Construction Project

Interface Management Plan

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CHIARA Montanari Firmato digitalmente da CHIARA Montanari Data: 2021.04.13 10:54:44 +02'00'

Chiara Montanari — Date

Approved by .....

Digitally signed by Nick Whyborn Date: 2021.04.13 13:30:26 +02'00'

Nick Whyborn, Lead Systems Engineer — Date

Released by .....

Wolfgang Wild Digitally signed by Wolfgang Wild Date: 2021.09.16 14:18:22 +02'00'

Wolfgang Wild, Project Manager — Date

Change Log

Issue	Revision	Date	Section/Page affected	Reason/ Remarks / Initiation Documents
1	a	18.12.2018	all	New document
	b	15.05.2019	all	Updates and implementation for Midterm Review
	c	29.10.2019	All	Version for CTA N internal review
	d	2021-01-15	All	Version revised as per outcome of CTA-N CDR CTA N-square diagram revised Incorporated feedback from external reviewers

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1 List of Abbreviations

ACADA	Array Control and Data Acquisition System
ACS	Array Calibration System
CTA	Cherenkov Telescope Array
CTA-N	Cherenkov Telescope Array North
CTA-S	Cherenkov Telescope Array South
CTAO	Cherenkov Telescope Array Observatory
CR	Change Request
DPPS	Data Processing & Preservation System
ELEC	Electrical/Electronic Interface
EMS	Environmental Monitoring System
ENVi	Environmental Interface
HUM	Human Interface
HYD	Hydraulic Interface
ICD	Interface Control Document
ICT	Information and Communication Technology
IDD	Interface Definition Document
IGDD	Interface General Definition Document
IID	Interface Identification Document
IPS	Integrated Protection Systems
IPSi	IPS Interface
IRD	Interface Requirements Document
MEC	Mechanical Interface
MEC-GLI	Mechanical - General Layout - Interface
MST	Medium-Sized Telescope
LST	Large-Sized Telescope
OPT	Optical Interface
ORM	Observatory Roque de los Muchachos
PDR	Preliminary Design Review
PMP	Project Management Plan
QP	Quality Plan
SCP	Service Connection Points
SDMC	Science Data Management Centre
SOSS	Science Operations Support System
SSi	Supplied Services Interface
SSI-ELEC	Supplied Services – Electrical- Interface
SSI-NET	Supplied Services – Network- Interface
SST	Small-Sized Telescope
SUSS	Science User Support System
SWDi	Software Data Interface
THC	Thermal Control Interface
TOSS	Technical Operations Support System
WIP	Work In Progress

2 Scope

This plan establishes the definitions, the processes and the methodology for interface management throughout the life cycle of CTA.

The purpose of this systematic interface approach is to achieve functional and physical compatibility amongst all interrelated elements involved.

3 Applicable and Reference Documents and Definitions

3.1 Applicable Documents

The following applicable documents (AD) of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of the specification shall be considered a superseding requirement.

AD Nr.	Document Nr.	Issue	Document Title
AD 1	CTA-PLA-MGT-000000-0003	1c	CTA Project Management Plan (PMP)
AD2	MAN-QA/110405	1c	Quality Plan (QP)

3.2 Reference Documents

The following reference documents (RD), of the exact version shown herein, are listed as background references only. They are not to be construed as a binding complement to the present document.

RD Nr.	Reference	Issue	Document Title
RD1	ECSS-E-ST-10-24C	1	Space Engineering Interface Management

3.3 Definitions List

The following Definition List (DL) shows terms and definitions specific to the present document. It is to be construed as a binding complement to the present document.

Term	Definition
interface actor	the organization or person responsible for the design, the development and the verification of one interface-end
interface responsible	the organization or person responsible for the requirement specification, definition, development and verification of the interface

customer	the organization or person requiring the interface-end information to be provided, since receiving the product as part of business agreement
supplier	the organization or person providing the required interface-end information, since provider of the product as part of business agreement
interface-end	the point of interaction of one of the elements of an interface
interface plane	the plane that distinguishes the two interface ends
external interface	the interface outside the control of a given actor
internal interface	the interface under the control of a given actor

4 Principles

4.1 Interface Management Process

The CTA approach to Interface Management considers interface definition as a process, throughout its life cycle.

The purpose of this process is to assist the controlling of the products development when efforts are divided amongst different parties (e.g. different agencies, different contractors, geographically dispersed technical teams, etc.). Thus, it shall be iterated any time the compliance between products and actors that interoperate needs to be achieved.

The CTA Interface Process shall be organised into the following steps, as per the standard approach defined in RD1:

- interfaces identification
- interfaces requirements specification
- interfaces definition
- interfaces approval and control
- interfaces verification and validation

Each phase is detailed in the following paragraphs, Figure 4.1-1 and Table 4.1-1 below show the overall progression in a nutshell.

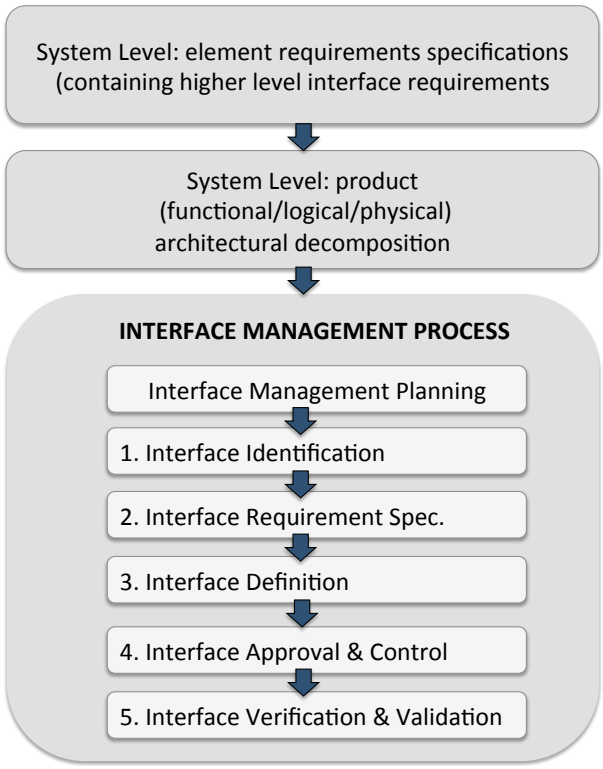

Figure 4.1-1 Interface process: main steps, input and outputs.

1. Interface Identification	To identify Interfaces: finding boundaries & actors fro interface ownership. Each *Customer* identifies: - the interface - the interface-end owner The output is the IID (Interface Identification Document), e.g. list of interface.
2. Interface Requirement Specification	To define the specific needs for each interface-end. Each *Customer* defines the requirements for each interface-end: - functional requirements - performance requirements - electrical requirements - environmental requirements - human requirements - physical requirements The output is the IRD (Interface Requirement Document), which defines all the design requirements to be adherent by the *Supplier* of each interface-end, who is responsible for: - its design - its development - its verification The IRD as self-standing document is not mandatory, however it can be useful when: - separate actors are developing components of the system - the system places requirements on other components outside the project control.
3. Interface Definition	To define the Interface Specifications. This is the result of the Design process performed by - the *Customer* (who is responsible fro the interface as a whole) - and the *Suppliers* (who are responsible for each interface-end) The input of this phase is the IRD. The output is the IDD (Interface Definition Document) and as part of this process evolutions may happen leading to updates of the IRDs.

4. Approval & Interface Control	The Interface Control is formalised in two steps: - the *Controlled* Interface Control Document (ICD) - the *Frozen* Interface Control Document (ICD) The *Controlled ICD* reflects an evolving IDD, which converges from the *Suppliers'* preliminary design to the final one. The *Frozen ICD* reflects the Interface Baseline considered to be final and complete in order to start manufacturing, integration and implementation activities. Signature: the Frozen ICD is signed by the interface responsible and all the actors involved to reflect acceptance. Further evolutions shall be controlled and modifications approved by all the actors.
5. Interface Validation	To demonstrate that the interface is able to accomplish its intended use in the intended operational environment and can be performed as part of interface management or as part of any higher-level product validation activity. This will be performed accordingly to the system validation processes.

Table 4.1-1 Interface process: main steps, input and outputs.

This systematic approach to the Interface Definition, Control and Validation shall be applied at all levels of the supplier/customer chain and must show consistency with the CTA product breakdown. The term "product" is used in this document as a generic term which defines any component, any equipment, any element as per defined in the CTA product breakdown.

4.2 Interface Actors, Roles and Responsibilities

As regards to the actors, the terms "customer" and "supplier" are used in this document as just context roles. The customer (or his/her delegate) is responsible for the definition, the development and the verification of the interface as a whole, while the suppliers are responsible for the production and verification their own interface ends (Figure 4.1-2). In addition to these, the interface actors are all the parties involved in the interface end definition, design, development.

Conclusively, the overall CTA Interface Process shall be the result of the interface activities performed by the customer (or his delegate) and the suppliers accordingly to the present document, e.g. at the level of CTA System, the customer is the CTAO SE and the suppliers are each SE of Sub-system.

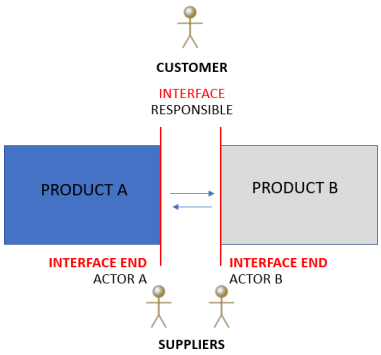

Figure 4.1-2 CTA-Interface actors.

4.3 Type and Nature of Interfaces

CTA Interfaces shall be identified according to their types.

In the CTA approach, the notion of type implies first an identification of an interface as internal or external, then its characterization by the information flow that it generates (nature of the interface).

The distinction between external/internal interface depends on the position and role of an actor in the customer supplier chain. The internal interface is an interface under the control of a given actor. The external interface is an interface outside the control of a given actor (e.g. an interface between two suppliers of the same customer is considered external by the suppliers and internal by the customer).

The characterization by the nature of the interface shall be performed in CTA accordingly to the interface taxonomy defined in the following paragraphs.
All the documents defined in the following paragraphs are subject to the applicable configuration control process as per the Project Management Plan [AD1].

5 CTA Interface Process and Interface Definitions

5.1 Interface Identification

The CTA interface identification is the process though which each customer identifies the interfaces under his/her own responsibility, and it shall be repeated by each actor at each level of the customer/supplier chain. As mentioned above, this process shall remain consistent with the present document in the overall CTA life cycle.

In order to reach this goal, the following documents shall be produced:

- a CTA Interface General Definition Document (IGDD), to provide consistency in the interface definition across different CTA's actors and products
- a system to system N-Squared Diagram, to provide consistency with the CTA Product Breakdown
- an Interface Control Documents Master List, to provide an overall view of the ICDs related to the specific interfacing systems.

5.1.1 The Interface General Definition Document (IGDD)

The IGDD document shall define the interface taxonomy - namely, it defines each type of interface - that shall be used in CTA interface process. This IGDD shall be considered as a living document and it must be iteratively updated any time needed.

Particularly, the IGDD shall identify the interfaces by categories, accordingly to their different nature (e.g. Mechanical, Electrical, Software, etc.). This will provide a common base and a common language (namely, an interface definition list), in order to uniquely identify the interfaces amongst different CTA's actors and products.

The IGDD shall be used as a standard for the CTA Interface Identification process. The Interface manager is responsible for the update of it.

5.1.2 The Interface N-Squared Diagram

The Purpose of the CTA N-Squared Diagrams is to provide consistency with the CTA Product Breakdown at all level of the interface identification. An example of N-Squared Diagram can be found in the following paragraphs of the present document (section 8, including the CTA Interface N-Square diagram). Each customer, at any level of CTA Interface definition, is responsible to define the interface N-square diagram and the related Interface master list as per below defined.

5.1.3 The Interface Control Documents Master List

The Purpose of the CTA Interface Control Documents Master List is to provide an overall view of the ICDs related to the specific interfacing systems.

For each System A to System B interface, the ICDs Master List shall include:

- Interface ID
- Interface Types
- IID/ICD Number
- Person Responsible for the Interface
- Document Description
- Document URL
- Document Status
- Others (TBD)

5.1.4 The Interface Identification Document (IID)

The output of the Interface Identification Process is an Interface Identification Document (IID). This document shall be consistent with the Product Breakdown, and it shall include both the interface diagrams (N-squared diagram) and the related ICDs Master List.

The IID shall be considered as a living document, it shall be updated in the process of interface identification and this shall retroact on the IGDD (which has to be updated accordingly).

5.2 Interface Requirements

The CTA interface requirements specification is a process though which, following the interfaces identification, each supplier (interface-end responsible) shall define the requirements for each related interface-ends.

These interface requirements shall be derived from the higher-level requirements and from functional, logical and physical architectural decomposition, as well as from the verification requirements. Particularly, at each common boundary between two or more products (interface-ends), each interface requirement shall define the functional, physical and performance requirements using the taxonomy given in the IGDD.

When the interface requirements specifications is completed and baselined, each supplier will be responsible for the compliance of the related interface-end in all phases, e.g. design, development, verification.

The output of the interface requirements specification process shall be documented in the CTA Interface Requirement Document (IRD). This shall include the

applicability of each interface requirement to the related interface-ends (e.g. one interface end, all interface ends).

The use of an IRD as a self-standing document is not mandatory, however it might be useful when the system places requirements on other systems outside programme/project control (e.g. for CTA-N the supplied services under the responsibilities of ORM actors, etc.). Alternatively, the Interface Requirement specification shall be included into the Interface Definition Document, as per below defined.

5.3 Interface Definition (Interface Control Document)

The CTA Interface definition is the result of the process though which each interface actor develops a design solution compliant with the applicable interface requirements that ensures compatibility between the involved products (namely, an iterative and converging process, where the number of modifications decreases over time).

The inputs for CTA Interface definition process are the IRD(s) provided by the customer and the different suppliers.

The output of this process can be provided in the form of Interface Definition Document (IDD) for each interface end and it shall be documented and formally agreed by all parties with the release of the related CTA's Interface Control Document (ICD).

This process shall be brought under configuration control with the approval of this ICD.

6 Interface Approval and Control

This process follows the configuration control process as per the PMP [AD1] and QMP [AD2].

7 Interface Verification and Validation

The CTA Interface validation is the process to demonstrate that the interface is able to accomplish its intended use in the intended operational environment and can be performed as part of interface management or as part of any higher-level product validation activity, as per Quality Plan [AD2].

8 CTA Interface Templates (Diagrams/Documents)

8.1 Interface N-squared Diagram for CTA (template)

The Figure 8.1-1 shows an example of Internal Interface N-Squared Diagram for CTA, the "X" indicates that an interface had been identified, while the green colour code indicate the priorities identified.

In order to facilitate the ICDs Master List Definition, this can also include the characterization by type of interface accordingly to the definitions provided in the IGDD (figures 8.1-1; 8.1-2).
The CTA Product Definition and Interface Definition processes are not yet completed yet. Thus, the following fig. 8.1-1; 8.1-2 shall not be considered the final Interface Matrix but examples included herein for the purpose of this document only

		1	2		3	4	5	6	7	8	9	10	11	12	13	14
		Civil infra	ICT ON SITE	OFF SITE ICT	ACADA	DPPS	SST	MST	LST	ACS	EMS	IPS	SOSS	SUSS	TOSS	ADMIN
1	Civil Infra															
2	ICT	X														
3	ACADA	X	X													
4	DPPS		X		X											
5	SST	X	X		X											
6	MST	X	X		X											
7	LST	X	X		X											
8	ACS	X	X		X		TBD	TBD	TBD							
9	EMS	X	X		X											
10	IPS	X	X		X		X	X	X	X	X					
11	SOSS		X		X	X										
12	SUSS		X		X	X							X			
13	TOSS		X		X	X						X	X	X		
14	ADMIN		X												X	

Figure 8.1-1 CTA Interface N-Squared Diagram.

		1	2		3	4	5	6	7	8	9	10	11	12	13	14
		Civil infra	ICT ON SITE	OFF SITE ICT	ACADA	DPPS	SST	MST	LST	ACS	EMS	IPS	SOSS	SUSS	TOSS	ADMIN
1	Civil Infra			NO												
2	ICT	(ON SITE) MEC-GLI SSI-ELEC SSI-NET														
3	ACADA	MEC-GLI SSI-ELEC SSI-NET	SWDi Software running environment; SSI CLK low precision)	NO												
4	DPPS		SWDi Software running environment; SSI CLK low precision)	NO	SWDi											
5	SST	MEC-GLI SSI-ELEC SSI-NET	SSI-NET Array data network SWDI- e.g the IP address; and SSI-CLK (V	NO	SWDi											
6	MST	MEC-GLI SSI-ELEC SSI-NET	SSI-NET Array data network SWDI- e.g the IP address; and SSI-CLK (V	NO	SWDi											
7	LST	MEC-GLI SSI-ELEC SSI-NET	SSI-NET Array data network SWDI- e.g the IP address; and SSI-CLK (V	NO	SWDi											
8	ACS	MEC-GLI SSI-ELEC SSI-NET	SWDi Software running environment; SSI CLK low precision)	NO	SWDi		TBD	TBD	TBD							
9	EMS	MEC-GLI SSI-ELEC SSI-NET	SWDi Software running environment; SSI CLK low precision)	NO	SWDi											
10	IPS	IPSi	IPSi (SWDi)- TBD	NO	IPSi (SWDi)		IPSi	IPSi	IPSi	IPSi	IPSi					
11	SOSS		SWDi - Software running envir.	SWDI-applications	SWDI (Status information Data; Science	SWDI (Status information Data;										
12	SUSS		SWDi - Software running envir.	SWDI-applications that run on off site	SW DATA (mid-term schedule, Science data, etc)	SW DATA (Science Data, etc)							SWDI(Status Informations, e.g. on the proposal)			
13	TOSS**		SWDi - Software running envir.	SWDI-applications that run on off site	SWDI (Monitoring data, configuration etc)	SWDI (Data quality monitoring, more TBD)						SWDI- (Reporting on the status of IPS systems etc- IPS generates High level info on the health of	SWDI (Data quality monitoring, and more TBD)	SWDI (Data quality monitoring, and more TBD)		
14	ADMIN														SWDI	

Figure 8.1-2 CTA Interface N-Squared Diagram including IGDD's Categories.

8.2 Interface Documents for CTA (template)

In order to integrate all the CTA documents in a harmonized and systematic way, including consistency with the IGDD (which is currently under development - according to RD1- with the different CTA teams), the CTA Interface Templates (see references in the table below) are still continuously updated according to the progress in the CTA definition process.

N	**Interface:** **System to System**	**Interface Type**	**Doc N.**
1	ACADA- TELESCOPE Interface Identification Document (IID)	SWDi	CTA-INS-SEI-000000-0001_2a
2	INFRA - TELESCOPES Interface Requirement Document – (IRD)	MEC-GLI SSI-ELEC SSI-NET	CTA-INS-SEI-000000-0001_1a