololo Inter-american Observatory (CTIO), now merged into NSF'S OIR Lab Central Operating Services)
CTIO	Cerro Tololo Inter-American Observatory
DAC	Data Access Center
DAQ	Data Acquisition System
DM	Data Management

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DMCS	Data Management Control System
DMS	Data Management Subsystem
DMS-REQ	Data Management top level requirements (LSE-61)
DMSR	DM System Requirements; LSE-61
DMSSIT	DM Subsystem Integration Test
DMTR	DM Test (Plan and) Report
DTN	Data Transfer Node
DWDM	Dense Wave Division Multiplex
Db	Decibel
EFD	Engineering and Facility Database
EPO	Education and Public Outreach
FIU	Florida International University
HL	Higher Level
IP	Internet Protocol
ISO	International Standards Organization
IT	Information Technology
LAN	Local Area Network
LATISS	LSST Atmospheric Transmission Imager and Slitless Spectrograph
LDF	LSST Data Facility
LDM	LSST Data Management (Document Handle)
LHN	Long-Haul Networks
LL	Lower Level
LS	La Serena
LSE	LSST Systems Engineering (Document Handle)
LSST	Legacy Survey of Space and Time (formerly Large Synoptic Survey Telescope)
LVV	LSST Verification and Validation (Jira project)
MTBF	Mean Time Between Failures
MTTR	Mean Time to Repair
NA	Not Available
NCSA	National Center for Supercomputing Applications
NET	Network Engineering Team
OCS	Observatory Control System
OSI	Open System Interconnect

OSS	Observatory System Specifications; LSE-30
OTDR	Optical Time Domain Reflectometer
PMCS	Project Management Controls System
REUNA	Red Universitaria Nacional
RFC	Request For Comment
SC	Science Collaboration
SCL	Santiago, Chile
SIT	LSST System Integration Test
SL	Same Level
SLAC	SLAC National Accelerator Lab
TCS	Telescope Control System
US	United States
VNVD	Vera C Rubin Observatory Network Verification Document
VOIP	Voice Over Internet Protocol
WBS	Work Breakdown Structure