Vera C. Rubin Observatory
Data Management

Network Verification Elements

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LDM-732

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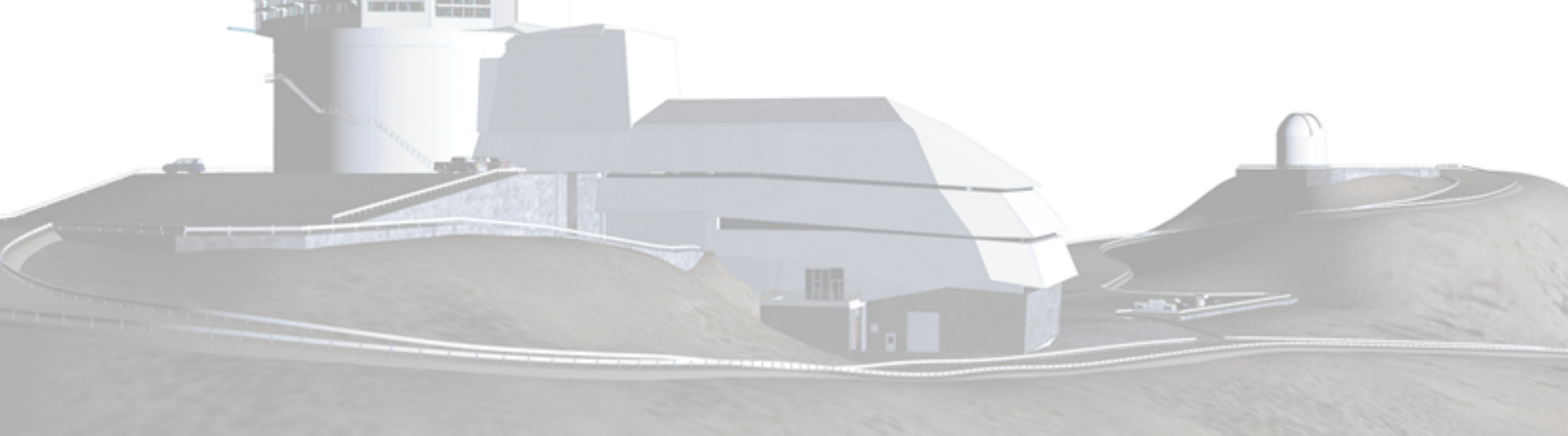

Abstract

The Network Verification Elements document and associated LSST Verification and Validation (LVV) Jira project present the flow-down of specifications from higher level documents to the Observatory Network (as defined in LSE-61 Data Management System (DMS) Requirements), as well as defining the methods and resources that will be used to verify that network requirements have been met.

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Network Verification Elements

1 Introduction

1.1 Scope

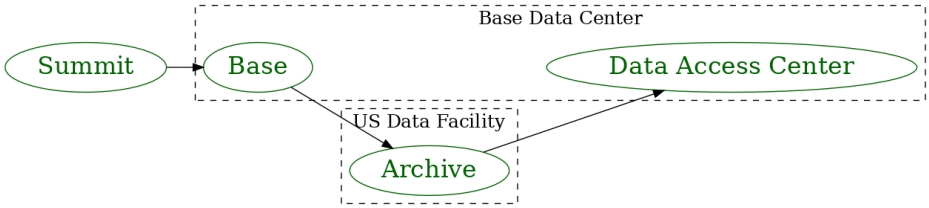

FIGURE 1: A diagram depicting the inter-facility network data transfers identified in LSE-61.

This document pertains only to the verification of the network infrastructure, not the applications and services that use the network, specifically, up to OSI Layer 3 for the Summit facility, the Base Facility, Summit to Base communication, Base to Archive communication, and Archive to the [Chilean] Data Access Center communication. The transfer of data products, such as alert streams or pixel data, from the US Data Facility to parties external to the observatory are explicitly out of scope.

As such, all of the Verification Elements defined in the LSST Verification and Validation (LVV) Jira project and presented in this document are Lower Level (LL) in the System Engineering test hierarchy.

LL corresponds to Data Management Subsystem Integration. Where appropriate, additional comments regarding Same Level (SL) which corresponds to LSST System Integration, and Higher Level (HL) which corresponds to LSST Commissioning, are called out in the Verification Elements.

Note that significant testing of the networks occurs prior to subsystem and system integration, i.e. prior to verification, as discussed in LSST LHN End-to-End Plan and associated documentation in Collection-3758.

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1.2 Specification Flow-down

1.2.1 Data Management Subsystem Requirements Flow-down

The Data Management Subsystem Requirements (DMSR) (LSE-61) drive the LSST Observatory Network Design. The specific DMSR requirements that directly drive network design are listed here for convenience.

Name	ID
1.3.1 Nightly Data Accessible Within Specified Time	DMS-REQ-0004 (Priority: 1b)
1.6.4 Constraints on Level 1 Special Program Products Generation	DMS-REQ-0344 (Priority: 2)
2.2.3 Transient Alert Distribution	DMS-REQ-0002 (Priority: 1b)
2.2.3.1 Alert Stream Distribution	DMS-REQ-0391 (Priority: 2)
2.2.3.2 Alert Delay and Failure Tolerances	DMS-REQ-0392 (Priority: 2)
2.2.7 DIASource Precovery	DMS-REQ-0287 (Priority: 1b)
2.2.9 Solar System Objects Available Within Specified Time	DMS-REQ-0089 (Priority: 1b)
4.1.2 Engineering & Facility Database Archive	DMS-REQ-0102 (Priority: 1b)
4.4.1 Summit to Base Network	DMS-REQ-0171 (Priority: 1a)
4.4.2 Summit to Base Network Availability	DMS-REQ-0172 (Priority: 1b)
4.4.3 Summit to Base Network Reliability	DMS-REQ-0173 (Priority: 1b)
4.4.4 Summit to Base Network Secondary Link	DMS-REQ-0174 (Priority: 1b)
~~4.4.5 Summit to Base Network Ownership and Operation~~	DMS-REQ-0175 (Priority: 1b)
4.5.5 Base Wireless LAN (WiFi)	DMS-REQ-0352 (Priority: 2)
4.6.1 Base to Archive Network	DMS-REQ-0180 (Priority: 1b)
4.6.2 Base to Archive Network Availability	DMS-REQ-0181 (Priority: 1b)
4.6.3 Base to Archive Network Reliability	DMS-REQ-0182 (Priority: 1b)
4.6.4 Base to Archive Network Secondary Link	DMS-REQ-0183 (Priority: 1b)
4.8.1 Archive to Data Access Center Network	DMS-REQ-0188 (Priority: 1b)
4.8.2 Archive to Data Access Center Network Availability	DMS-REQ-0189 (Priority: 1b)
4.8.3 Archive to Data Access Center Network Reliability	DMS-REQ-0190 (Priority: 1b)
4.8.4 Archive to Data Access Center Network Secondary Link	DMS-REQ-0191 (Priority: 1b)

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1.2.2 Observatory System Specifications Flow-down

Note that the Observatory System Specifications (OSS) (LSE-30) also include general requirements on security, disaster recovery, physical environment (including seismic activity), and shipping which are flowed down to the subsystems, and while they apply to all subsystems, including the networks, they will be tested and verified in the Telescope and Data Management Subsystem Integration Tests and in the LSST Commissioning Phase, as part of the LSST System Integration Test. Those requirements are excluded from this specification and the associated verification matrix, as they will be addressed during system integration testing.

1.3 LSST Verification and Validation (LVV) Jira project

The LSST Verification and Validation (LVV) Jira project lists the specifications within or derived from, and traceable to, the DMSR specifications, in Verification Elements that also specify the methods to be used to verify, the responsible parties, and additional notes regarding verification, per the LSE-160 LSST Verification and Validation Process. The Verification Elements then have one or more Test Cases associated with them that describe the implementation of the verification activities in terms of specific tests to be executed. Those Test Cases are then scheduled via Test Plans and Campaigns, and executed with results reported in Test Cycles.

1.4 Verification and Validation Schedule and Resources

The schedule and resources required for network verification are defined in the LSST Project Management Control System (PMCS). They are covered by the final integration test activities in the WBS elements 02C.08.03 Long-Haul Networks. In each Verification Element, a cross-reference to the ID of the appropriate predecessor PMCS activities is provided in the pre-conditions field.

1.5 Applicable Documents

LSE-61	LSST DM Subsystem Requirements
LSE-78	LSST Observatory Network Design
LSE-160	Verification and Validation Process
LSE-309	Summit to Base Information Technology and Communication (ITC) Design
LSE-479	Network Technical Document

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2 DM - NETWORK Verification Elements

The following is the list of verification elements defined in the context of the NETWORK component[1] of the DM subsystem.

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

Jira Link	Assignee	Status	Test Cases
LVV-71	Joshua Hoblitt	Covered	LVV-T1097 LVV-T2338

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).

Requirement Details	
Requirement ID	DMS-REQ-0168
Requirement Priority	1a
Requirement Description and Discussion:	

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.

Upper Level Requirement	OSS-REQ-0002	The Summit Facility

[1] Major product in the subsystem.

2.1.1 Test Cases Summary

LVV-T1097	Verify Summit Facility Network Implementation			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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.

LVV-T2338	Replicated telemetry data agrees with telemetry produced at the summit			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
Simon Krughoff	Defined	1	false	Demonstration

Objective:

Show that telemetry data can be accessed from the replicated EFD. Further, show that the values in the replicated database agree with the values in the summit EFD over a specified time range and set of topics.

This test case provides partial coverage of the requirement DMS-REQ-0168, Summit Facility Data Communications: "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.", as adapted to the current design for EFD replication (see DMTN-082).

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

Jira Link	Assignee	Status	Test Cases
LVV-73	Joshua Hoblitt	In Verification	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. Demonstrate transfer of data at or exceeding rates specified in LDM-142.

Requirement Details	
Requirement ID	DMS-REQ-0171
Requirement Priority	1a
Requirement Description and Discussion:	

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.
Upper Level Requirement	OSS-REQ-0003 The Base Facility OSS-REQ-0127 Level 1 Data Product Availability

2.2.1 Test Cases Summary

LVV-T1168	Verify Summit - Base Network Integration			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
Jeff Kantor	Approved	1	false	Inspection

Objective:

Verify the integration of the summit to base network by demonstrating a sustained and uninterrupted 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).

LVV-T1612	Verify Summit - Base Network Integration (System Level)			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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.

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

Jira Link	Assignee	Status	Test Cases
LVV-74	Joshua Hoblitt	Covered	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.

Requirement Details	
Requirement ID	DMS-REQ-0172
Requirement Priority	1b
Requirement Description and Discussion:	

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.	
Upper Level Requirement	OSS-REQ-0373	Unscheduled Downtime Subsystem Allocations
	DMS-REQ-0161	Optimization of Cost, Reliability and Availability in Order

2.3.1 Test Cases Summary

LVV-T185	Verify implementation of Summit to Base Network Availability			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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.

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

Jira Link	Assignee	Status	Test Cases
LVV-75	Joshua Hoblitt	Covered	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. Network operator will provide MTTR data on links during commissioning and operations.

Requirement Details	
Requirement ID	DMS-REQ-0173
Requirement Priority	1b
Requirement Description and Discussion:	

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.	
Upper Level Requirement	OSS-REQ-0373	Unscheduled Downtime Subsystem Allocations
	DMS-REQ-0161	Optimization of Cost, Reliability and Availability in Order

2.4.1 Test Cases Summary

LVV-T186	Verify implementation of Summit to Base Network Reliability			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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.

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

Jira Link	Assignee	Status	Test Cases
LVV-76	Joshua Hoblitt	Covered	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 exposures) within summToBaseNet2TransMax (72 hours).

Requirement Details		
Requirement ID	DMS-REQ-0174	
Requirement Priority	1b	
Requirement Description and Discussion:		

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 **summToBaseNet2TransMax** or less.

Requirement Parameters	**summToBaseNet2TransMax = 72[hour]** Maximum time to transfer one night of data via the network secondary link.	
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

2.5.1 Test Cases Summary

LVV-T187	Verify implementation of Summit to Base Network Secondary Link			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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.

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

Jira Link	Assignee	Status	Test Cases
LVV-77	Joshua Hoblitt	Covered	LVV-T188

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

Requirement Details		
Requirement ID	DMS-REQ-0175	
Requirement Priority	1b	
Requirement Description and Discussion:		

Specification: The Summit to Base communications link shall be owned and operated by LSST and/or the operations entity to ensure responsiveness of support.

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

2.6.1 Test Cases Summary

LVV-T188	Verify implementation of Summit to Base Network Ownership and Operation			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
Jeff Kantor	Draft	1	false	Inspection

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.

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

Jira Link	Assignee	Status	Test Cases
LVV-81	Joshua Hoblitt	Covered	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. Analyze the network performance and show that data can be transferred by DAQ within the required time.

Requirement Details	
Requirement ID	DMS-REQ-0180
Requirement Priority	1b
Requirement Description and Discussion:	

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 Parameters	**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.
Upper Level Requirement	OSS-REQ-0053 Base-Archive Connectivity Loss OSS-REQ-0055 Base Updating from Archive DMS-REQ-0162 Pipeline Throughput

2.7.1 Test Cases Summary

LVV-T193	Verify implementation of Base to Archive Network			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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.

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

Jira Link	Assignee	Status	Test Cases
LVV-82	Joshua Hoblitt	Covered	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.

Requirement Details		
Requirement ID	DMS-REQ-0181	
Requirement Priority	1b	
Requirement Description and Discussion:		

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.	
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

2.8.1 Test Cases Summary

LVV-T194	Verify implementation of Base to Archive Network Availability			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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])

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

Jira Link	Assignee	Status	Test Cases
LVV-83	Joshua Hoblitt	Covered	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

Requirement Details	
Requirement ID	DMS-REQ-0182
Requirement Priority	1b
Requirement Description and Discussion:	

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.	
Upper Level Requirement	OSS-REQ-0053	Base-Archive Connectivity Loss
	DMS-REQ-0161	Optimization of Cost, Reliability and Availability in Order

2.9.1 Test Cases Summary

LVV-T195	Verify implementation of Base to Archive Network Reliability			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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].

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

Jira Link	Assignee	Status	Test Cases
LVV-84	Joshua Hoblitt	Covered	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.

Requirement Details		
Requirement ID	DMS-REQ-0183	
Requirement Priority	1b	
Requirement Description and Discussion:		

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.

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

2.10.1 Test Cases Summary

LVV-T196	Verify implementation of Base to Archive Network Secondary Link			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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.

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

Jira Link	Assignee	Status	Test Cases
LVV-88	Joshua Hoblitt	Covered	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.

Requirement Details	
Requirement ID	DMS-REQ-0188
Requirement Priority	1b
Requirement Description and Discussion:	

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.
Upper Level Requirement	

2.11.1 Test Cases Summary

LVV-T200	Verify implementation of Archive to Data Access Center Network			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
Jeff Kantor	Draft	1	false	Test

Objective:

Verify archiving of data to Data Access Center Network at or exceeding rates specified in LDM-142, i.e at archToDacBandwidth = 10000[megabit per second].

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

Jira Link	Assignee	Status	Test Cases
LVV-89	Joshua Hoblitt	Covered	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.

Requirement Details	
Requirement ID	DMS-REQ-0189
Requirement Priority	1b
Requirement Description and Discussion:	

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.
Upper Level Requirement	DMS-REQ-0161 Optimization of Cost, Reliability and Availability in Order

2.12.1 Test Cases Summary

LVV-T201	Verify implementation of Archive to Data Access Center Network Availability			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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].

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

Jira Link	Assignee	Status	Test Cases
LVV-90	Joshua Hoblitt	Covered	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.

Requirement Details	
Requirement ID	DMS-REQ-0190
Requirement Priority	1b
Requirement Description and Discussion:	

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.	
Upper Level Requirement	DMS-REQ-0161	Optimization of Cost, Reliability and Availability in Order

2.13.1 Test Cases Summary

LVV-T202	Verify implementation of Archive to Data Access Center Network Reliability			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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].

Draft

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

Jira Link	Assignee	Status	Test Cases
LVV-91	Joshua Hoblitt	Covered	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.

Requirement Details		
Requirement ID	DMS-REQ-0191	
Requirement Priority	1b	
Requirement Description and Discussion:		

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.

Upper Level Requirement	DMS-REQ-0189	Archive to Data Access Center Network Availability
	DMS-REQ-0190	Archive to Data Access Center Network Reliability

2.14.1 Test Cases Summary

LVV-T203	Verify implementation of Archive to Data Access Center Network Secondary Link			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
Kian-Tat Lim	Draft	1	false	Test

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.

DRAFT NOT YET APPROVED – The contents of this document are subject to configuration control by the Rubin Observatory DM Change Control Board. – DRAFT NOT YET APPROVED

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

Jira Link	Assignee	Status	Test Cases
LVV-183	Joshua Hoblitt	Covered	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.

Requirement Details	
Requirement ID	DMS-REQ-0352
Requirement Priority	2
Requirement Description and Discussion:	

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.
Upper Level Requirement	OSS-REQ-0003 The Base Facility

2.15.1 Test Cases Summary

LVV-T192	Verify implementation of Base Wireless LAN (WiFi)			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
Jeff Kantor	Draft	1	false	Test

Objective:

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

Draft

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

Jira Link	Assignee	Status	Test Cases
LVV-18491	Joshua Hoblitt	Covered	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.

Requirement Details	
Requirement ID	DMS-REQ-0352
Requirement Priority	2
Requirement Description and Discussion:	

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.
Upper Level Requirement	OSS-REQ-0003 The Base Facility

2.16.1 Test Cases Summary

LVV-T181	Verify Base Voice Over IP (VOIP)			
Owner	**Status**	**Version**	**Critical Event**	**Verification Type**
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.

A Traceability

Requirements	Verification Elements	Test Cases
DMS-REQ-0168	LVV-71	LVV-T1097
		LVV-T2338
DMS-REQ-0171	LVV-73	LVV-T1168
		LVV-T1612
DMS-REQ-0172	LVV-74	LVV-T185
DMS-REQ-0173	LVV-75	LVV-T186
DMS-REQ-0174	LVV-76	LVV-T187
DMS-REQ-0175	LVV-77	LVV-T188
DMS-REQ-0180	LVV-81	LVV-T193
DMS-REQ-0181	LVV-82	LVV-T194
DMS-REQ-0182	LVV-83	LVV-T195
DMS-REQ-0183	LVV-84	LVV-T196
DMS-REQ-0188	LVV-88	LVV-T200
DMS-REQ-0189	LVV-89	LVV-T201
DMS-REQ-0190	LVV-90	LVV-T202
DMS-REQ-0191	LVV-91	LVV-T203
DMS-REQ-0352	LVV-183	LVV-T192
	LVV-18491	LVV-T181

Note that some of the requirements listed in this traceability table may be related with additional Verification Elements not in the scope of *DM* component *NETWORK* subcomponent Verification, and therefore not listed here.

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B References

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[2] **[LSE-61]**, Dubois-Felsmann, G., Jenness, T., 2019, Data Management System (DMS) Requirements, LSE-61, URL https://lse-61.lsst.io/, Vera C. Rubin Observatory

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

[4] **[LSE-309]**, Kantor, J., 2017, Summit to Base Information Technology and Communication (ITC) Design, LSE-309, URL https://ls.st/LSE-309

[5] **[LSE-78]**, Lambert, R., Kantor, J., Huffer, M., et al., 2017, LSST Observatory Network Design, LSE-78, URL https://ls.st/LSE-78

[6] **[LSE-479]**, Network Engineering Team (NET), 2020, Network Technical Document, LSE-479, URL https://ls.st/LSE-479

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C Acronyms

Acronym	Description
CCB	Change Control Board
DAQ	Data Acquisition System
DM	Data Management
DMCS	Data Management Control System
DMS	Data Management Subsystem
DMS-REQ	Data Management top level requirements (LSE-61)
DMSR	DM System Requirements; LSE-61
DMTN	DM Technical Note
DWDM	Dense Wave Division Multiplex
EFD	Engineering and Facility Database
EPO	Education and Public Outreach
HL	Higher Level
IP	Internet Protocol
ISO	International Standards Organization
ITC	Information Technology Center
LAN	Local Area Network
LDM	LSST Data Management (Document Handle)
LHN	Long-Haul Networks
LL	Lower Level
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
OCS	Observatory Control System
OSI	Open System Interconnect
OSS	Observatory System Specifications; LSE-30
OTDR	Optical Time Domain Reflectometer
PMCS	Project Management Controls System
RFC	Request For Comment
SL	Same Level

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US	United States
VOIP	Voice Over Internet Protocol
WBS	Work Breakdown Structure

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