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Authors	BULGARELLI, ANDREA
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ASTRI Mini-Array Use Cases of the Telescope Service Cabinet Control System



Prepared by:	Name:	A. Bulgarelli	Signature:	<i>A. Bulgarelli</i>	Date:	Nov 29, 2022
Verified by:	Name:	G. Tosti	Signature:	<i>G. Tosti</i>	Date:	Nov 29, 2022
Approved by:	Name:	A. Bulgarelli/F. Lucarelli	Signature:	<i>A. Bulgarelli</i> <i>Fabrizio Lucarelli</i>	Date:	Nov 29, 2022
Released by:	Name:	S. Scuderi	Signature:	<i>Salvatore Scuderi</i>	Date:	Nov 29, 2022



ASTRI Mini-Array

Astrofisica con Specchi a Tecnologia Replicante Italiana



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Main Authors: A. Bulgarelli

Contributor Authors: G. Tosti

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1 Introduction

The **ASTRI Mini-Array (MA)** is an INAF project to construct and operate an experiment to study gamma-ray sources emitting at very high-energy in the TeV spectral band. The MA consists of an array of nine innovative Imaging Atmospheric Cherenkov Telescopes that are an evolution of the double-mirror ASTRI Horn telescope successfully tested since 2014 at the Serra La Nave Astronomical Station of the INAF Observatory of Catania. Each telescope will be equipped with the new version of the ASTRICAM Silicon photomultiplier Cherenkov Camera. The main scientific goal of the ASTRI Mini-Array is to perform high-energy ($E > 1$ TeV) observations of galactic and extragalactic sources with a sensitivity better than that reachable by the other Imaging Atmospheric Cherenkov telescopes currently in operation (HESS, MAGIC, VERITAS). Furthermore, the Mini-Array will also perform Intensity Interferometry of a selected sample of bright sources. The nine telescopes will be installed at the Teide Astronomical MA System, operated by the Instituto de Astrofísica de Canarias (IAC), on Mount Teide (~2400 m a.s.l.) in Tenerife (Canary Islands, Spain). The ASTRI MA will be operated by INAF on the basis of a host agreement with IAC.

1.1 Purpose

This document defines the Use Cases of the Telescope Service Cabinet Control System (TSCCS).

The Use Cases are divided into these main groups following the functional decomposition of the system:

1. TSCCS Lifecycle
2. TSCCS acquisition

1.2 Scope

The TSCCS is part of the Central Control of the Supervisory Control and Data Acquisition System (SCADA), as described in [AD3].

The TSCCS is a software system that acquire monitoring point and alarms from the Telescope Service Cabinets of ASTRI Mini-Array, and control the switch-on and switch-off of the telescopes.

1.3 Content



Sect 4 reports the use cases of the TSCCS.

1.4 Definitions, abbreviations and acronyms

The definitions and abbreviations used in this document can be found in [AD8] ASTRI-MA Glossary: ASTRI-INAF-LIS-9000-001.

TSC: Telescope Service Cabinet

TSCCS: Telescope Service Cabinet Control System

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2 Applicable and reference documents

2.1 Applicable documents

- [AD1] ASTRI-MA Management Plan: ASTRI-INAF-PLA 1000-001
- [AD2] ASTRI-MA Quality Plan: ASTRI-INAF-PLA-3000-0001
- [AD3] ASTRI-MA Top Level Software Architecture: ASTRI-INAF-DES-2100-001
- [AD4] ASTRI-MA Software Product Breakdown Structure: ASTRI-INAF-DES-2100-002
- [AD5] ASTRI-MA Data Model: ASTRI-INAF-DES-2100-003
- [AD6] ASTRI-MA Top Level Use Cases: ASTRI-INAF-SPE-2100-001
- [AD7] ASTRI-MA Software Development Plan: ASTRI-INAF-PLA-2100-002
- [AD8] ASTRI-MA Glossary: ASTRI-INAF-LIS-9000-001
- [AD8] ASTRI-MA System Engineering Management Plan: ASTRI-INAF-PLA-2100-002
- [AD9] ASTRI-MA Operation Concept: ASTRI-INAF-DES-1000-001
- [AD10] ASTRI-MA Risk Management Plan: ASTRI-INAF-PLA-1000-002
- [AD11] ASTRI Mini-Array Product Tree: ASTRI-INAF-DES-2000-001
- [AD12] Service Cabinet Concept Design ASTRI-INAF-DES-5600-001, issue 1.1 16/04/2021
- [AD13] CCTV Concept Design ASTRI-INAF-DES-6200-001, draft

2.2 Reference documents

- [RD1]



3 Actors

Human:

- **Operator**
- **Expert Operator**

System

- **Central Control System**
- **Monitoring System**
- **Operator HMI**

4 Use Cases

The list of use cases that must be developed are:

1. The Central Control system starts the Telescope Service Cabinet Control System
2. The Telescope Service Cabinet Control System acquire monitoring points and alarms
3. The Central Control system shutdown the Telescope Service Cabinet Control System
4. The Telescope Service Cabinet Control System switch-on the telescope
5. The Telescope Service Cabinet Control System switch-off the telescope

4.1 ASTRI-UC-9.1.1.7-010: The Central Control system starts the Telescope Service Cabinet Control System

Summary and Scope: This UC describes how the **Central Control System** starts and configures the TSCCS.

Authors: Andrea Bulgarelli, Gino Tosti

Version: 1.0

Trigger: Start of the Central Control System.

Frequency:

Phase: AIT/AIV, commissioning and nominal phase.

Assumptions:

Actors: Central Control System, TSCCS Manager

PRE-CONDITION CONSTRAINTS
- The Central Control System is running.
SCENARIOS
<p>Basic Path.</p> <ol style="list-style-type: none"> 1. The Central Control System starts the TSCCS Manager ACS component. <i>Alternate: 1a, The Expert Operator starts the TSCCS manually.</i> 2. The TSCCS Manager reads configurations from the configuration files. 3. The TSCCS Manager start the TSC Collector 4. The TSCCS Collector connects with each assembly of the Telescope Service Cabinet <p>Exception: 4a, The TSC Collector cannot connets to some Telescope Service Cabinet assemblies. Rejoins Main Scenario at End.</p>



5. The **Central Control System** checks that the **TSCCS Manager** is ready to operate and connected with all available assemblies.

Exception: 5a, The Central Control System cannot checks the TSCCS status. Rejoins Main Scenario at Step 1.

Exception: 5b, The TSCCS Manager cannot send feedback to the Central Control System. Rejoins Main Scenario at End.

Exception: 5c, The TSC Collector cannot connets to some Telescope Service Cabinet assemblies. Rejoins Main Scenario at End.

Alternate. The TSCCS is started manually

1. The **Expert Operator** starts the **TSCCS Manager** ACS component.

Exception. The TSCCS Manager cannot connets to some Telescope Service Cabinet assemblies.

1. The **TSCCS Collector** retries the connection.
2. After N secs the **TSCCS Collector** sends an alarm to ACS alarm system:
 - i. notification event is received by the **Central Control System**.
 - ii. alarm is received by the **Alarm System**.
 - iii. the **Operator HMI** display the alarm to the **Operator**
3. If the assembly goes online, the **TSCCS Collector** notify the **Central Control System** and the **Alarm System** that the problem is solved.

Exception. The Central Control System cannot checks the TSCCS status.

1. The **Central Control System** restart the TSCCS.

Exception. The TSCCS Manager cannot send feedback to the Central Control System..

1. The **TSCSC** shutdown itself.

POST CONDITION CONSTRAINT

MINIMAL GUARANTEE

- The **TSCCS Collector** is running.

SUCCESS GUARANTEE

- The **TSCCS Collector** is running, configured and connection with the Telescope Service Cabinet

OPEN POINTS

4.2 ASTRI-UC-9.1.1.7-020: The Telescope Service Cabinet Control System acquire monitoring points and alarms

Summary and Scope: This UC describes how the **TSCCS** acquire monitoring points from Telescope Service Cabinet and notify events, i.e. a notification that a warning condition or a critical condition (i.e. an abnormal condition or fault) has happened.

Authors: Andrea Bulgarelli, Gino Tosti

Version: 1.0

Trigger:

Frequency:

Phase: AIT/AIV, commissioning and nominal phase.

Assumptions:

Actors: TSCCS

PRE-CONDITION CONSTRAINTS

- The **Telescope Service Cabinet** is reachable.
- The **TSCCS** is running.

SCENARIOS

Basic Path. Monitoring points

1. The **TSCCS Collector** acquires monitoring points via OPC-UA protocol.

Exception: 1a, The TSC Collector cannot connect to some Telescope Service Cabinet assemblies. Rejoins Main Scenario at Step 1.

Exception: 1b, A TSC assembly monitoring point goes outside operative ranges. Rejoins Main Scenario at Step 1.

2. The **TSCCS Collector** publish monitoring points to the Kafka topic *mon-collector* using the AVRO schema.

3. The **TSCCS Collector** fill a table with the status of all Telescope Service Cabinet assemblies.

4. The **Central Control System** gets the table of the status of the Telescope Service Cabinet assemblies from the **TSC Collector**.

5. The **Monitoring System** publish a selection of the monitoring points to the Kafka topic *mon-collector-ophmi*.

6. The **Operator** checks the selected monitoring points using the **Operator HMI**.

Alternate: 6a, The **Expert Operator** checks all monitoring points using the **Monitoring System Engineering GUI**.



Basic Path. Event notification

1. The **TSCCS Collector** acquires monitoring points via OPC-UA protocol.

Exception: *1a, The TSCCS Manager cannot connect to some Telescope Service Cabinet assemblies. Rejoins Main Scenario at End.*
2. The **TSCCS Collector** publish notification events from warning or errors to the **Alarm System** and to the **Central Control System**.
3. The **Operator** checks the alarms using the **Operator HMI**.

Alternate: *4a, The Expert Operator checks the alarms using the Alarm System Engineering GUI.*

Exception. The TSCCS Manager cannot connect to some Telescope Service Cabinet assemblies.

1. The **TSCCS Collector** retries the connection.
2. After N secs the **TSCCS Collector** sends an alarm to ACS alarm system:
 - i. notification event is received by the **Central Control System**.
 - ii. alarm is received by the **Alarm System**.
 - iii. the **Operator HMI** display the alarm to the **Operator**
3. If the assembly goes online, the **TSCCS Collector** notify the **Central Control System** and the **Alarm System** that the problem is solved.

Exception. A Telescope Service Cabinet assembly monitoring point goes outside operative ranges.

1. the **TSCCS Collector** sends an alarm to ACS alarm system:
 - i. notification event is received by the **Central Control System**.
 - ii. alarm is received by the **Alarm System**.
 - iii. the **Operator HMI** display the alarm to the **Operator**

POST CONDITION CONSTRAINT

MINIMAL GUARANTEE

- The **TSCCS Collector** is running.

SUCCESS GUARANTEE

- The **TSCCS Collector** is running, configured, connected with the Telescope Service Cabinet and acquires monitoring points.

OPEN POINTS

4.3 ASTRI-UC-9.1.1.7-030: The Central Control system shutdown the Telescope Service Cabinet Control System

Summary and Scope: This UC describes how the **Central Control System** stops the TSCCS.



Authors: Andrea Bulgarelli, Gino Tosti

Version: 1.0

Trigger:

Frequency:

Phase: AIT/AIV, commissioning and nominal phase.

Assumptions:

Actors: Central Control System, TSCCS Manager

PRE-CONDITION CONSTRAINTS

- The **Central Control System** is running.

SCENARIOS

Basic Path.

1. The **Central Control System** stops the **TSCCS Manager**
Alternate: 1a, The TSCCS is stopped manually.
2. The **Central Control System** checks that the **TSCCS** is shutdown.

Alternate. The TSCCS is stopped manually

1. The **Expert Operator** stops the **TSCCS**

POST CONDITION CONSTRAINT

MINIMAL GUARANTEE

- The **TSCCS Manager** is shutdown.

SUCCESS GUARANTEE

- The **TSCCS Manager** is shutdown.

OPEN POINTS

4.4 ASTRI-UC-9.1.1.7-040: The Telescope Service Cabinet Control System switch-on the telescope

Summary and Scope: This UC describes how the TSCCS switch-on the telescope.

Authors: Andrea Bulgarelli, Gino Tosti

Version: 1.0

Trigger:

Frequency:

Phase: AIT/AIV, commissioning and nominal phase.

Assumptions:

Actors: TSCCS Manager

PRE-CONDITION CONSTRAINTS
SCENARIOS
<p>Basic Path.</p> <ol style="list-style-type: none"> 1. The TSCCS Manager connects the telescope interface Exception: <i>1a, The TSCCS does not found the telescope interface</i> 2. The TSCCS Manager switch-on the telescope.
<p>Exception. The TSCCS does not found the telescope interface</p> <ol style="list-style-type: none"> 1. The TSCCS Manager raises an alarm to the Alarm System
POST CONDITION CONSTRAINT
MINIMAL GUARANTEE
<ul style="list-style-type: none"> - The telescope is switched on
SUCCESS GUARANTEE
<ul style="list-style-type: none"> - The telescope is switched on
OPEN POINTS

4.5 ASTRI-UC-9.1.1.7-050: The Telescope Service Cabinet Control System switch-off the telescope

Summary and Scope: This UC describes how the TSCCS switch-off the telescope.



Authors: Andrea Bulgarelli, Gino Tosti

Version: 1.0

Trigger:

Frequency:

Phase: AIT/AIV, commissioning and nominal phase.

Assumptions:

Actors: TSCCS Manager

PRE-CONDITION CONSTRAINTS

SCENARIOS

Basic Path.

3. The **TSCCS Manager** connects the telescope interface

Exception: 1a, *The TSCCS does not found the telescope interface*

4. The **TSCCS Manager** switch-off the telescope.

Exception. The TSCCS does not found the telescope interface

2. The **TSCCS Manager** raises an alarm to the **Alarm System**

POST CONDITION CONSTRAINT

MINIMAL GUARANTEE

- The telescope is switched off

SUCCESS GUARANTEE

- The telescope is switched off

OPEN POINTS