



ESOC End-to-End Ground Segment Reference Facility

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SESP 2017 - 30/03/2017

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Outline

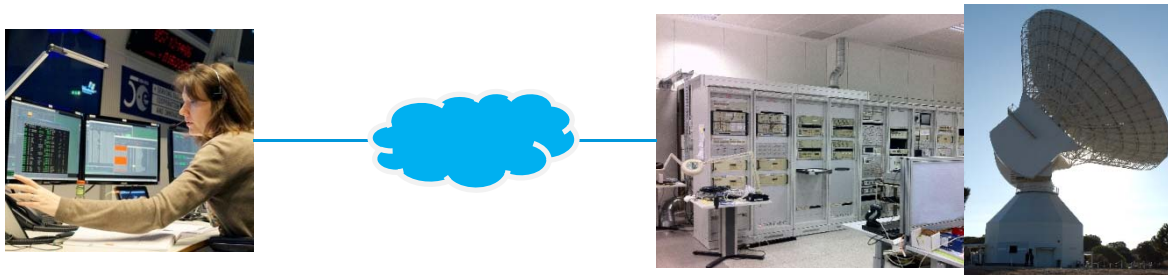


1. Introduction
2. The End-to-End Ground Segment Reference Facility (E2E GSRF)
3. The E2E GSRF Architecture
4. The E2E GSRF Representativeness
5. Test Automation
6. Conclusions

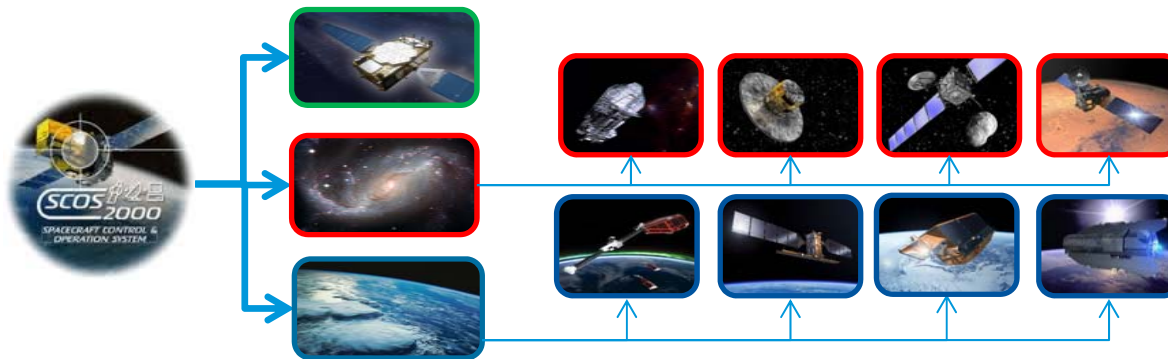


Introduction

- Ground Segment: a complex Systems of Systems



- ESOC: from **generic** Infrastructure to mission **specific** tailoring



Introduction (C'ed)

- ESOC initiative to achieve **highest MOI quality** at **minimum cost**:
 - ⇒ establish **End-to-End Ground Segment Reference Facility** (E2E GSRF)
 - ⇒ one-stop environment for **MOI System level Integration and Testing**
 - ⇒ effectiveness through **representativeness**
 - ⇒ efficiency through:
 - Usage **throughout** system engineering lifecycle
 - **convergence** of various integration and test environments
 - deployment of **automation** wherever possible



The E2E Ground Segment Reference Facility



vs.



- ⇒ issues detected late, sometimes during operations
- ⇒ hard reproducibility
- ⇒ difficult investigations



The E2E Ground Segment Reference Facility (C'ed)



- Engineering testing is mainly requirements driven
- Enhanced by integration of **operational** usage:
 - ⇒ mission **representative** test **chains**
 - ⇒ mission **representative** test **scenarios**
 - ⇒ as **early** as possible in the systems engineering lifecycle



The E2E Ground Segment Reference Facility (C'ed)



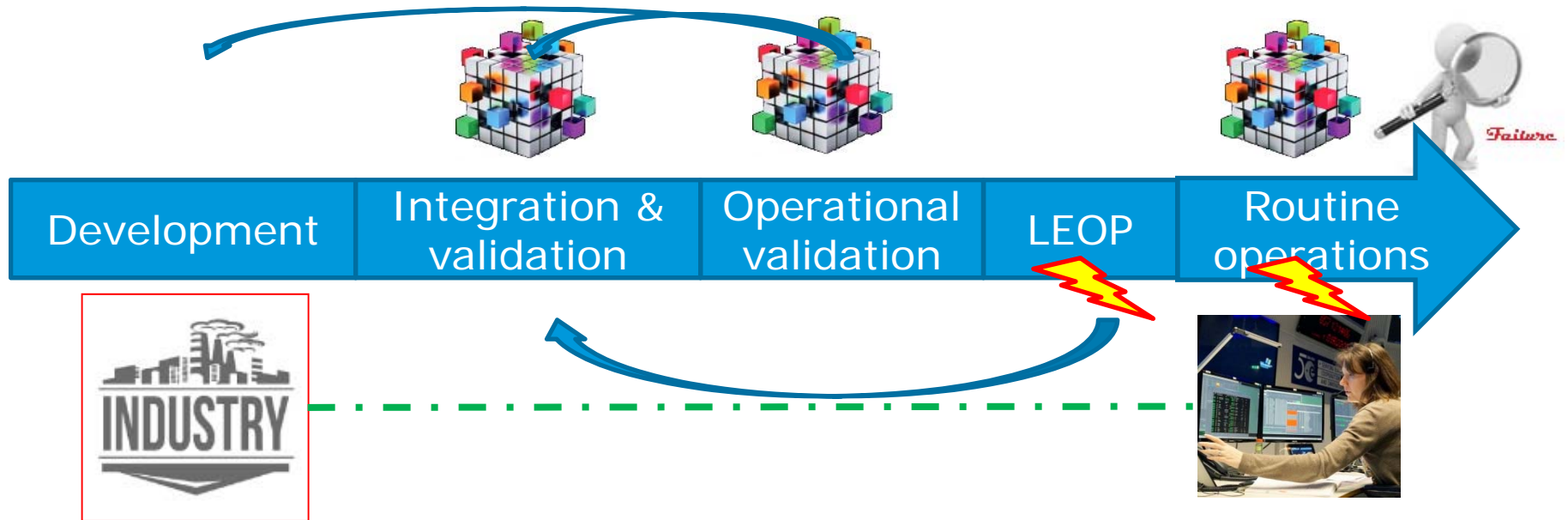
- The E2E GSRF:
 - a **coherent** Ground Segment Integration and Test as a Service (**ITaaS**) system
 - Ground Segment E2E **reference**, mission **representative** I&T Environment
 - Reference Test Scenarios and Test Cases on **mission-based** configurations
 - Highly **automated** environment and test execution
 - Platform for **sharing** knowledge, experience and expectations in multi-disciplinary team
 - **cross-fertilisation** among **engineering** domains and with **operations**



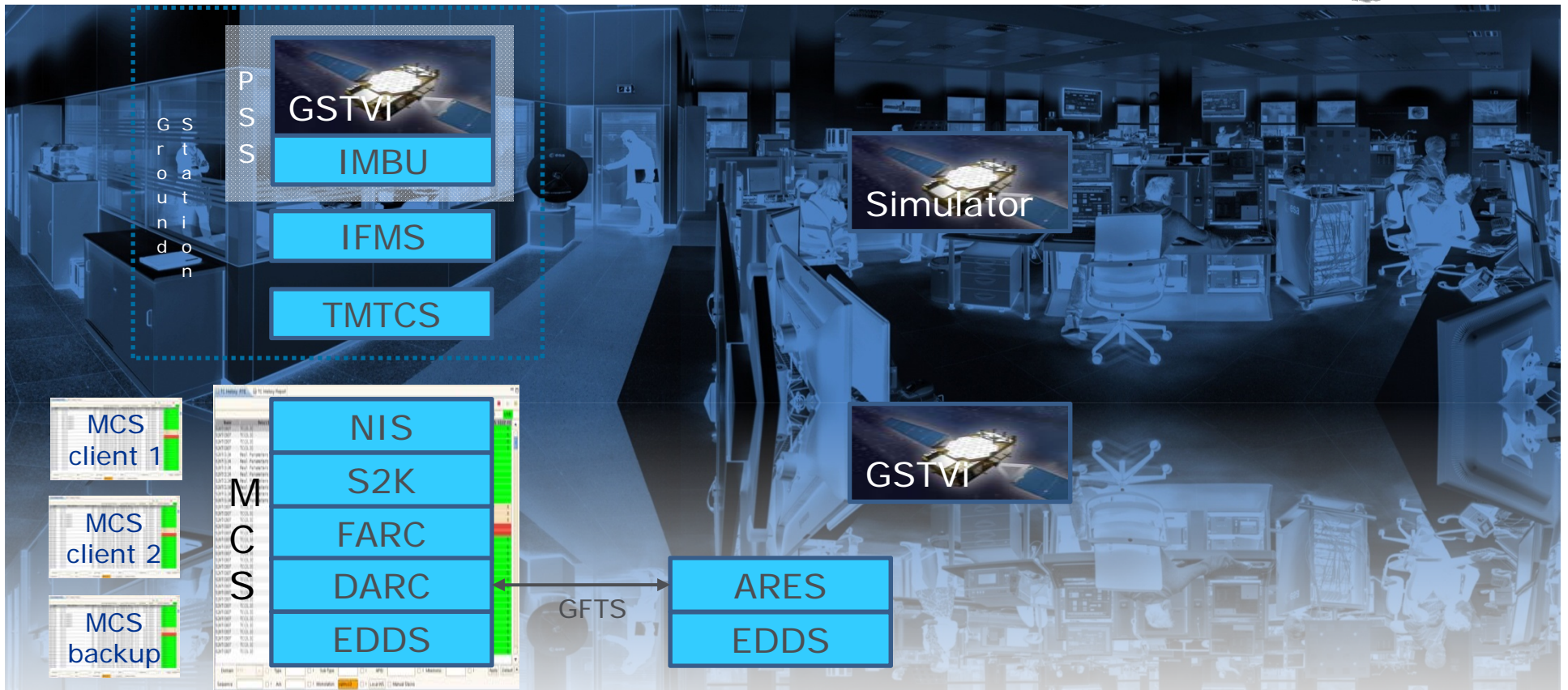
The E2E Ground Segment Reference Facility (C'ed)



- A single, standardised reference throughout the MOI systems lifecycle:



The E2E GSRF Architecture



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The E2E GSRF Architecture (C'ed)



Basic TM/TC Test Assembly

MCS client 1

MCS client 2

MCS backup

MCS

NIS

S2K

FARC

DARC

EDSS

Simulator

GSTVI

ARES

EDSS

GFTS

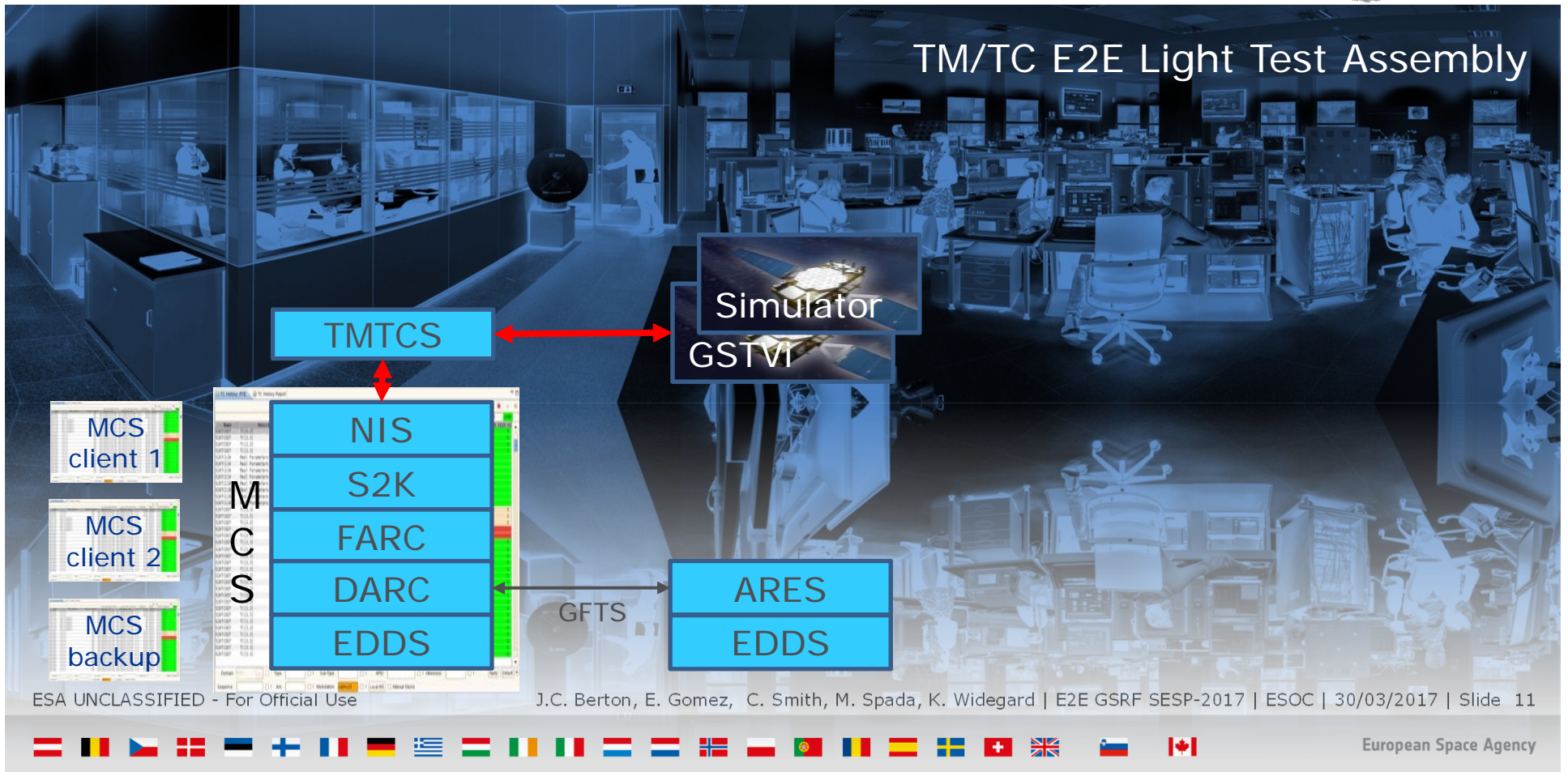
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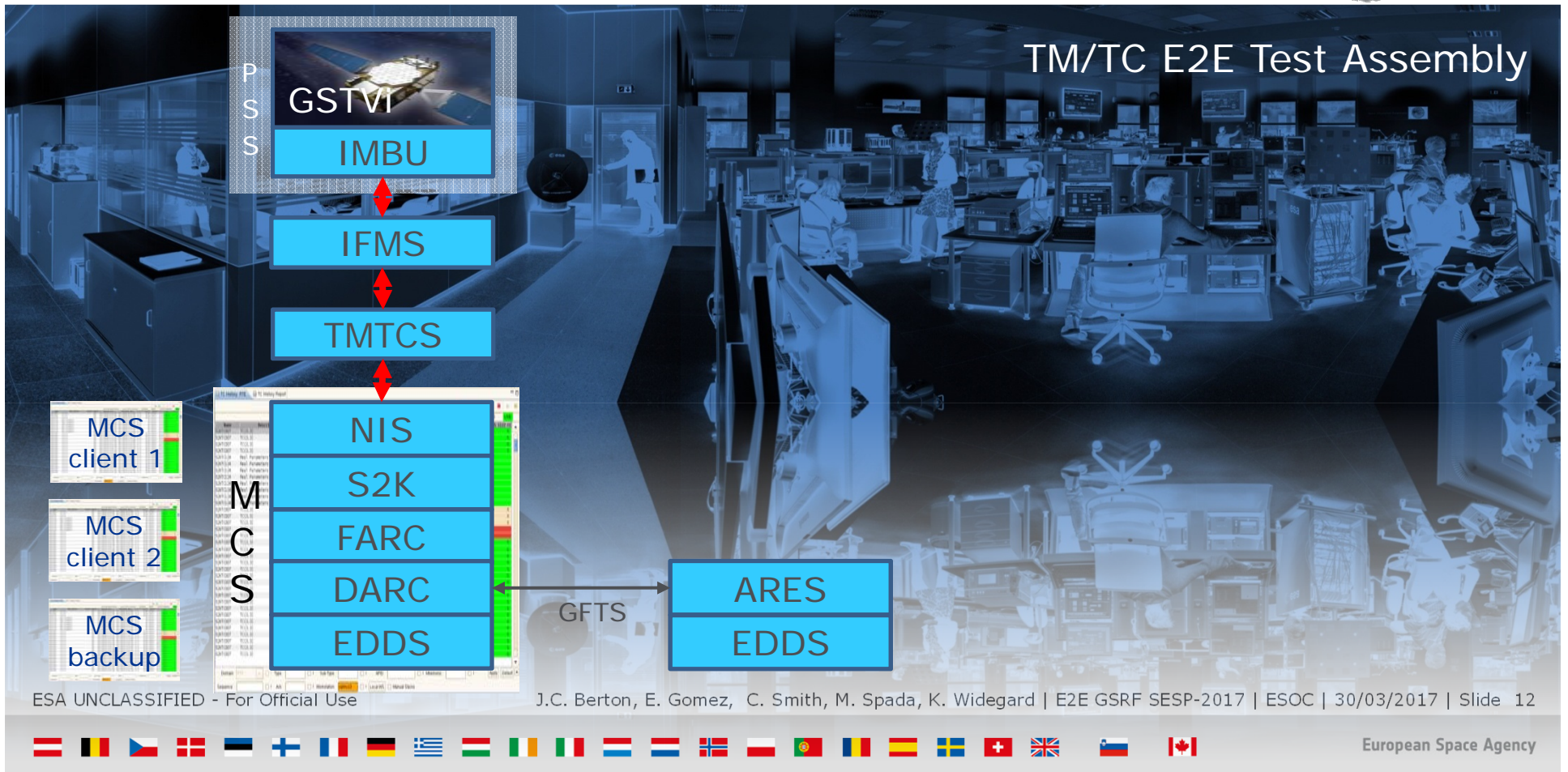
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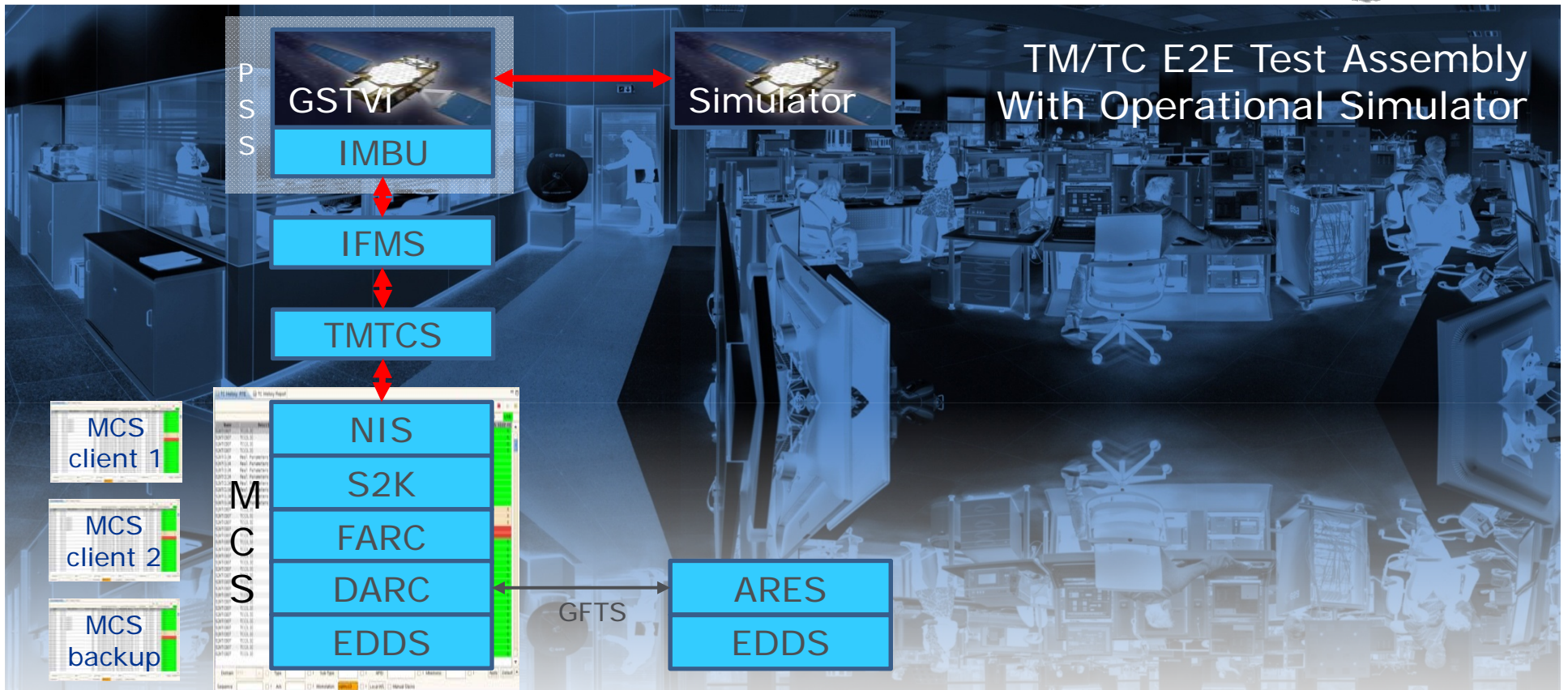
The E2E GSRF Architecture (C'ed)



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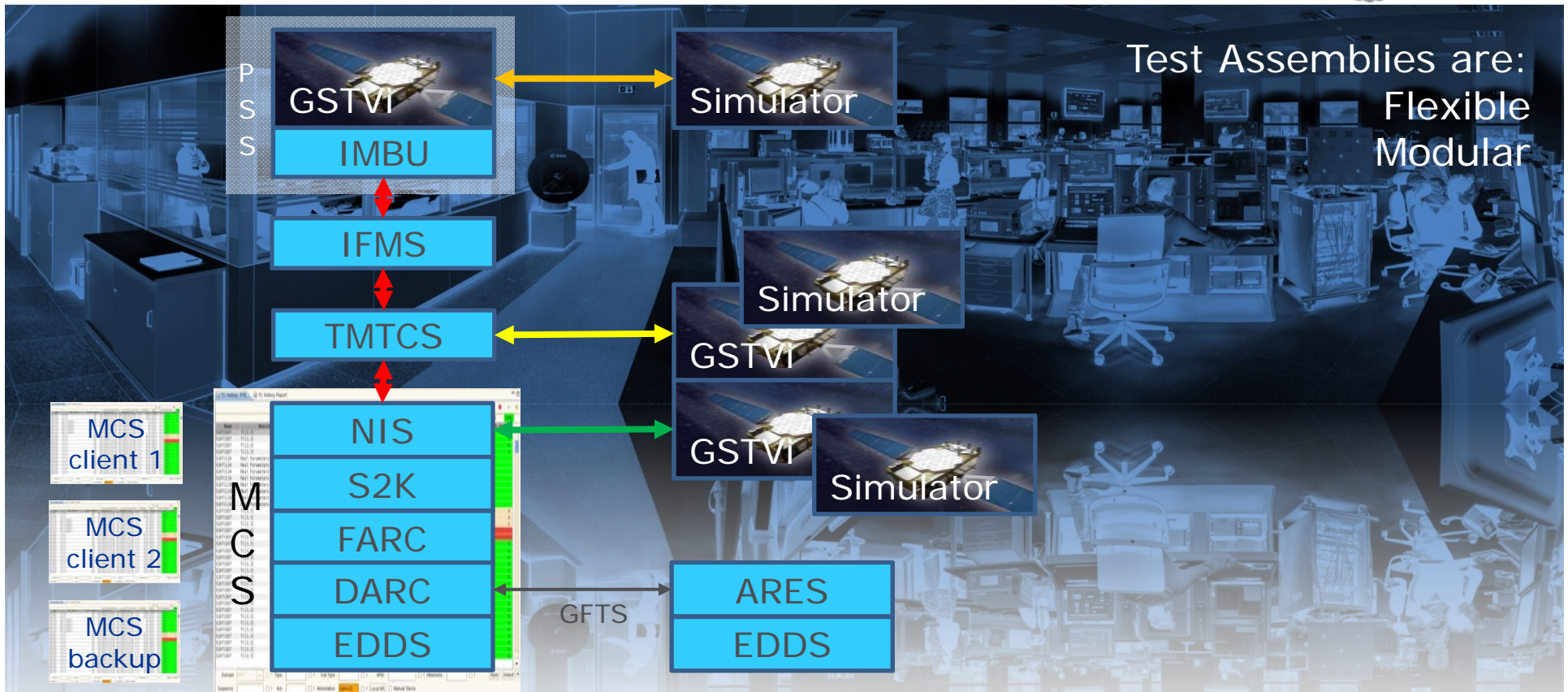
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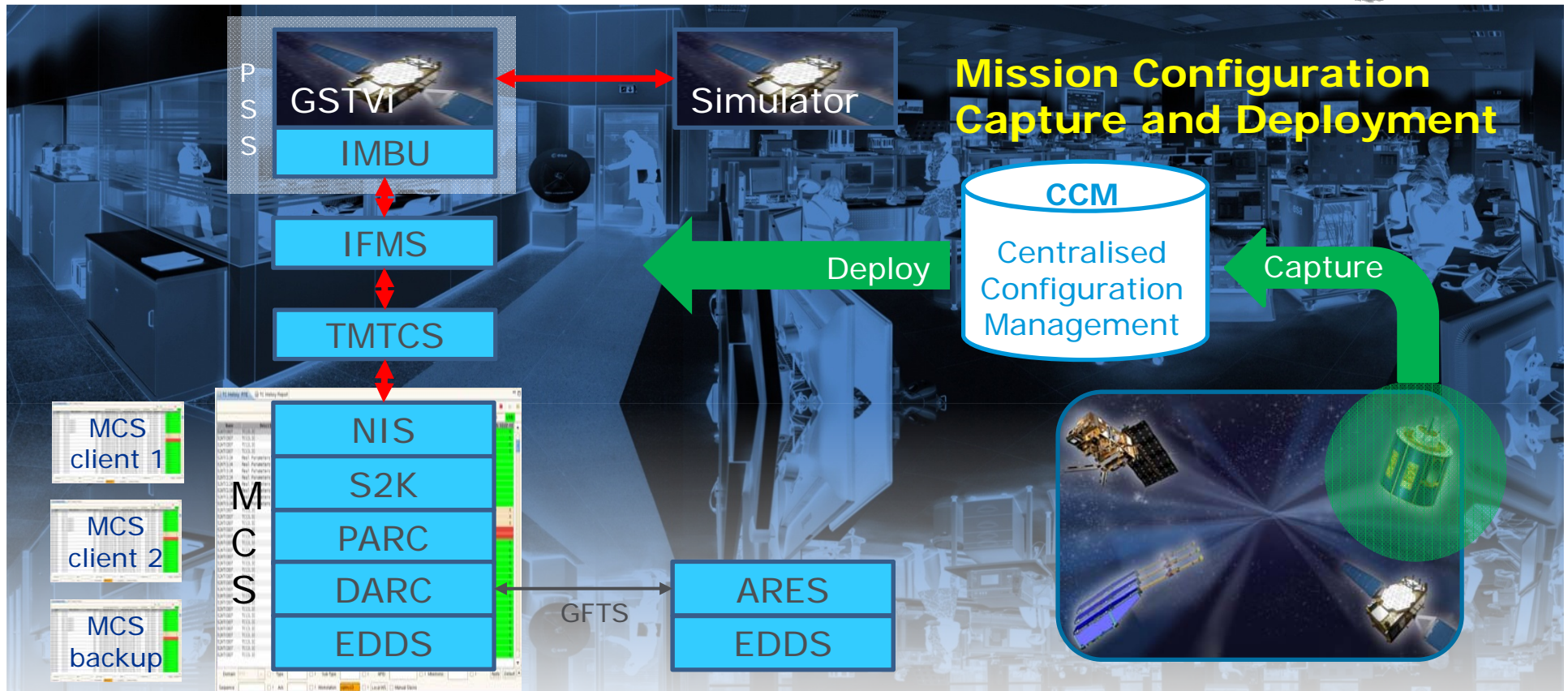
The E2E GSRF Architecture (C'ed)



Test Assemblies are:
Flexible
Modular



The E2E GSRF Representativeness



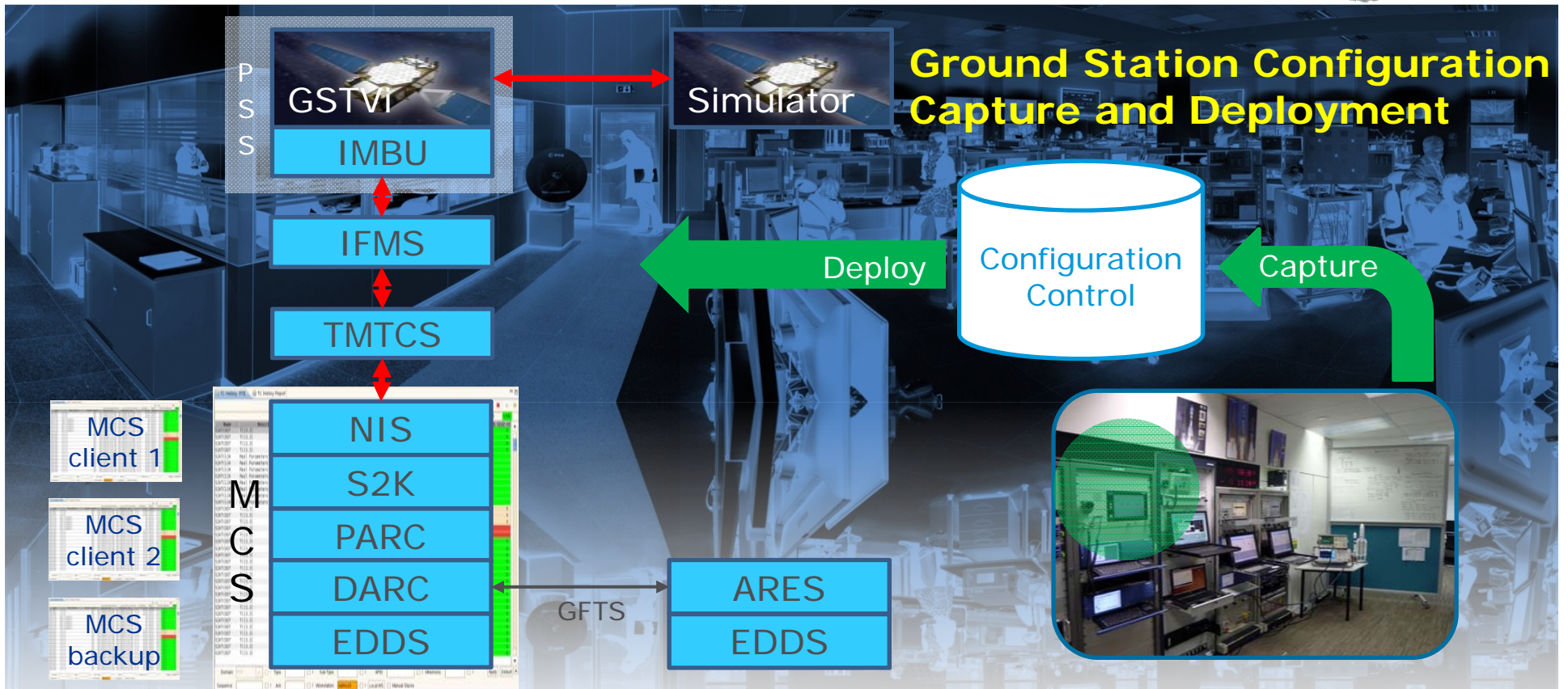
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The E2E GSRF Representativeness (C'ed)



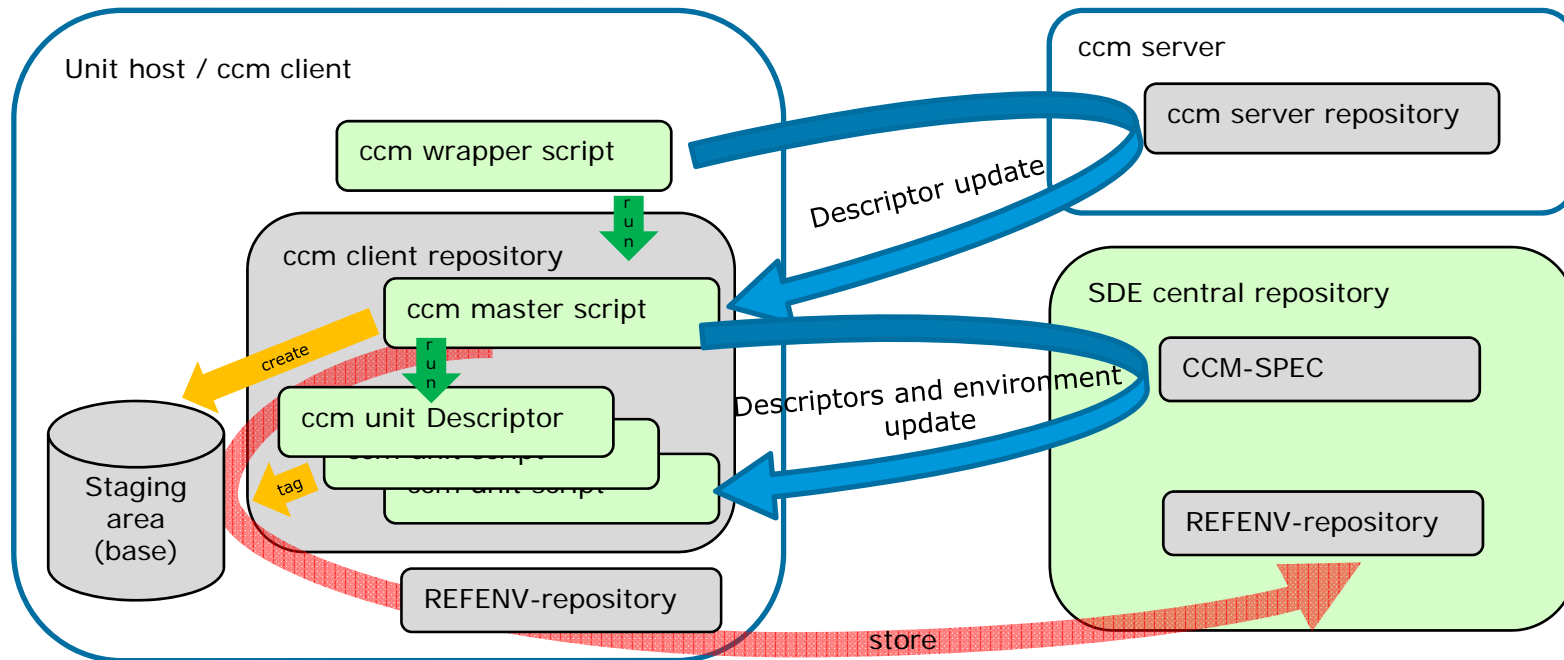
Ground Station Configuration Capture and Deployment



The E2E GSRF Representativeness (C'ed)



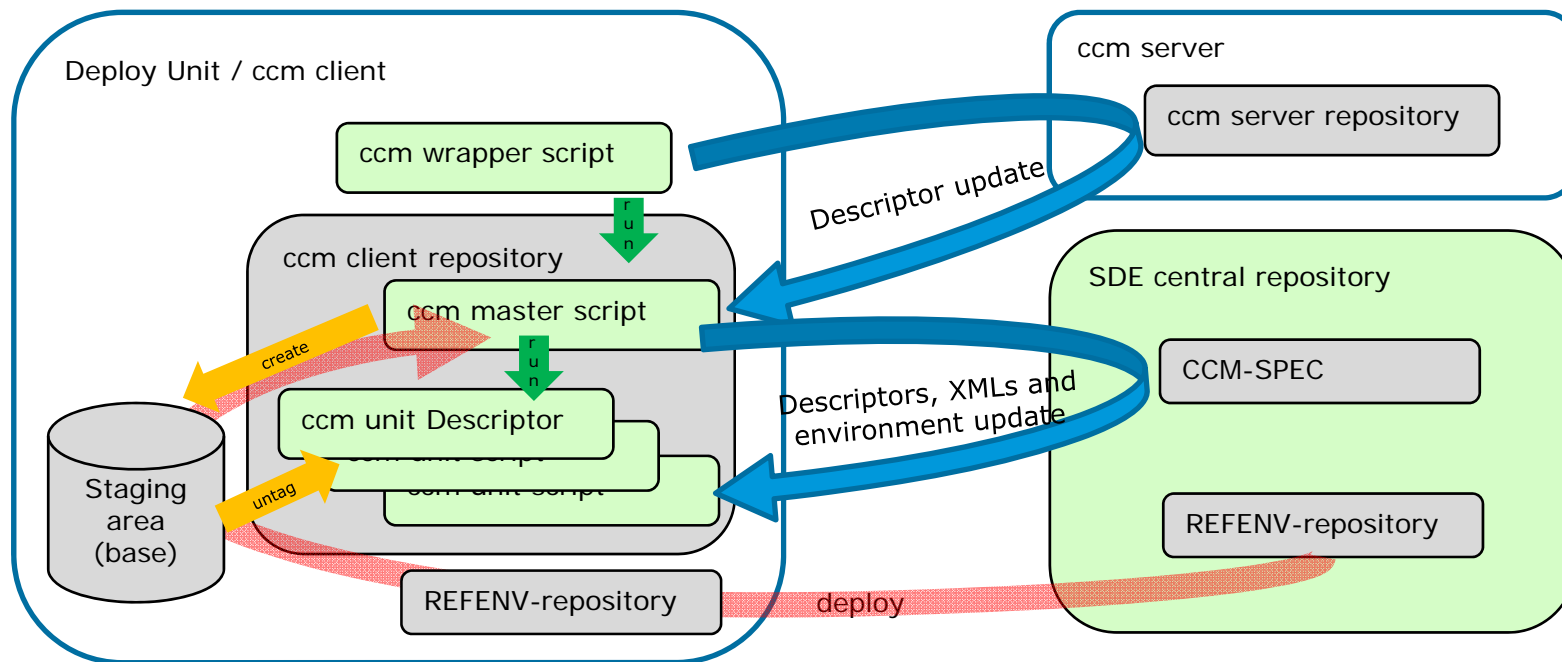
- **Centralised Configuration Management (CCM) – Capture process**



The E2E GSRF Representativeness (C'ed)



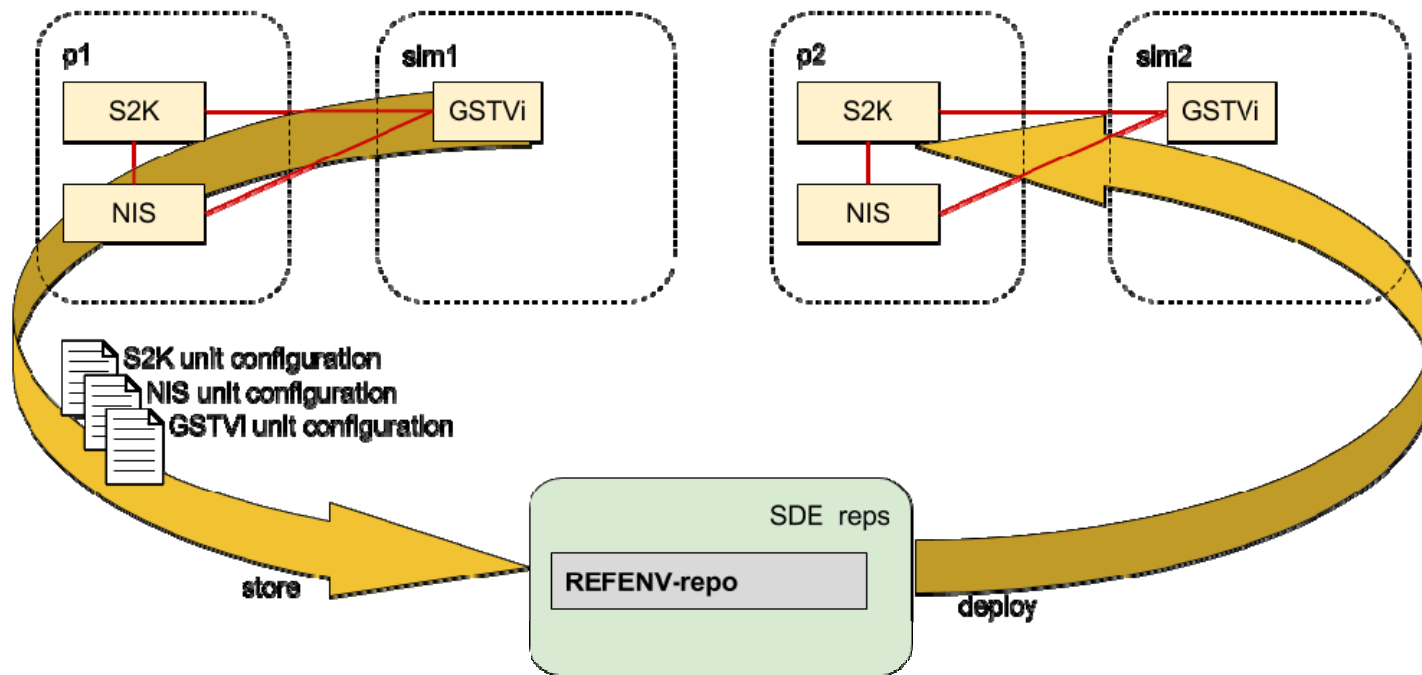
- Centralised Configuration Management (CCM) – Deployment process



The E2E GSRF Representativeness (C'ed)



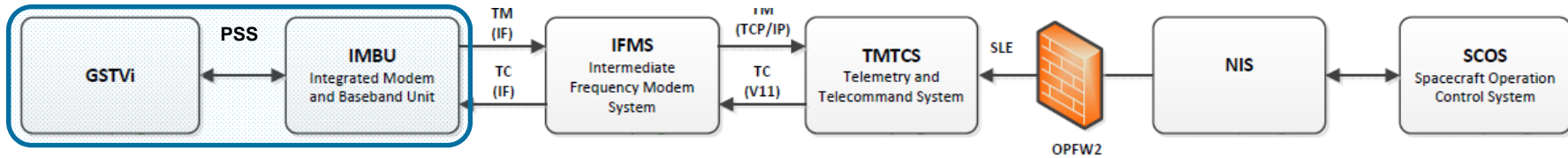
- Centralised Configuration Management (CCM) – Test Assemblies



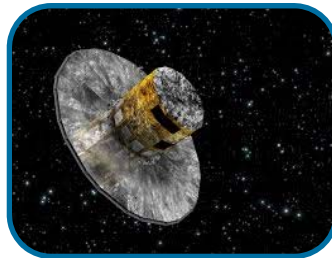
The E2E GSRF Representativeness (C'ed)



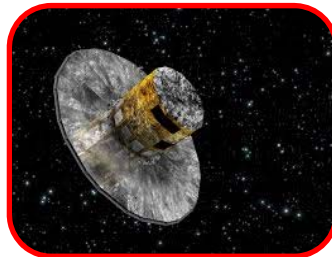
- Test Assemblies



SLES11



SLES12



The E2E GSRF Representativeness (C'ed)



- **Test Scenarios and Test Cases Suite**



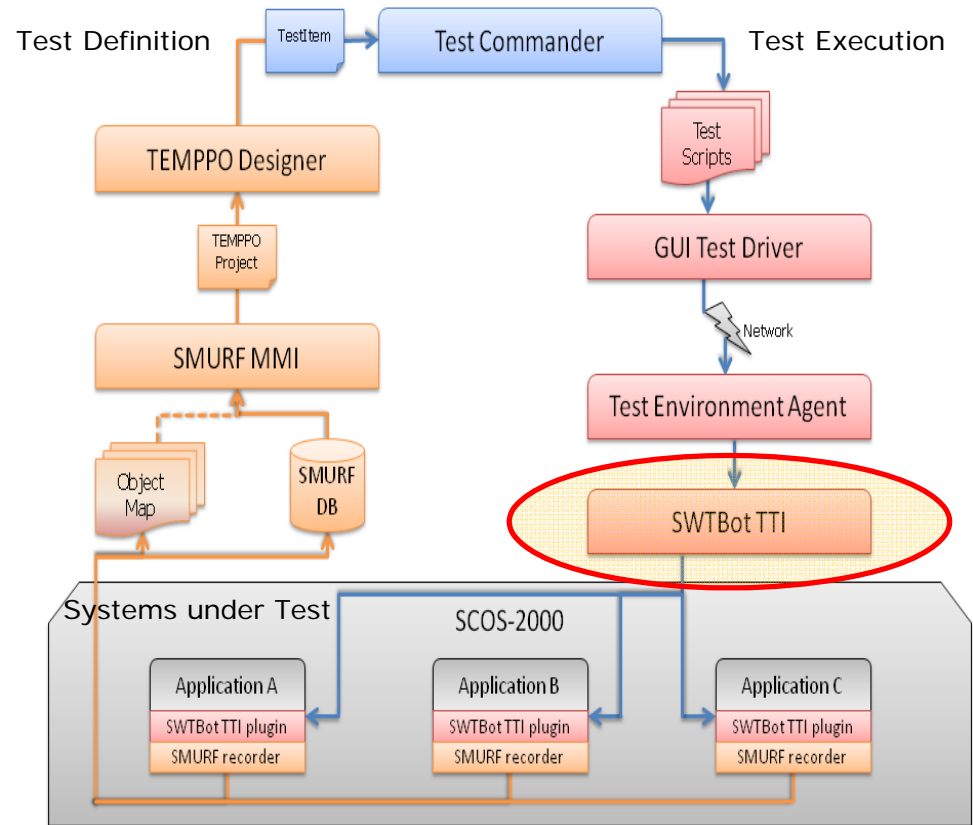
- **Test categories**

- Confidence Tests: environment sanity checks
- System Tests: non-regression testing
- E2E Tests: complex mission scenarios or performance testing



Test Automation

- Automation
 - ⇒ efficiency in a complex environment
- Reuse of ART/MMIT
 - ⇒ evolve existing capabilities
- Replication of user actions
 - ⇒ Representativeness breakthrough



Test Automation (C'ed)



- The Test Commander functionalities:
 - executes commands
 - provides results
 - debugging capability
 - production of test reports
 - system state recovery

| Index | Stepname | Result | Criticality | Timeout | Exp. fail | Instruction | Exp. result | Parameter 1 | Parameter 2 |
|-------|-----------------|--------------|-------------|---------|-----------|-------------|-------------|----------------------|----------------|
| 0 | PASS | Passed | MAJOR | 0 | 0 | PASS | 0 | | |
| 1 | Sleep | Passed | MAJOR | 0 | 0 | SLEEP | 0 | time=1000 | |
| 2 | Set_Variable | Passed | MAJOR | 0 | 0 | VSET | 0 | name=TESTVAR1 | value=TESTVAL1 |
| 3 | Verify_Var | Passed | MAJOR | 0 | 0 | VCHECK | TEST.+1 | name=TESTVAR1 | |
| 4 | Unset_Var | Passed | MAJOR | 0 | 0 | VSET | 0 | name=TESTVAR1 | value= |
| 5 | Verify_Emptyvar | Passed | MAJOR | 0 | 0 | VCHECK | ^\$ | name=TESTVAR1 | |
| 6 | Test_Prompt | Failed | MAJOR | 0 | 0 | PROMPT | 0 | text=Please say yes. | |
| 7 | C_Shell | Not Executed | CRITICAL | 0 | 0 | SHELL | 0 | script=/bin/csh | flags=-f |
| 8 | Bourne_Shell | Not Executed | CRITICAL | 0 | 0 | SHELL | 0 | script=/bin/sh | file=/dev/null |

Messages

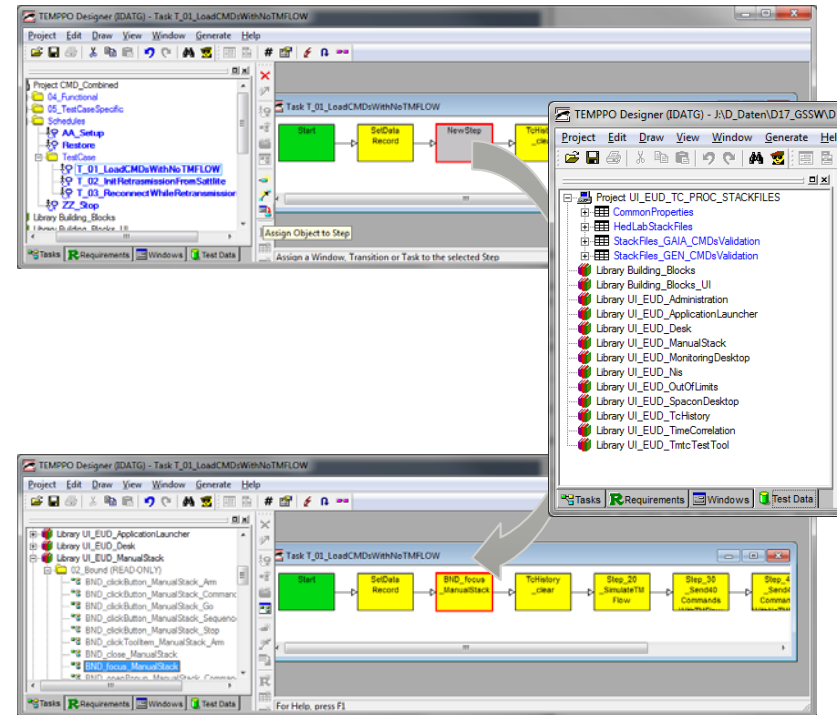
```
[2005-280T11:59:13 I] Test step #5 (Name=Verify_Emptyvar) executed successfully.  
[2005-280T11:59:13 I] Executing step #6 (Name=Test_Prompt). Command to execute: PROMPT 0 {text {Please say yes.}} {descr {This is t  
[2005-280T11:59:16 W] Test step status: Failed Error code=1; Error info=Selected button with value=1 does not correspond to the expected  
[2005-280T11:59:16 F] Test case 'TECO_Basic_Instructions_1' failed
```



Test Automation (C'ed)



- Issues to be addressed:
 1. Test abstraction
 2. Test reusability
 3. Mapping/recognition of controls
- The Test Management tool (TEMPPPO):
 1. Contains a set of nested building blocks
 2. Building blocks are parametrised (libraries)
 3. Manages object maps (control details)



Test Automation (C'ed)



- Scalability: a 5-tiers approach

| | |
|---|-------------------------|
| 1. Actions common to most controls | Valid across subsystems |
| 2. Link actions to specific widgets | |
| 3. Combine a set of actions into complex ones | Subsystem specific |
| 4. Combine complex actions to match functionalities | |
| 5. Combine functionalities in common test sequences | Assembly specific |

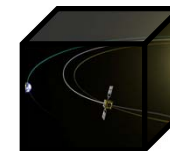


Test Automation (C'ed)

- Current status:
 - 8/12 hours of automated test cases (overnight continuous testing)
 - Automated tests are daily executed on different systems versions
 - Provision of reassurance of non-regression, reliability, robustness
- Lessons Learned:
 - GUI standardisation is critical
 - Need to repeat tests several times to separate spurious errors from regression
- Improvements:
 - Automated reporting of failed test steps
 - Provision of different testing views and levels of resolution granularity

Conclusions & Outlook

- ESOC focus on MOI **E2E** Integration & Testing
- E2E Ground Segment **Reference** Facility established
- High degree of **representativeness** and **automation**
- Offers ground segment systems **I&TaaS**
- **Throughout** systems engineering **lifecycle**
- Reproduction/troubleshooting of **complex** problems
- Extend usage from **suppliers** to **end users**
 - ⇒ **Earlier** and **combined** I&T activities
- Increased **cooperation** between stakeholder
 - ⇒ **Optimised** and **merged** IV&V processes



Conclusions & Outlook (C'ed)



- Future developments:
 - **automation** of system deployment and configuration
 - enable **continuous** integration and testing
 - include automated problem **root cause analysis** and forecasting
 - include system **security** testing
 - extend to E2E Reference Environment Space mission (**ERES**)
- E2E GSRF evolves towards future ground segment architecture based on new major developments, in particular **EGS-CC** based Monitoring and Control





Thank you

Questions ?

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