

PLATO Mission Parameter Database

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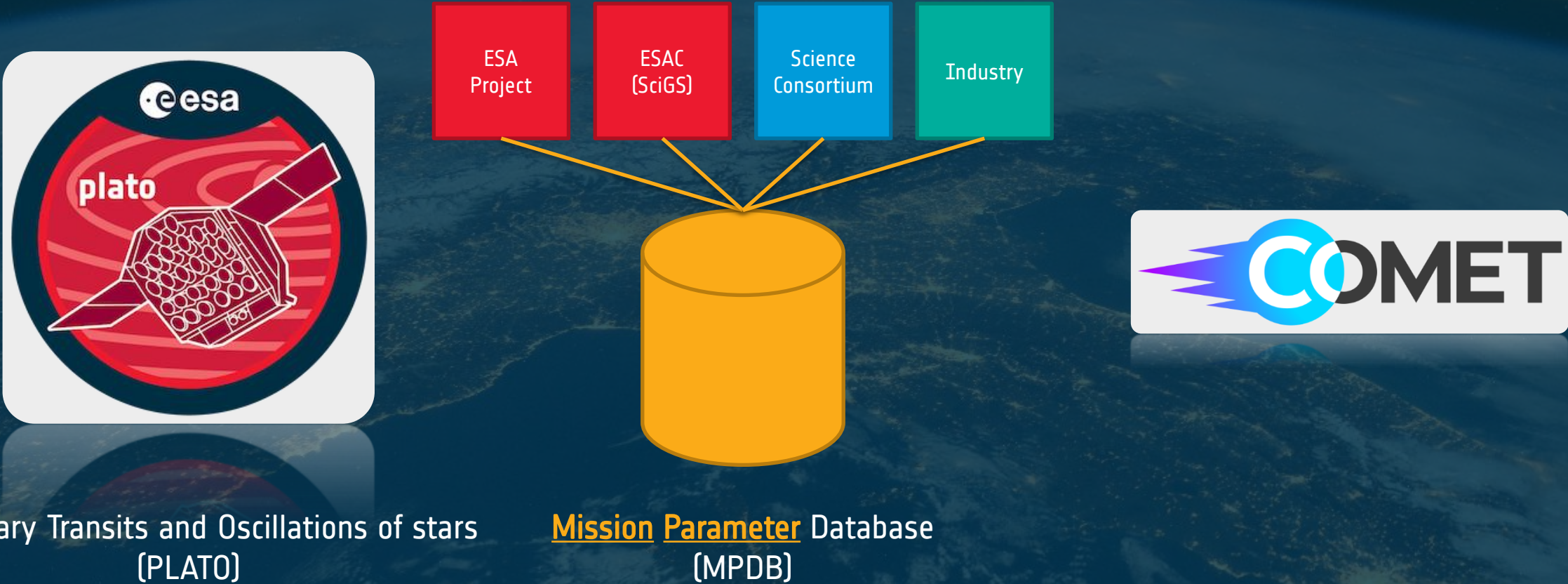
(1) Aurora Technology B.V. for European Space Agency / ESTEC

(2) European Space Agency / ESTEC

(3) Telespazio UK S.L. for European Space Agency / ESAC

MBSE2022

24/11/2022



Deciding on Solution

Criteria



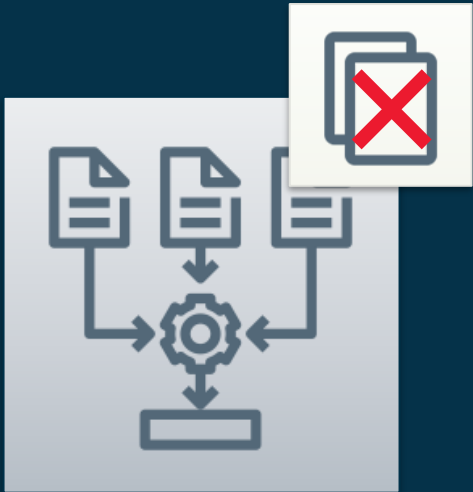
Centralised Storage & Management



Version Control, Baselines, Tracking



Parameter Data / Metadata Consistency



Controlled Usage
(No copy-paste!)



Online and Offline
Data Interfaces

Deciding on a Solution



Heritage Solutions

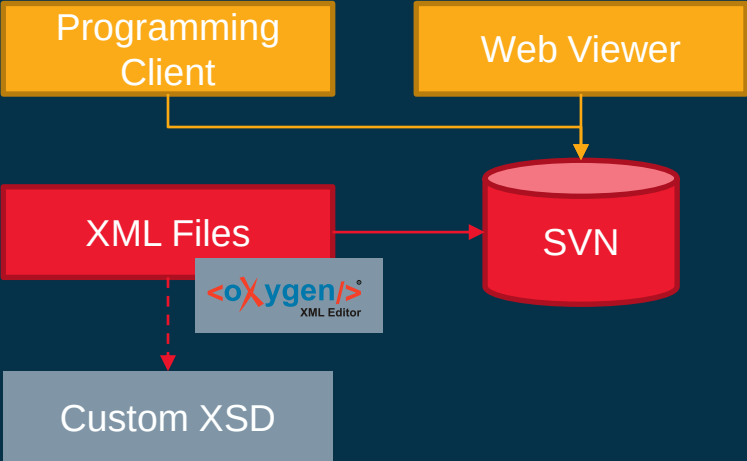


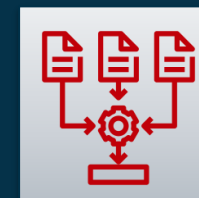
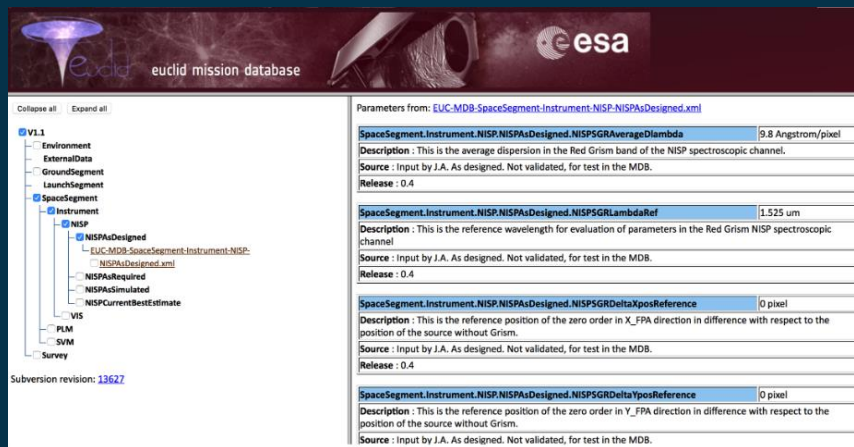
euclid mission database

esa

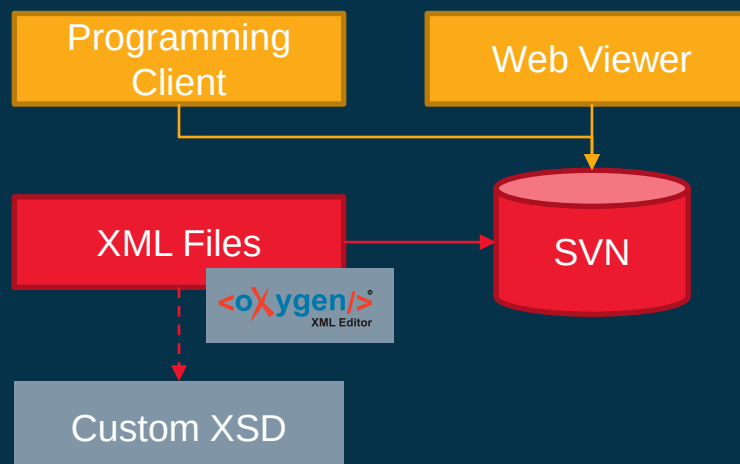
Parameters from: `EUC-MDB-SpaceSegment-Instrument-NISP-NISPAAsDesigned.xml`

<code>SpaceSegment.Instrument.NISP.NISPAAsDesigned.NISPSGRAverageDlambda</code>	9.8 Angstrom/pixel
Description : This is the average dispersion in the Red Grism band of the NISP spectroscopic channel.	
Source : Input by J.A. As designed. Not validated, for test in the MDB.	
Release : 0.4	
<code>SpaceSegment.Instrument.NISP.NISPAAsDesigned.NISPSGRLambdaRef</code>	1.525 um
Description : This is the reference wavelength for evaluation of parameters in the Red Grism NISP spectroscopic channel	
Source : Input by J.A. As designed. Not validated, for test in the MDB.	
Release : 0.4	
<code>SpaceSegment.Instrument.NISP.NISPAAsDesigned.NISPSGRDeltaXposReference</code>	0 pixel
Description : This is the reference position of the zero order in X_FPA direction in difference with respect to the position of the source without Grism.	
Source : Input by J.A. As designed. Not validated, for test in the MDB.	
Release : 0.4	
<code>SpaceSegment.Instrument.NISP.NISPAAsDesigned.NISPSGRDeltaYposReference</code>	0 pixel
Description : This is the reference position of the zero order in Y_FPA direction in difference with respect to the position of the source without Grism.	
Source : Input by J.A. As designed. Not validated, for test in the MDB.	





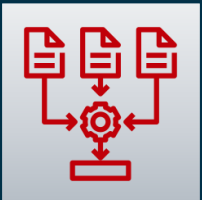
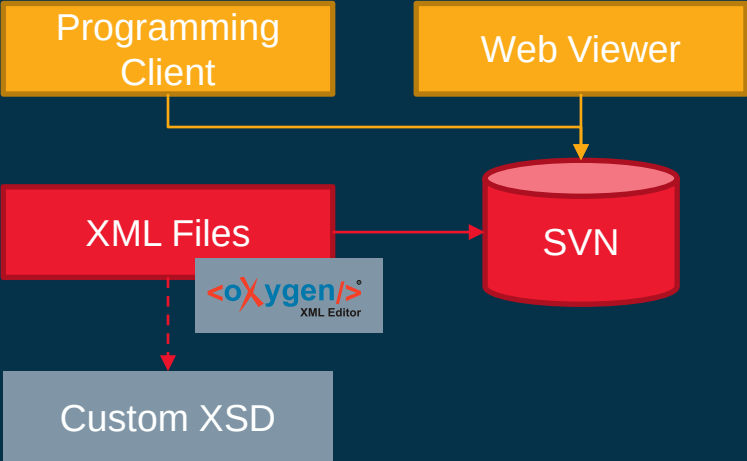
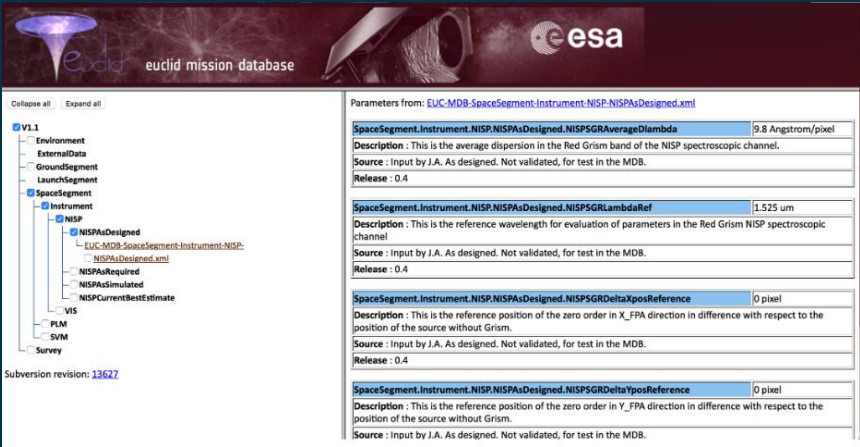
- Inconsistency
- Redefinition
- Duplication



Deciding on a Solution



Heritage Solutions



Custom Data Model

- Inconsistency
- Redefinition
- Duplication



Heavy (Manual) Workload

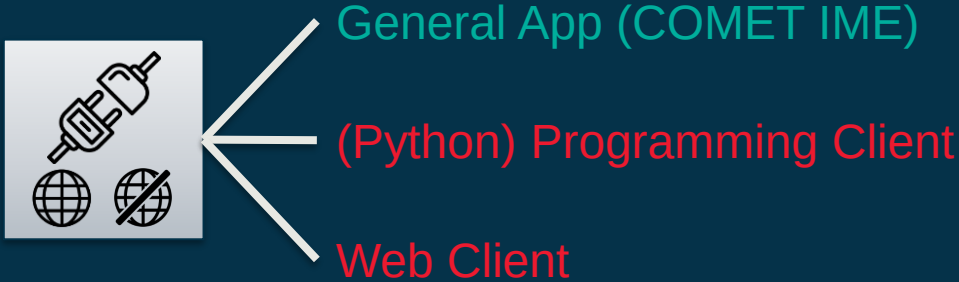
- Formatting and Input
- Semi-automated consistency check
- Manual coherence checks
- Manual baselining

Deciding on a Solution





+
ECSS-E-TM-10-25



Deciding on a Solution

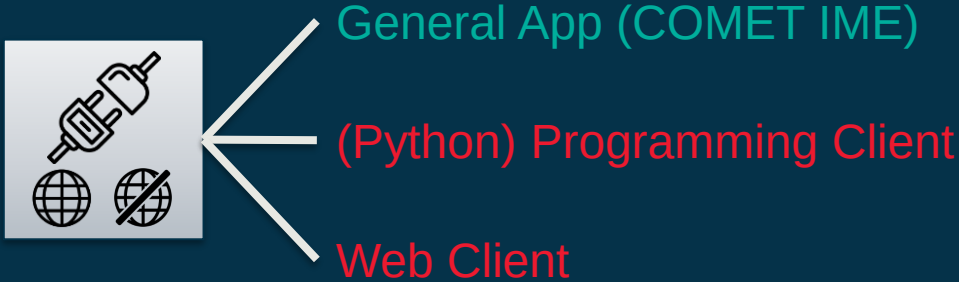


concurrent
design facility

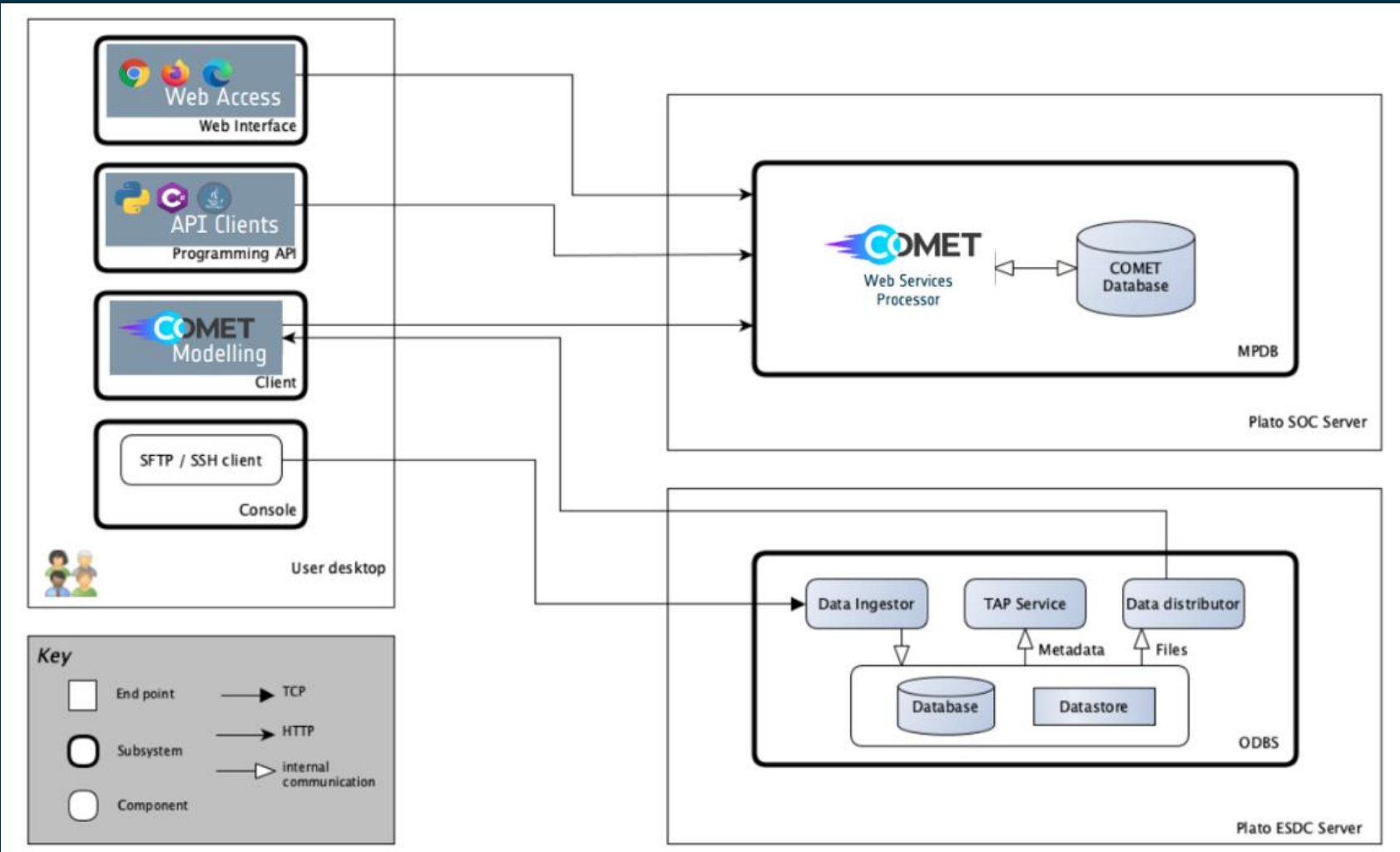


COMET ?

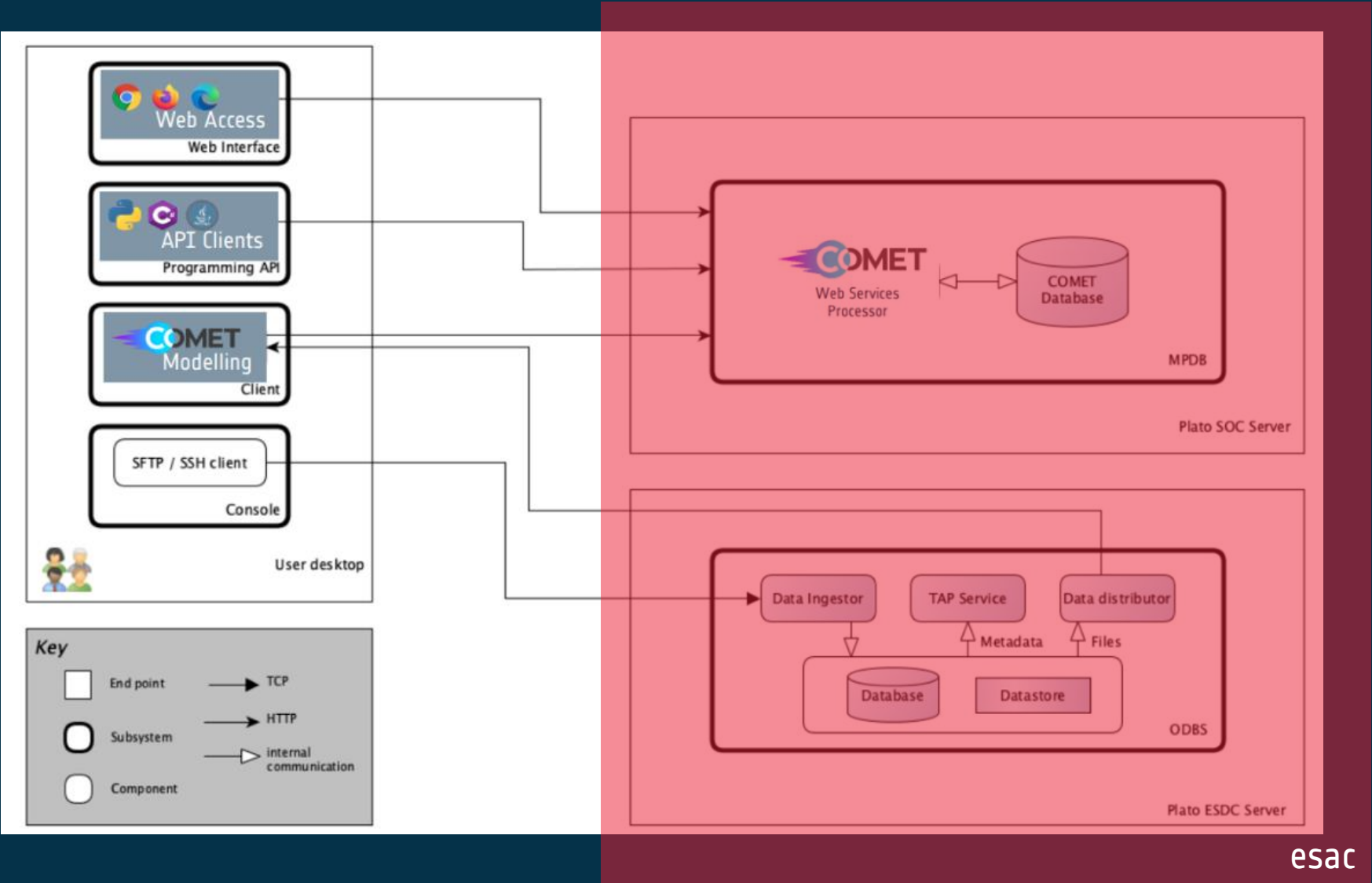
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ECSS-E-TM-10-25



PLATO MPDB Architecture



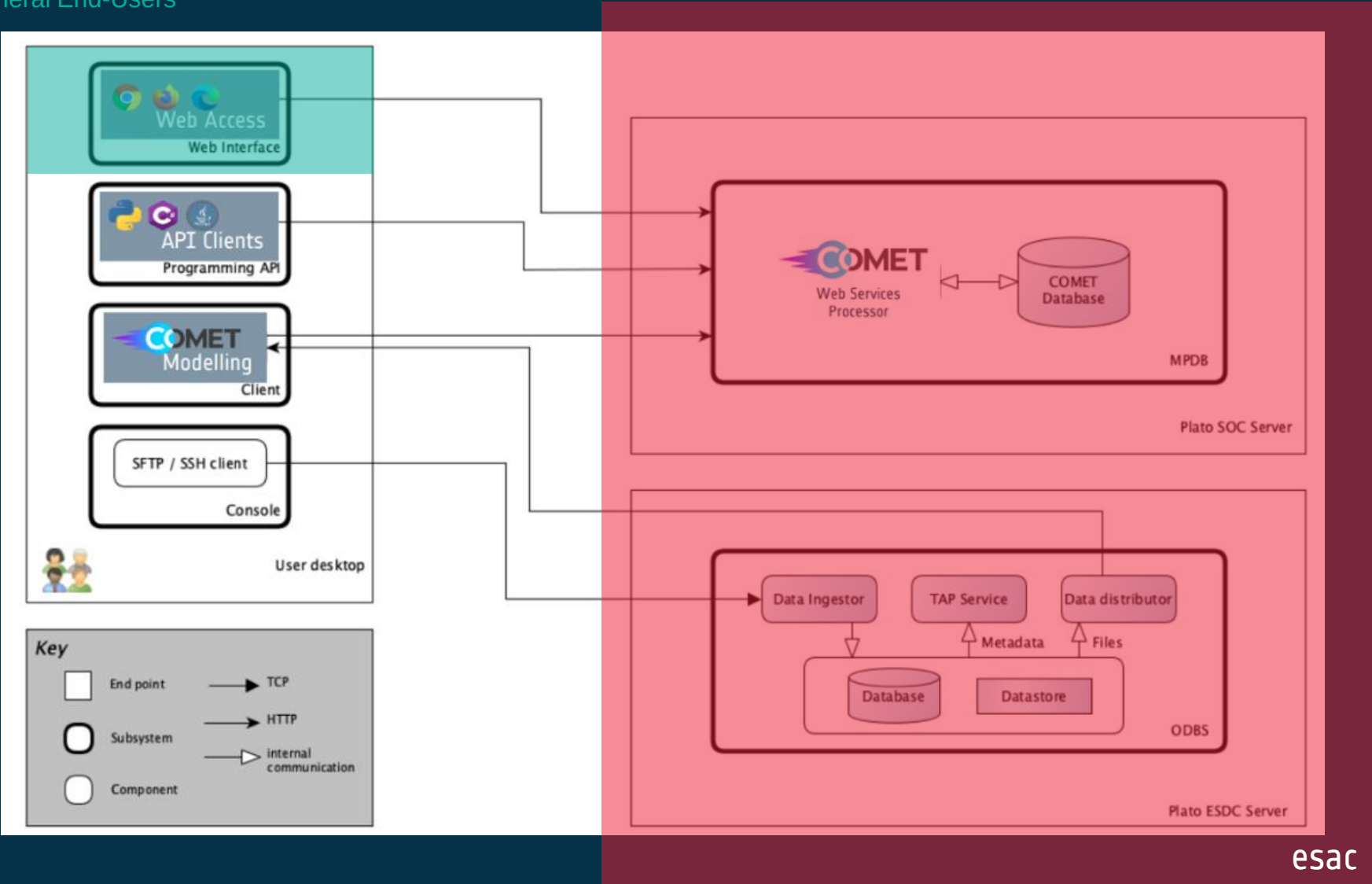
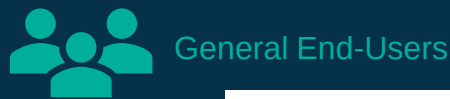
PLATO MPDB Architecture



System Admins



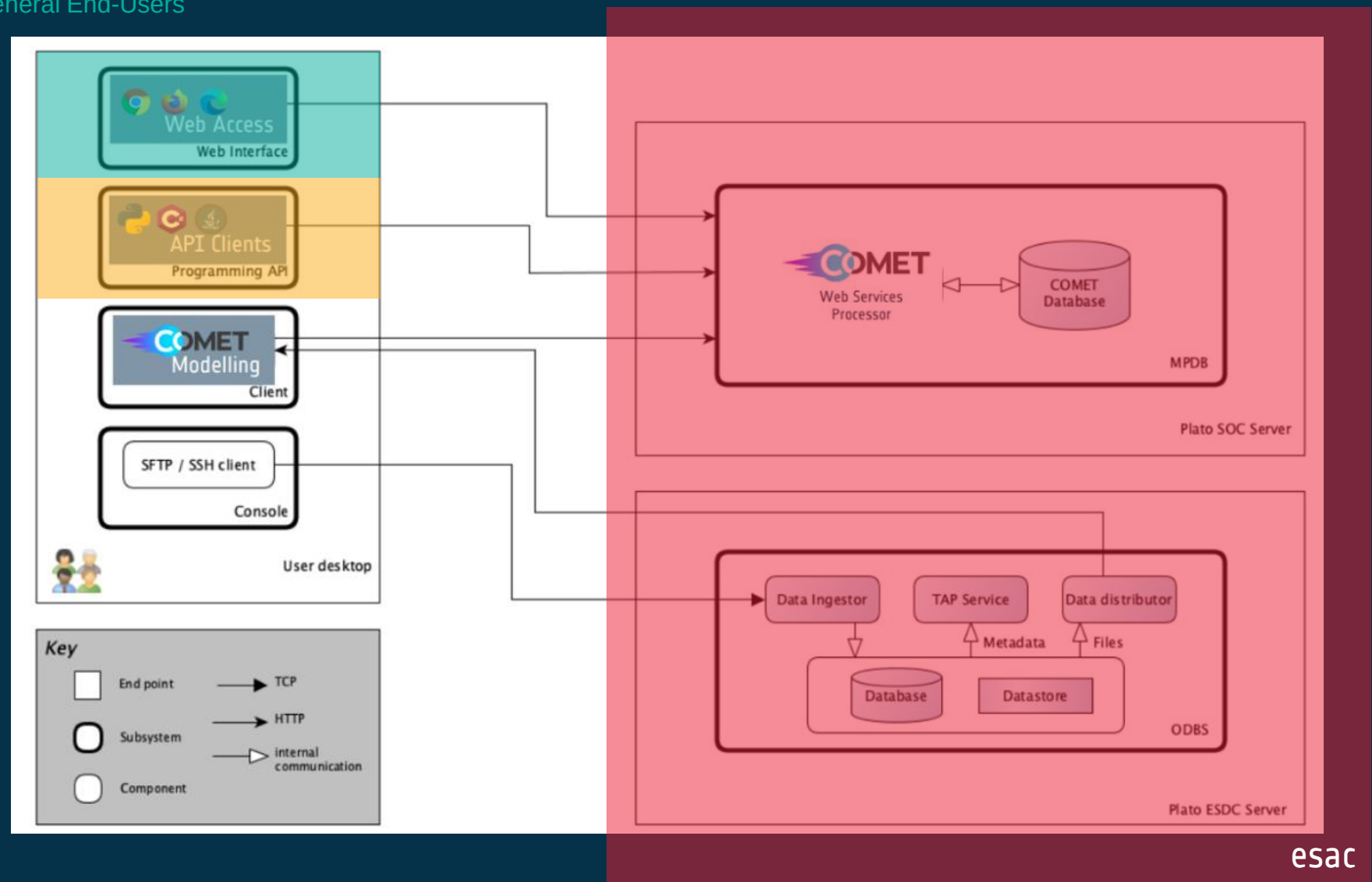
PLATO MPDB Architecture



System Admins

esac

PLATO MPDB Architecture



System Admins

esac



PLATO MPDB Architecture





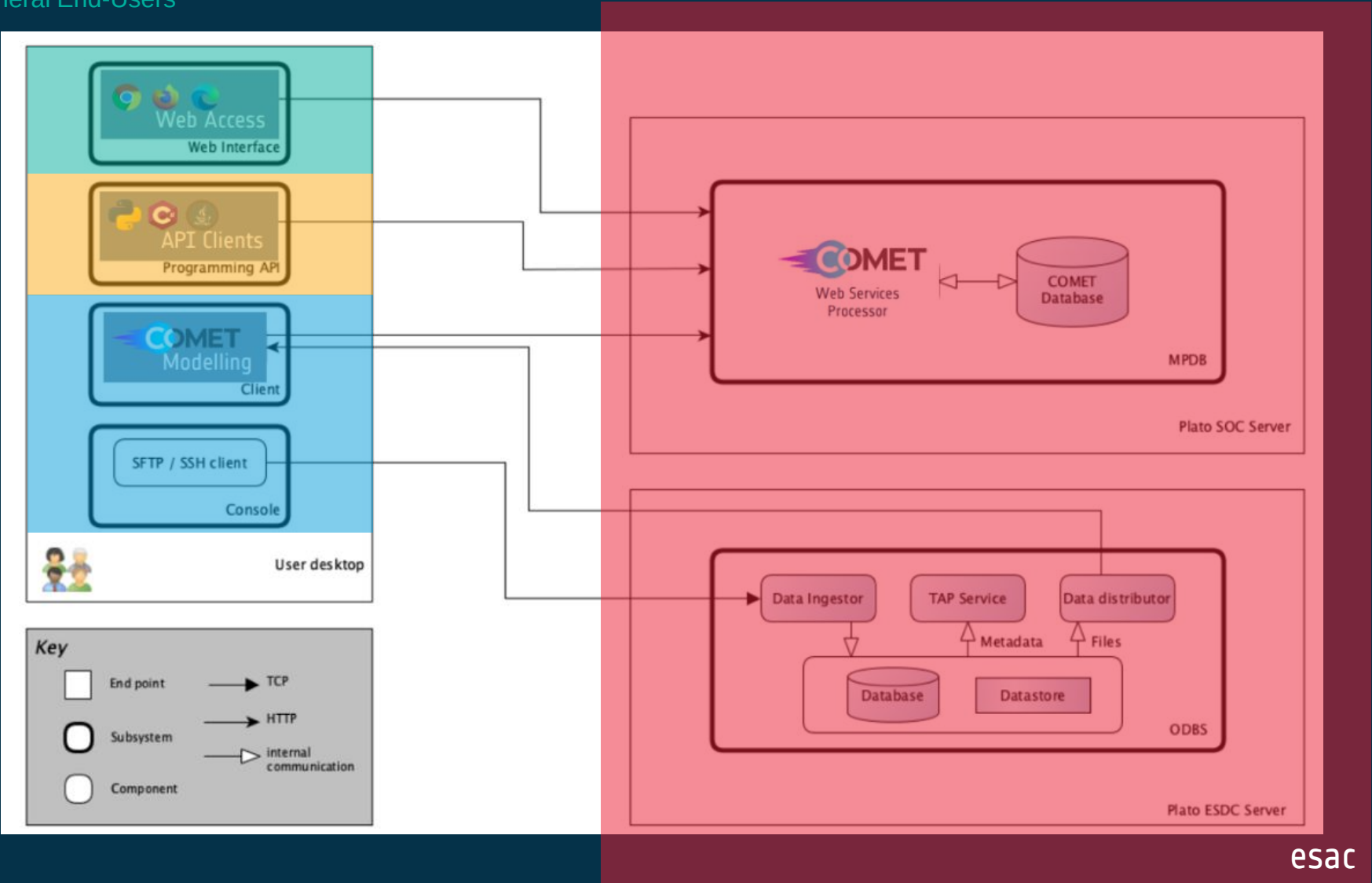
General End-Users



Analysis/Simulation Engineers



Parameter Owners





System Admins

esac



Conceptual Mapping

Product Tree, As Required

Element Definitions

Model: Plato Mission Parameter Database
Iteration: 1
Options: As Required
Data-Source: http://ptotest02.esac.esa.int/mdb/
Person: Sami Niemi
Domain Of Expertise: System Engineering [SYS]

Name	Value	Owner	Switch	Description
PLATO System		SYS		
Launch Vehicle : Launch Vehicle		SYS		
Mission Orbit : Mission Orbit		SYS		
PLATO Ground Segment : PLATO Ground Segment		SYS		
PLATO Space Segment : PLATO Space Segment		SYS		
PLATO Spacecraft : PLATO Spacecraft		SYS		
data rate	15 [kbit/s]	SYS	MANUAL	
data volume	- [MiByte]	SYS	MANUAL	
lifetime	- [s]	SYS	MANUAL	
manufacturer		SYS	MANUAL	
Mechanical Parameters		SYS		
Payload Module : Payload Module		SYS		
NCAM1 : Normal Camera		SYS		
CCD270_1 : CCD270		SYS		
Performance		SYS		
Quantum Efficiency		SYS		

Product Tree

(Standardised)
Parameter Types

Values/Units

Parameter Ownership

Options, iteration_2

Model: PLATO Mission
Iteration: 2
Data-Source: http://ptotest02.esac.esa.int/mdb/
Person: Jamie Whit
Domain Of Expertise: System Engineering [SYS]

Name	Short Name
As Required	as_required
As Designed	as_designed
As Simulated	as_simulated
As Built EM	as_built_em
As Built QM	as_build_qm
As Built FM	as_built_fm

Lifecycle Variants

Iteration Selection

PLATO Mission

Model Iterations

Name	Domain Of Expertise	Frozen On
iteration_2	System Engineering	Active
iteration_1	System Engineering	2022-09-30 12:43:34

Baselines

System Engineering
Owner

0.2 [arcsec]
Value

Log Entries

PTO-TAS-SYS-RS-0008 (AOCS Technical Requirements Specification) - PLT-AOCS-RQ-122 & PLT-AOCS-RQ-123

Sami Niemi
Aug 11, 2022, 4:45:22 PM

Value Justifications

Parameter Type Library

- (Partial) Reuse of Generic Reference Data Library
- (Partial) Reuse of CDF Reference Data Library
- Configuration of **>200** specific parameter types (PLATO Reference Data Library)

Name	Short Name	Symbol	Default Scale	Type	Container RDL
mass	m	m	kg	SimpleQuantityKind	Generic_RDL
serial number	serial_num	serial_num		TextParameterType	platoMRDL
mean consumed power	P_mean	P_mean	W	SpecializedQuantityKind	Generic_RDL
peak consumed power	P_peak	P_peak	W	SpecializedQuantityKind	Generic_RDL
product tree id	id_num	id_num		TextParameterType	platoMRDL
non-operational temperature bounds	T_nonop	T_nonop		CompoundParameterType	platoMRDL
operational temperature bounds	T_oper	T_oper		CompoundParameterType	platoMRDL
butting distance	bd	bd		CompoundParameterType	platoMRDL
exposure time	t_exp	t_exp	s	SpecializedQuantityKind	platoMRDL
cadence	cad	cad	s	SpecializedQuantityKind	platoMRDL
tcs frequency	f_tcs	f_tcs	Hz	SpecializedQuantityKind	platoMRDL
temperature measurement	t_meas	t_meas		TextParameterType	platoMRDL
temperature measurement accuracy	t_meas_acc	t_meas_acc		CompoundParameterType	platoMRDL
ccd voltage measurement	v_meas	v_meas	mV	SpecializedQuantityKind	platoMRDL
ccd voltage measurement accuracy	v_meas_acc	v_meas_acc	mV	CompoundParameterType	platoMRDL

Parameter Types, RHEA Docker Site Directory

Data-Source: <http://protest02.esa.int/mbd/> Person: Jamie Whitehouse

Search

Name	Short Name	Symbol	Default Scale	Type	Container RDL
smearing	smearing	smearing	e-/s	SpecializedQuantityKind	PLATOMRDL
tcs stability trp-1	tcs_stab_trp1	tcs_stab_trp1		CompoundParameterType	PLATOMRDL
number of N-DPU ASW images	num_ndpu_asw_img	num_ndpu_asw_img	-	SpecializedQuantityKind	PLATOMRDL
static power consumption f	spc_f	spc_f		CompoundParameterType	PLATOMRDL
inverse gain	gain	gain	e-/ADU	DerivedQuantityKind	PLATOMRDL
pixel mask weight	pix_mask_weight	pix_mask_weight	-	SpecializedQuantityKind	PLATOMRDL
science tm packet size	tm_sci_max_size	tm_sci_max_size	Byte	SpecializedQuantityKind	PLATOMRDL
iprnu	iprnu	iprnu	-	SpecializedQuantityKind	PLATOMRDL
sensitive area position FPA_ALN	pos_fpa_aln_sens_area	pos_fpa_aln_sens_area		CompoundParameterType	PLATOMRDL
gain stability e	gain_stab_e	gain_stab_e		CompoundParameterType	PLATOMRDL
parallel cte e	cte_par_e	cte_par_e		CompoundParameterType	PLATOMRDL
non-ionizing radiation	non_ioniz_rad	non_ioniz_rad	p+/cm ²	DerivedQuantityKind	PLATOMRDL
filter transmission	ft	ft		TextParameterType	PLATOMRDL
number of dark columns	n_darkc	n_darkc	-	SpecializedQuantityKind	PLATOMRDL
butting distance	bd	bd		CompoundParameterType	PLATOMRDL
maximum inner absorption	abs_max_inner	abs_max_inner	-	SpecializedQuantityKind	PLATOMRDL
camera name	cam_name	cam_name		TextParameterType	PLATOMRDL
number of bright pixels	n_bright_pix	n_bright_pix	-	SpecializedQuantityKind	PLATOMRDL
operational temperature bounds	T_oper	T_oper		CompoundParameterType	PLATOMRDL
efficiency due to pac	eff_pac	eff_pac	-	SpecializedQuantityKind	PLATOMRDL
number FGS imgettes	num_fgs_img	num_fgs_img	-	SpecializedQuantityKind	PLATOMRDL
offset thermal sensitivity	offset_ther_sens	offset_ther_sens		CompoundParameterType	PLATOMRDL
maximum heater power	P_heater_max	P_heater_max	W	SpecializedQuantityKind	PLATOMRDL
clock level temperature coeffi...	clock_temp_coeff	clock_temp_coeff	mV/K	SpecializedQuantityKind	PLATOMRDL

MPDB Python Client

Interactive Loading

Interactive loading guides the user in connecting to a model source and loading a model. It is the quickest way to get started.

Connect to model source

Create `MissionParameterDatabaseClient` instance

Display Model Data

```
from mpdb_client import cli
mpdb = client.MissionParameterDatabaseClient('as_designed')

# Display loaded model data
mpdb.display_model_data(model)
```

Run `connect()` without argument

Display Product Tree Data

```
mpdb.connect()

# Display product tree (for given option)
mpdb.display_product_tree('as_required')
```

Load model

Once connected, we can now interactive loading.

If successfully loaded, the Engine

Display Log Data

```
model = mpdb.load()

# Display all log data on model
mpdb.display_all_log_data(model)
```

```
mpdb.display_model_data(model)

# Display log data on parameter
[param] = mpdb.query_for_parameters_by_path(path_query)
mpdb.display_log_data(param)
```

Query for a single parameter

When querying for a single parameter, or a single component of a compound/vector parameter, we specify the full path. This can be copy-pasted directly from the web app or COMET-IME.

```
# Case 1: Scalar Parameter
path_query = r'PLATO.space_segment\as_required'
```

```
# Case 2: Compound Parameter Component
path_query = r'PLATO.space_segment.payload_module.pl.aeu.f_aeu\T_oper.max\as_required'
```

```
matching_params = mpdb.query_for_parameters_by_path(path_query)
mpdb.display_parameters(matching_params)
```

Query for all components of a compound/vector parameter

When querying for all component parameters of a compound or vector parameter, we can omit the component name from the parameter path section.

For instance, we can query for all components of the `T_oper` parameter by removing the `max` component reference, as so: `PLATO.space_segment.payload_module.pl.aeu.f_aeu\T_oper\as_required`.

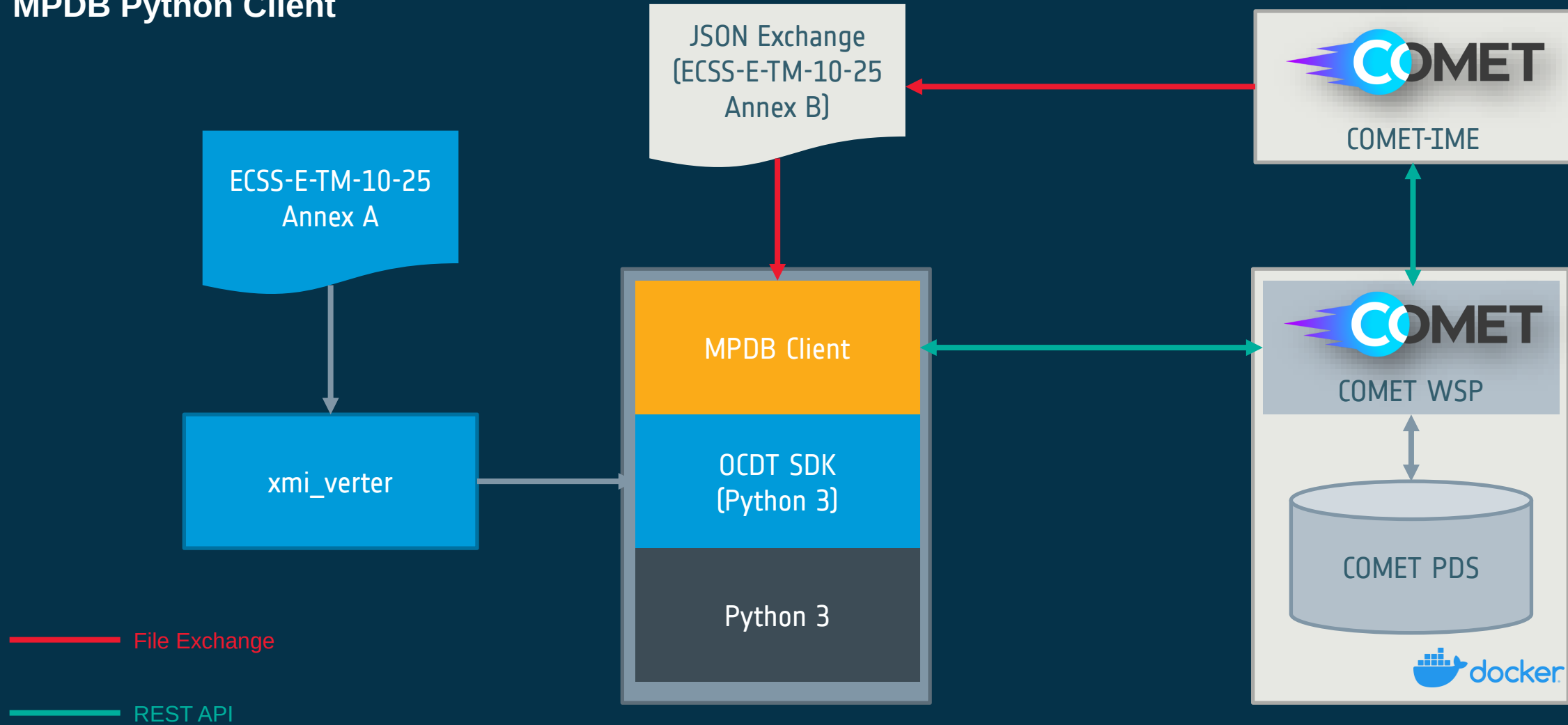
```
path_query = r'PLATO.space_segment.payload_module.pl.aeu.f_aeu\T_oper\as_required'
```

```
matching_params = mpdb.query_for_parameters_by_path(path_query)
mpdb.display_parameters(matching_params)
```

- Interactive load, load from configuration, load via function invocation
- Display site data, model data, product trees and parameter data
- Store and load parameter configuration files for replication of parameter data without copy-paste duplication
- Flexible query of parameters via path or parameter type
- Automated import of initial product data/parameterisation data
- “Current Best Estimate” computation
- Full documentation
 - User guides (via Jupyter Notebooks)
 - Design guides
 - Client API Reference

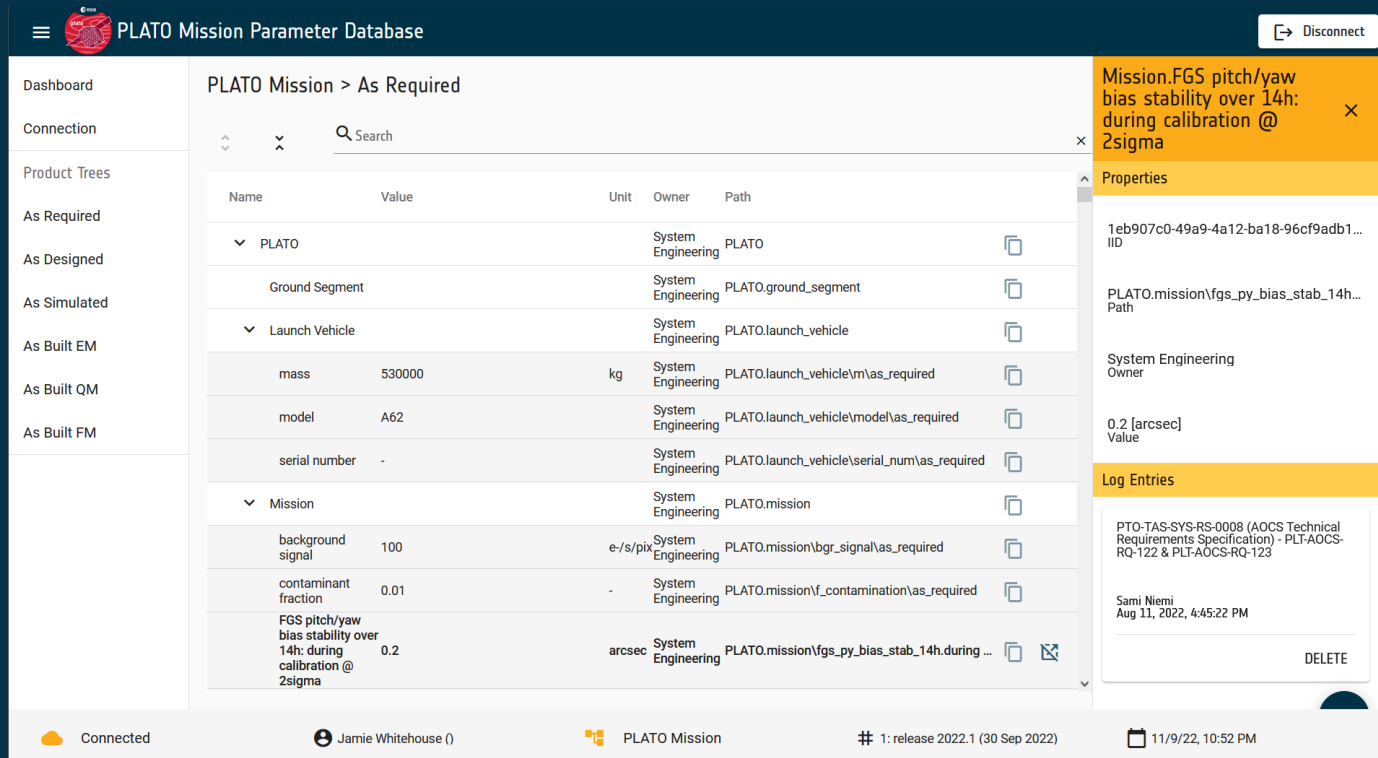
“Extension” of COMET

MPDB Python Client



“Extension” of COMET

MPDB Web App



PLATO Mission Parameter Database

Dashboard

Connection

Product Trees

As Required

As Designed

As Simulated

As Built EM

As Built QM

As Built FM

PLATO Mission > As Required

Search

Name	Value	Unit	Owner	Path
PLATO			System Engineering	PLATO
Ground Segment			System Engineering	PLATO.ground_segment
Launch Vehicle			System Engineering	PLATO.launch_vehicle
mass	530000	kg	System Engineering	PLATO.launch_vehicle\vm\as_required
model	A62		System Engineering	PLATO.launch_vehicle\model\as_required
serial number	-		System Engineering	PLATO.launch_vehicle\serial_num\as_required
Mission			System Engineering	PLATO.mission
background signal	100	e-/s/pix	System Engineering	PLATO.mission\bgr_signal\as_required
contaminant fraction	0.01	-	System Engineering	PLATO.mission\vf_contamination\as_required
FGS pitch/yaw bias stability over 14h: during calibration @ 2sigma	0.2	arcsec	System Engineering	PLATO.mission\fgs_py_bias_stab_14h.during ...

Mission.FGS pitch/yaw bias stability over 14h: during calibration @ 2sigma

Properties

1eb907c0-49a9-4a12-ba18-96cf9adb1... IID

PLATO.mission\fgs_py_bias_stab_14h... Path

System Engineering Owner

0.2 [arcsec] Value

Log Entries

PTO-TAS-SYS-RS-0008 (AOCS Technical Requirements Specification) - PLT-AOCS-RQ-122 & PLT-AOCS-RQ-123

Sami Niemi Aug 11, 2022, 4:45:22 PM

DELETE

Connected

Jamie Whitehouse ()

PLATO Mission

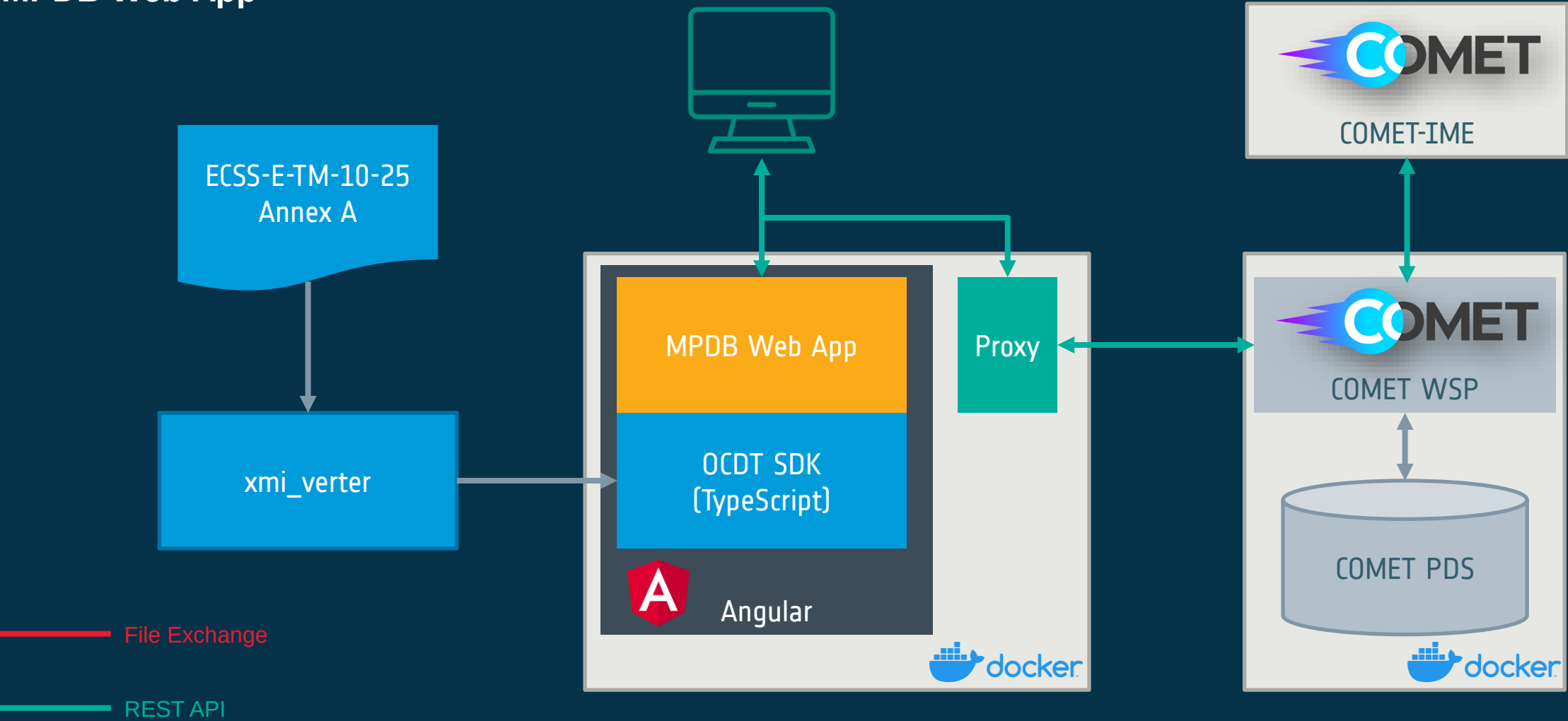
1: release 2022.1 (30 Sep 2022)

11/9/22, 10:52 PM

- Reader Interface with live connection
- Display of Product Tree data (Tabular Form) with expand/collapse function
- Queries/Filtering across Product Tree data
- Context sidebar
- Copy path to clipboard
- “Log Entries” to capture value justification
- Local caching for offline use

“Extension” of COMET

MPDB Web App



ESA UNCLASSIFIED – For Official Use

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DOCUMENT

PLATO Mission Parameter Database Management Plan

Prepared byS. Niemi, ESA/ESTEC

ReferencePTO-EST-MIS-PLA-1218

Issue1

Revision0

Date of Issue07/10/2021

StatusIssued

Document TypePL

Distribution

European Space Agency
Agence spatiale européenne

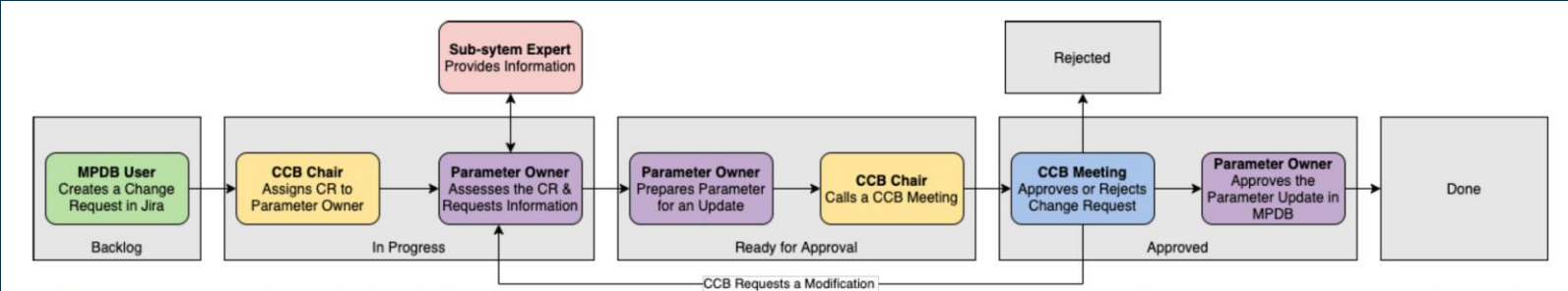


Figure 9: The PLATO MPDB configuration control process flow diagram for Change Requests. Only major activities and actors involved are shown. The status of the Jira Change Request issue is given by the grey background boxes. Note that the diagram shows only activities related to a CR and omits the decision of creating a new baseline and the accompanied release note.

1. Conceptual Flexibility

1. Conceptual Flexibility

2. Extensibility via Open Data Model/Interface

1. Conceptual Flexibility

2. Extensibility via Open Data Model/Interface

3. 10-25 Limitations to Element Reuse

1. Conceptual Flexibility

2. Extensibility via Open Data Model/Interface

3. 10-25 Limitations to Element Reuse

4. Scalability & Usability

Current Status & Conclusions

- Rollout to Parameter Owners Summer 2022
- Initial release and roll out to all end users Sep 2022
- Handed over to Change Control Board for management/future releases
- Reuse of approach in other ESA Science missions

Conclusions

- Open, standardised data models and (web) interfaces are key enablers
- User experience and performance/scalability are key areas for improvement
 - Matches experience in broader MBSE efforts
- Management of database requires dedicated central authority (CCB) from across ESA/Industry/Consortia
 - Avoids single point of failure
 - End-users become stakeholders in system
 - Lessons learned from previous Parameter Database efforts

Thank you for your attention!

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