



The EGS-CC based Mission Control Infrastructure at ESOC

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Introduction



- At ESOC Mission Control applications are developed on the basis of a common infrastructure supporting all categories of missions
- The EGS-CC is being developed in the context of a European wide initiative with the ambition to:
 - Support all types of space systems
 - Support all mission phases
 - Support all mission categories
- ESA is leading the EGS-CC initiative and also playing the role of the 'Integrator'
- At ESOC the "EGOS-CC" Project has been set-up to cover the adoption of the EGS-CC as the basis for the future generation ground data system infrastructure supporting mission operations execution



Main objectives



- Tackle long-term obsolescence of the current generation Mission and G/S Network Control ground data systems infrastructure
- Leverage on the EGS-CC as a European level initiative to minimise Cost of Ownership of the next generation M&C Ground Data Systems Infrastructure at ESOC
- Enable long term reduction of development and maintenance costs of the ground data systems infrastructure and of the dedicated systems relying on it
- Provide the users communities with an efficient environment to prepare and execute operations using modern technologies
- Rationalise the organisation/architectures of the target systems to enable clean split of responsibilities for development/integration/validation/maintenance
- Promote/enable cross-fertilisation of concepts/solutions with other European EGS-CC stakeholders
- Promote/enable cross-fertilisation of concepts/solutions between the Missions and G/S Network operations domains



A 'disruptive' change

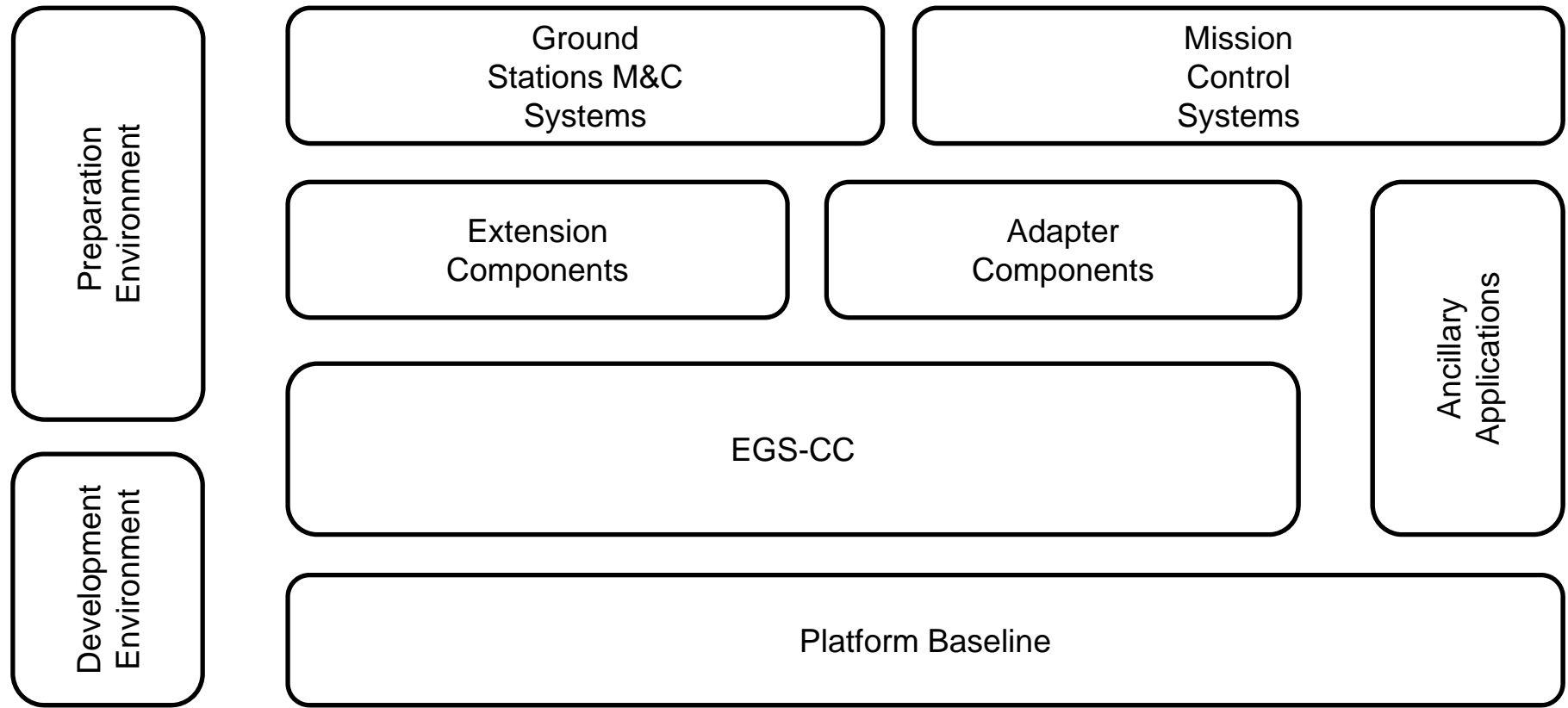


The EGS-CC adoption at ESOC will be 'disruptive' in many respects, namely:

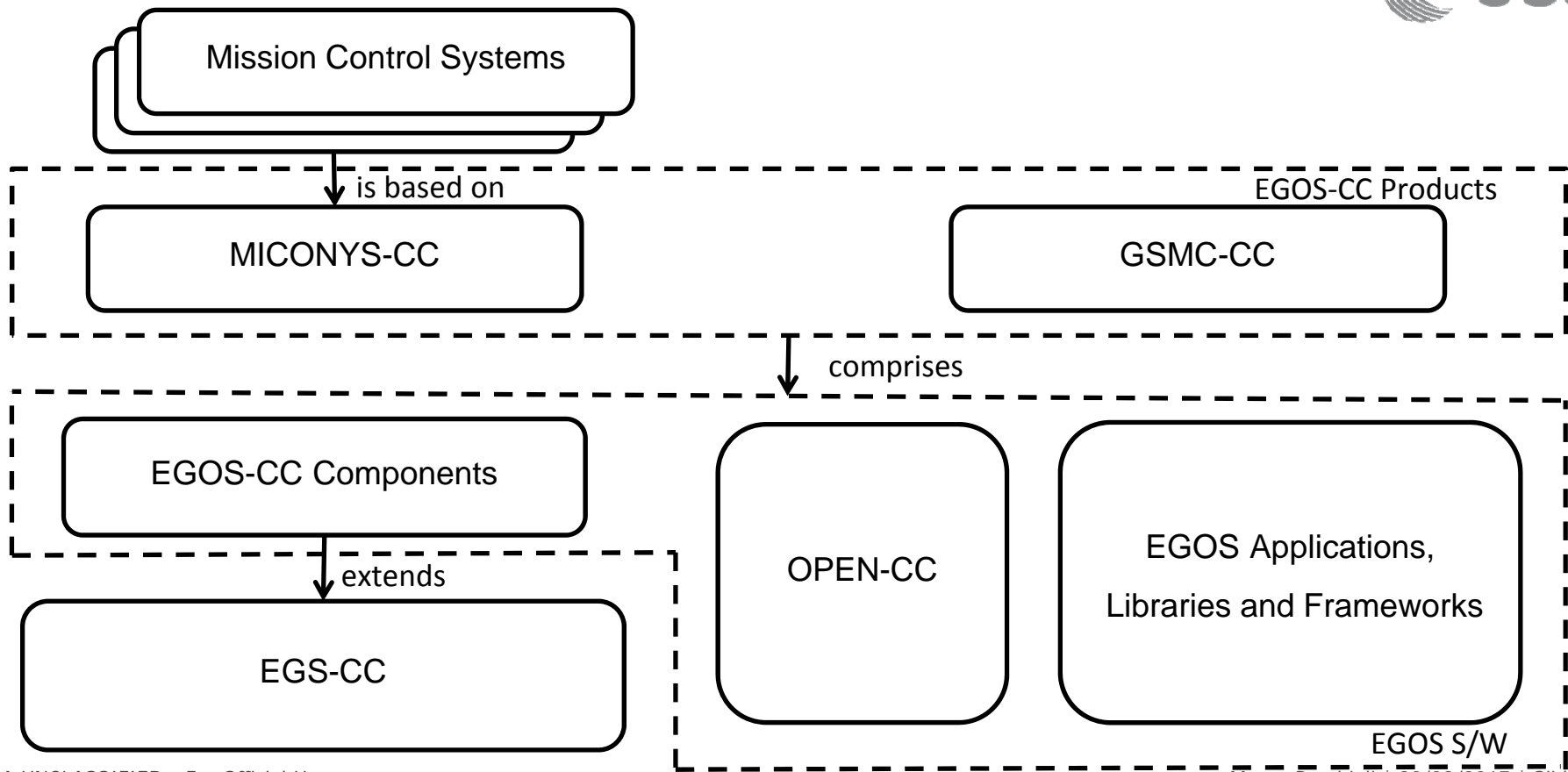
- Engineering culture
- Terminology
- Engineering support tools and associated processes (e.g. model based engineering, white-box testing, automated validation)
- Technology stack (e.g. no C++, no CORBA, no SQL)
- Development and maintenance approach of M&C systems (EGS-CC as a 3rd party product)
- M&C Data definitions exchange and lifecycle
- External interfaces (with other ground systems)
- Commonality/cross-fertilisation between missions and ground station teams
- Approach to operations (higher level of abstraction, native automation support, new data model for tailoring data, provision of a consistent preparation environment)



EGOS-CC Implementation model



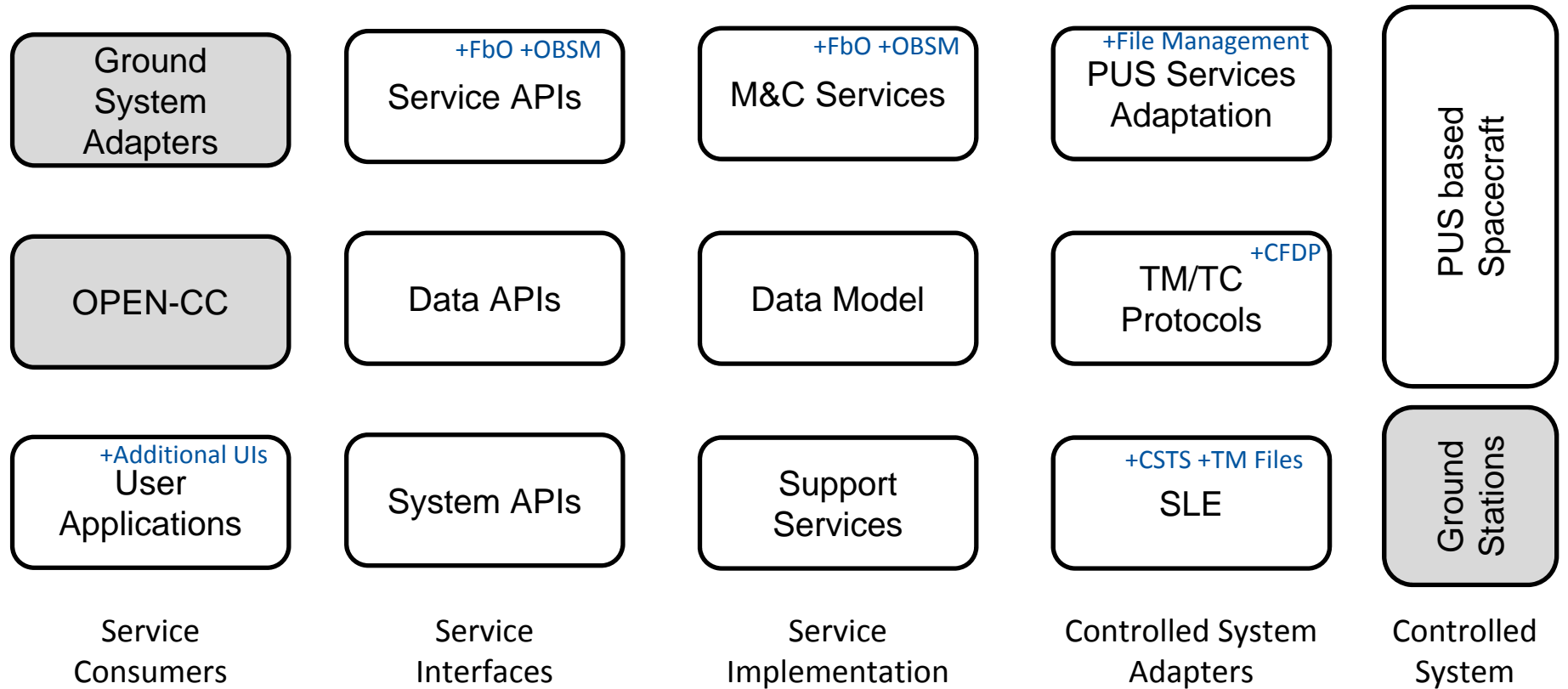
EGOS-CC Products implementation



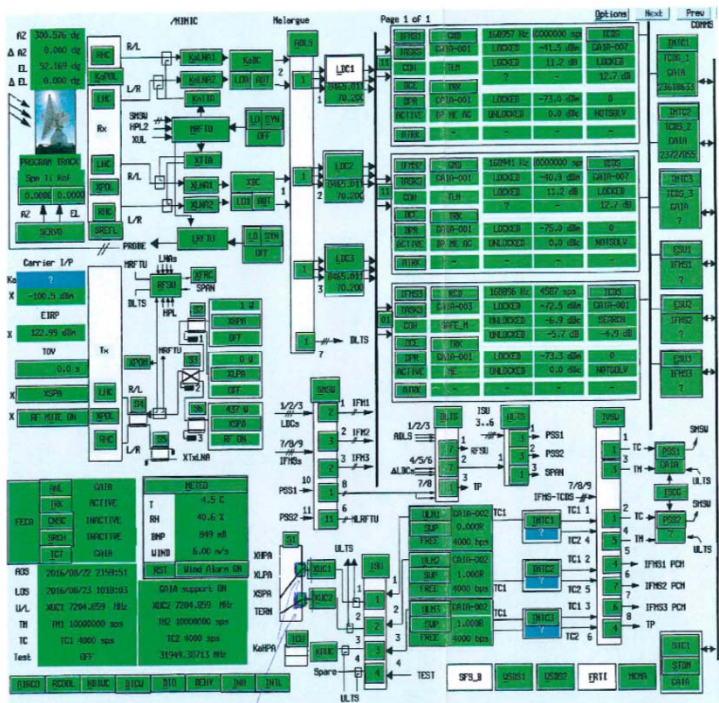
EGOS-CC Development principles

- Full adoption of EGS-CC at all levels
 - Concepts/Terminology/Methodologies
 - (Design and data) Models
 - Technologies and Tooling
- Extensions designed/implemented as 'EGS-CC like' components:
 - Additional 'services'
 - Adapters towards the controlled system
 - Adapters towards the (legacy) ground systems
- EGS-CC deliverables re-used as 3rd Party Product (no modification)
- Parallel EGS-CC/EGOS-CC development, integration and validation
- Emphasis on 'operations services' design, based on 'operations/engineering' collaboration
- Cross-fertilisation between mission and network operations wherever possible

EGS-CC Extensions for MICONYS-CC



Trying to 'emulate' the old system?



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Trying to emulate the old system?



File Transfer Stack Display - bmcv12 - BC (Database version: 061SMPFM) RTDB ver: 061SMPFM, 20170302-PFM-v9_0-v1

File Transfer Stack

Status & Control

Link: **BSIMB_NN** Static PTV: Global **ENABLED** Dynamic PTV: **ENABLED** Verification: **ENABLED** Interlock: **NONE** Time Correlation: **Valid** **Accurate**

TC: **NO TM FLOW** Local: **ENABLED** **ENABLED** **ENABLED** **NONE** Wait Mode: **ENABLED** Tx Mode: **BD** Source: **RUNNING** Commands: 24 Next to Release: 1

Commanding Actions: Reset IL:

Name	Description	StaPTV	DynPTV	Release Time	IL	G	B	CEV	Execution Time	SSID	Parent Seq	Subsystem	LDU	File ID	Unique ID
ZCD00D09	DMS Accept First Uplink Part - Pt. 1	GO	E WAIT	ASAP	LU			E	IMMEDIATE				38	00001200	0000000000
ZCD01101	DMS Perform Connection Test - Pt. 1	GO	E WAIT	E ASAP				E	IMMEDIATE				38	00001200	0000000000
ZCD01101	DMS Perform Connection Test - Pt. 1	GO	E WAIT	E ASAP				E	IMMEDIATE				38	00001200	0000000000
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ZCD01101	DMS Perform Connection Test - Pt. 1	GO	E WAIT	E ASAP				E	IMMEDIATE				38	00001200	0000000000
ZCD00D08	DMS Accept Last Uplink Part - Pt. 2	GO	E WAIT	ASAP	LU			E	IMMEDIATE				38	00001200	0000000000
ZCD00D09	DMS Accept First Uplink Part - Pt. 1	GO	E WAIT	ASAP	LU			E	IMMEDIATE				39	00001155	0000000000
ZCD01101	DMS Perform Connection Test - Pt. 1	GO	E WAIT	E ASAP				E	IMMEDIATE				39	00001155	0000000000
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ZCD01101	DMS Perform Connection Test - Pt. 1	GO	E WAIT	E ASAP				E	IMMEDIATE				39	00001155	0000000000
ZCD00D08	DMS Accept Last Uplink Part - Pt. 2	GO	E WAIT	ASAP	LU			E	IMMEDIATE				39	00001155	0000000000

Find: Match case

Mnemonic: Sequence:

[WARNING] This machine does not support playing the required audio file for alarms



Or rather rethinking it?



File Based Transactions M&C

UPLOAD FILES

Global Configuration

Max. processing requests: 4 Protocol: Closed-loop Auto re-transmit Re-transmission first Re-transmission after current

Global Transaction Control

AUTOMATIC **PROCESSING** [Play] [Pause] [Stop] **Abort** PDU Uplink queue

Start Time	Trans. ID	Transaction Type	TC File Type	Source Path	Destination Path	Source	State
2015-108T17:20:00:00	988	Upload & Verify File	OBCP	/ground/folder1/tc_file_456	/onboard/folder1/tc_file_456	Client 1	TRANSMITTING (25/30)
2015-108T17:18:00:00	854	Upload & Verify File	OBCP	/ground/folder1/tc_file_45	/onboard/folder1/tc_file_45	Client 1	RE-TRANSMITTING
2015-108T17:18:00:00	855	Upload & Verify File	OBCP	/ground/folder1/tc_file_46	/onboard/folder1/tc_file_45	Client 1	TRANSMITTING
2015-108T17:17:00:00	833	Upload & Execute File	TC File	/ground/folder1/tc_file_4	/onboard/folder1/tc_file_4	Automation	SUSPENDED

Pause
 Resume
 Abort
 Move up
 Move down
 Acknowledge
 Purge

Shows all transactions from all sources

If no "auto re-transmit", a confirmation is displayed before starting re-transmission

Warning

! Confirm resume re-transmission?

Resume Suspend Suspend All

ES

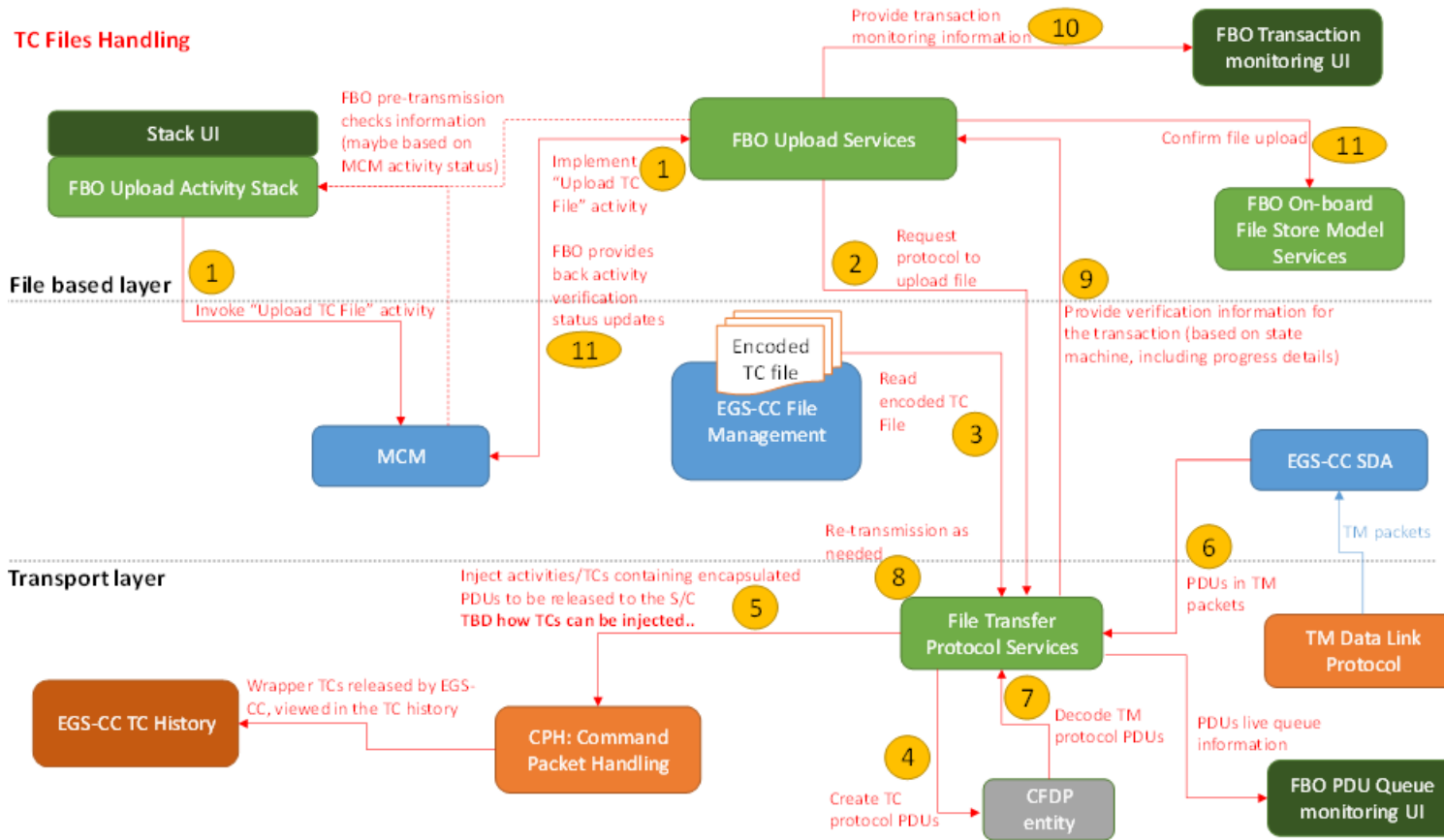


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Example of FbO Extensions (TC Files)



TC Files Handling



EGOS-CC Validation principles



- Incremental validation taking place at different levels but not necessarily in series:
 - White-box testing (implementation verification)
 - Level-0 components requirements based testing
 - Functional validation of the integrated system (scenario based)
 - Operational validation (in a representative environment)
 - Integrated ground segment (interfacing with real ground systems)
- Validation taking place at the lowest possible level meeting the validation objective
- Test Profiles (consisting of all soft artefacts in addition to the S/W installations) shared as much as possible across levels
- Validation responsibility mirroring the usage responsibility
- Distinct responsibilities between specification, implementation and verification
- Independent lifecycle for each validation scenario



Take-away



- The EGOS-CC Project at ESOC aims at developing and demonstrating the new generation (EGS-CC based) mission control ground data system infrastructure
- The Project covers the full lifecycle, up to operational demonstration
- Current target pilot application is the Juice Mission Control System
- Schedule is very tight, so 'parallelism' is a must
- This initiative is seen as an opportunity to rationalise the engineering practices to develop/manage M&C applications and also to harmonise the mission and network operations domains
- The '360 degree' effort to introduce a new generation of operations support system is considerable in many respects and shall not be underestimated
- Trying to 'emulate' the old systems can only lead to degradation/dissatisfaction
- Key to success will be the EGS-CC itself but also the motivation and commitment of the EGOS-CC stakeholders to consider new (engineering and operational) approaches



End of presentation



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