ESOC End-to-End Ground Segment Reference Facility

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Outline

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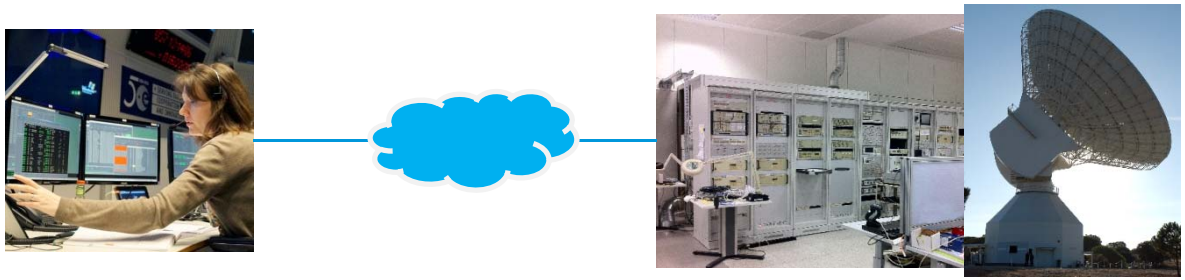
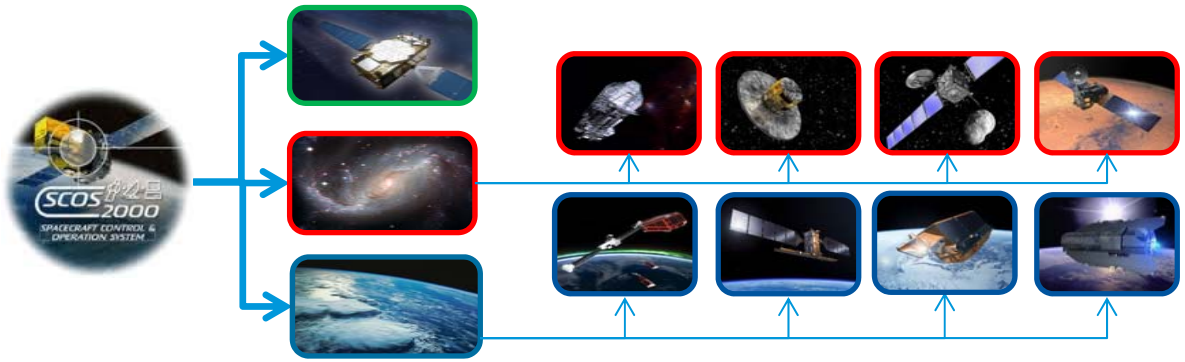
2. The End-to-End Ground Segment Reference Facility (E2E GSRF)
3. The E2E GSRF Architecture
4. The E2E GSRF Representativeness
5. Test Automation
6. Conclusions

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)

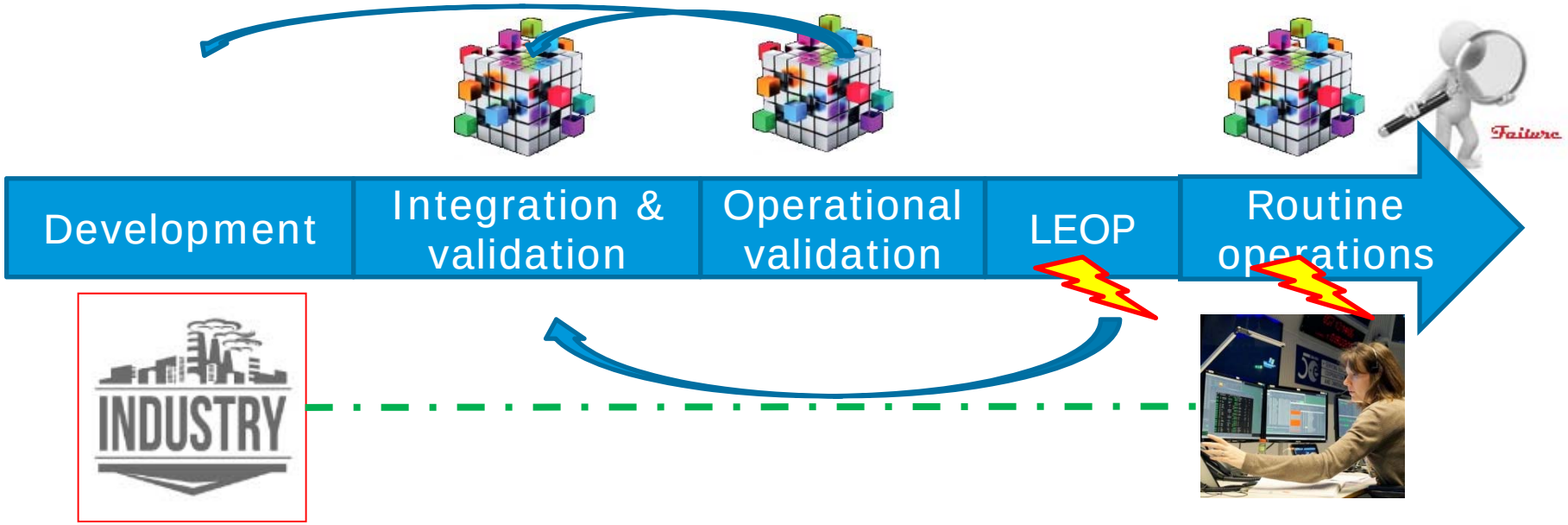
- Engineering testing is mainly requirements driven
- Enhanced by integration of **operational** usage:
  - ⇒ mission **representative** test **chains**
  - ⇒ mission **representative** test **scenarios**
  - ⇒ as **early** as possible in the systems engineering lifecycle

The E2E Ground Segment Reference Facility (C'ed)

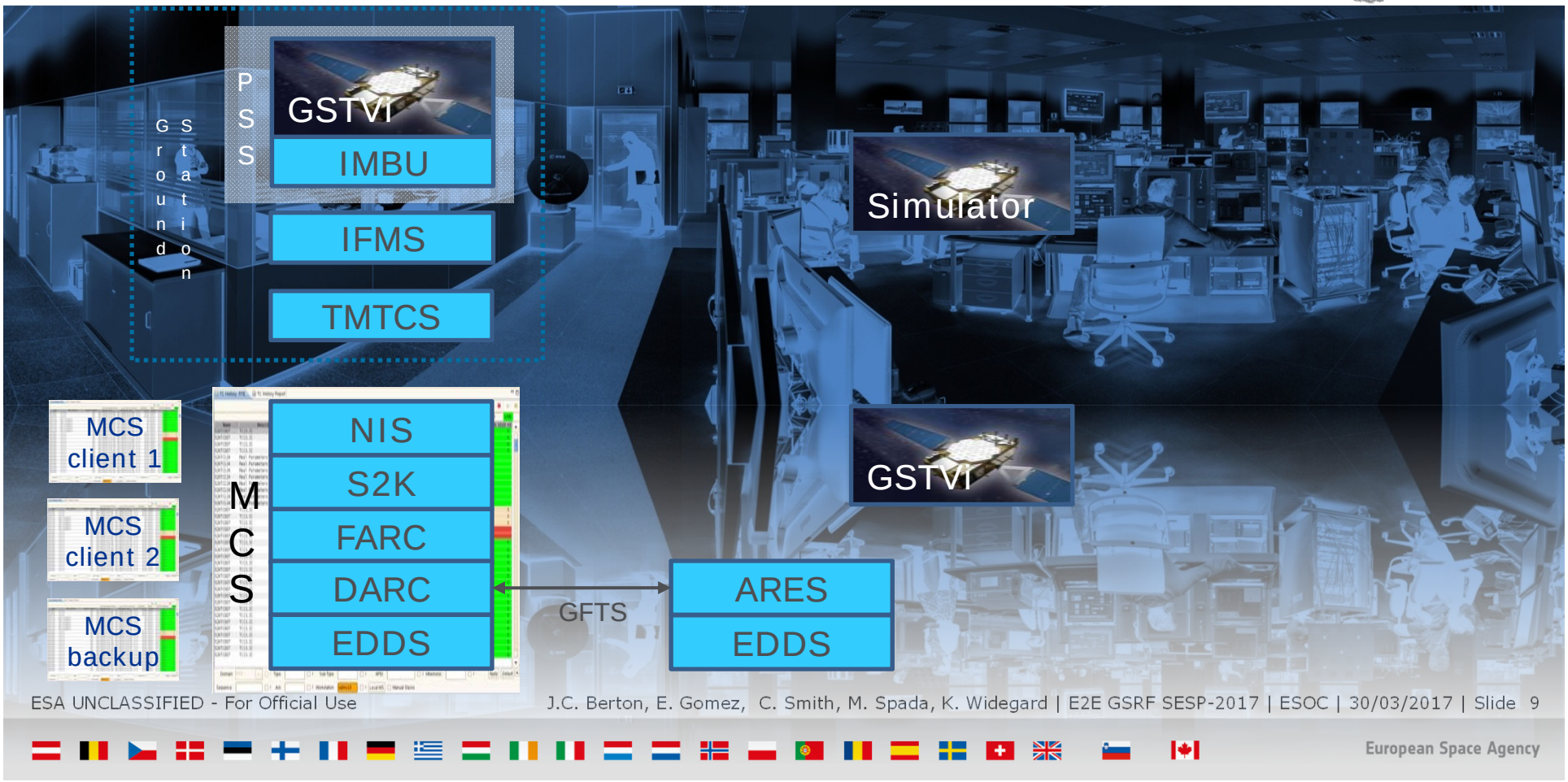
- The E2E GSRF:
- a **coherent** Ground Segment Integration and Test as a Service (**ITaaS**) system
- Ground Segment E2E **reference**, mission **representative** I&T Environment
- Reference Test Scenarios and Test Cases on **mission-based** configurations
- Highly **automated** environment and test 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)

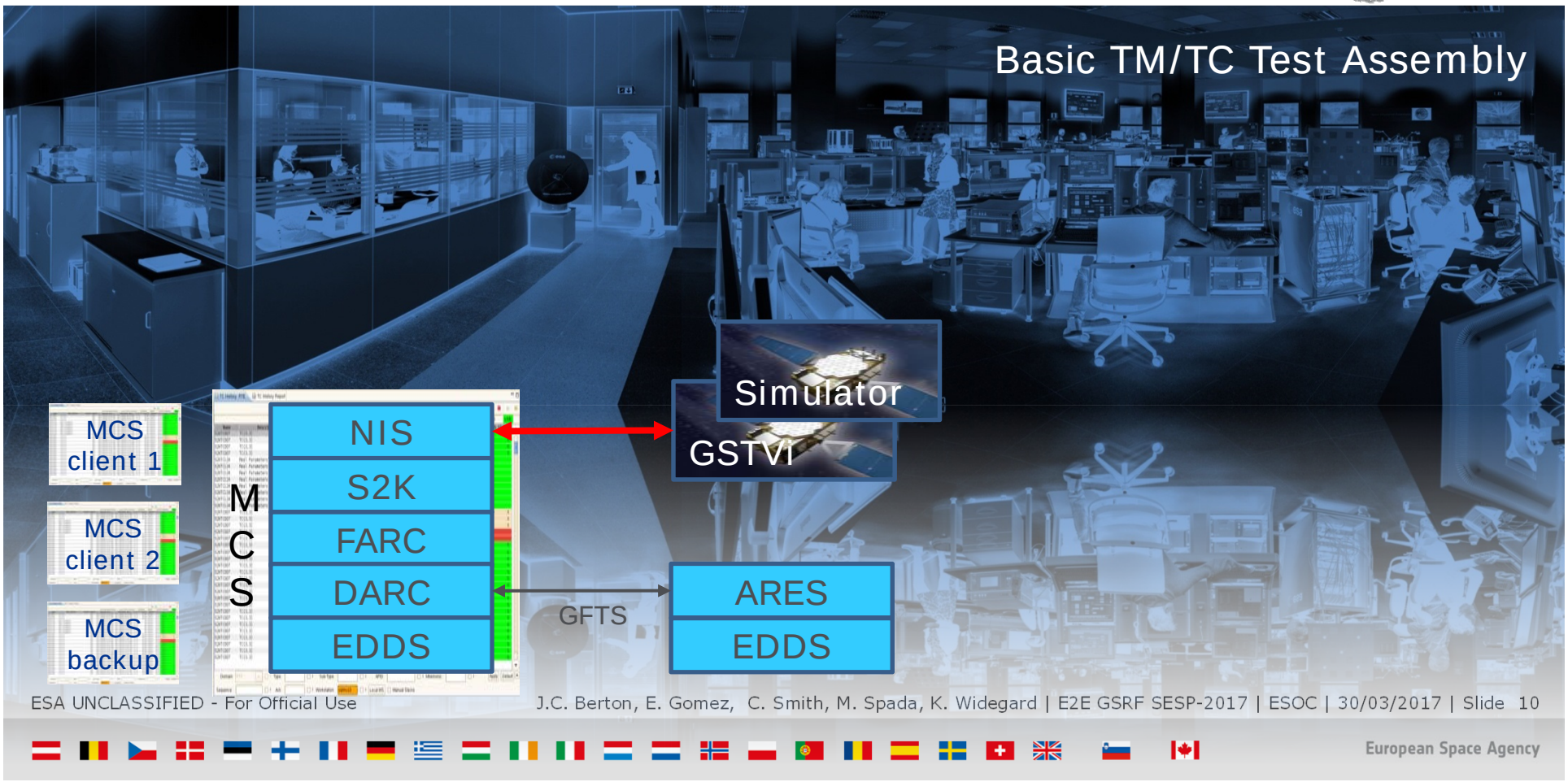
- A single, standardised reference throughout the MOI systems lifecycle:



The E2E GSRF Architecture



The E2E GSRF Architecture (C'ed)



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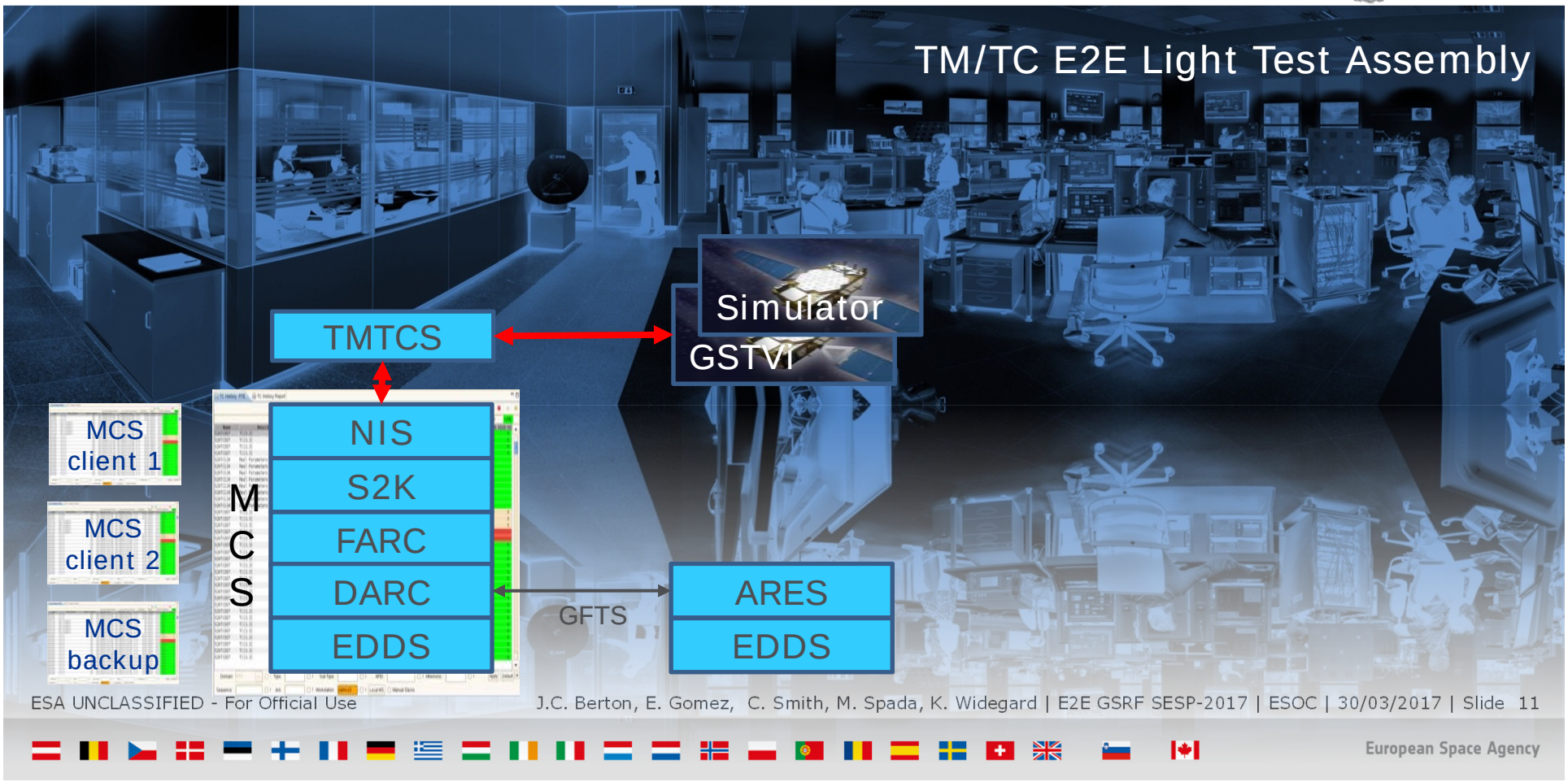

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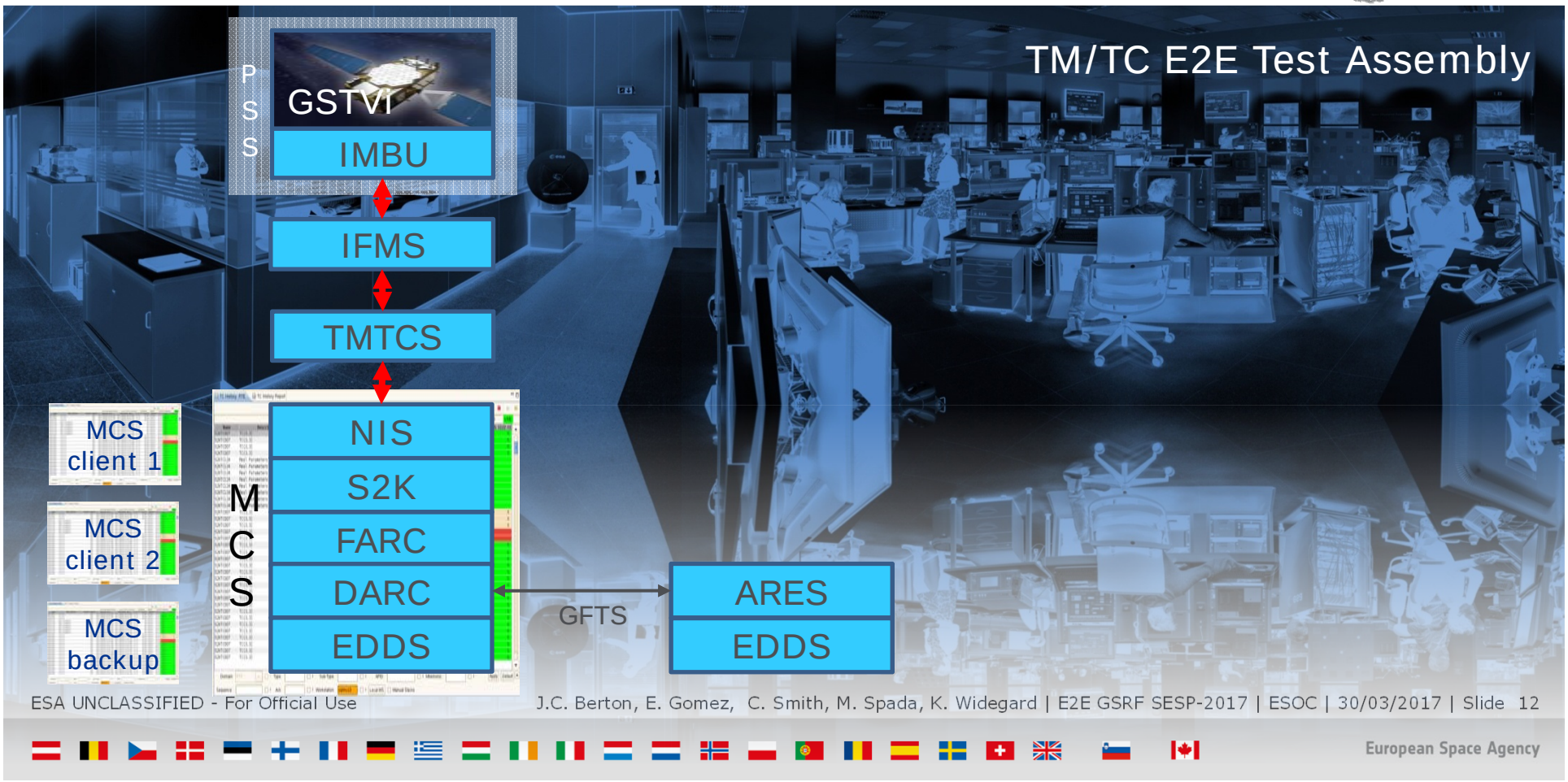

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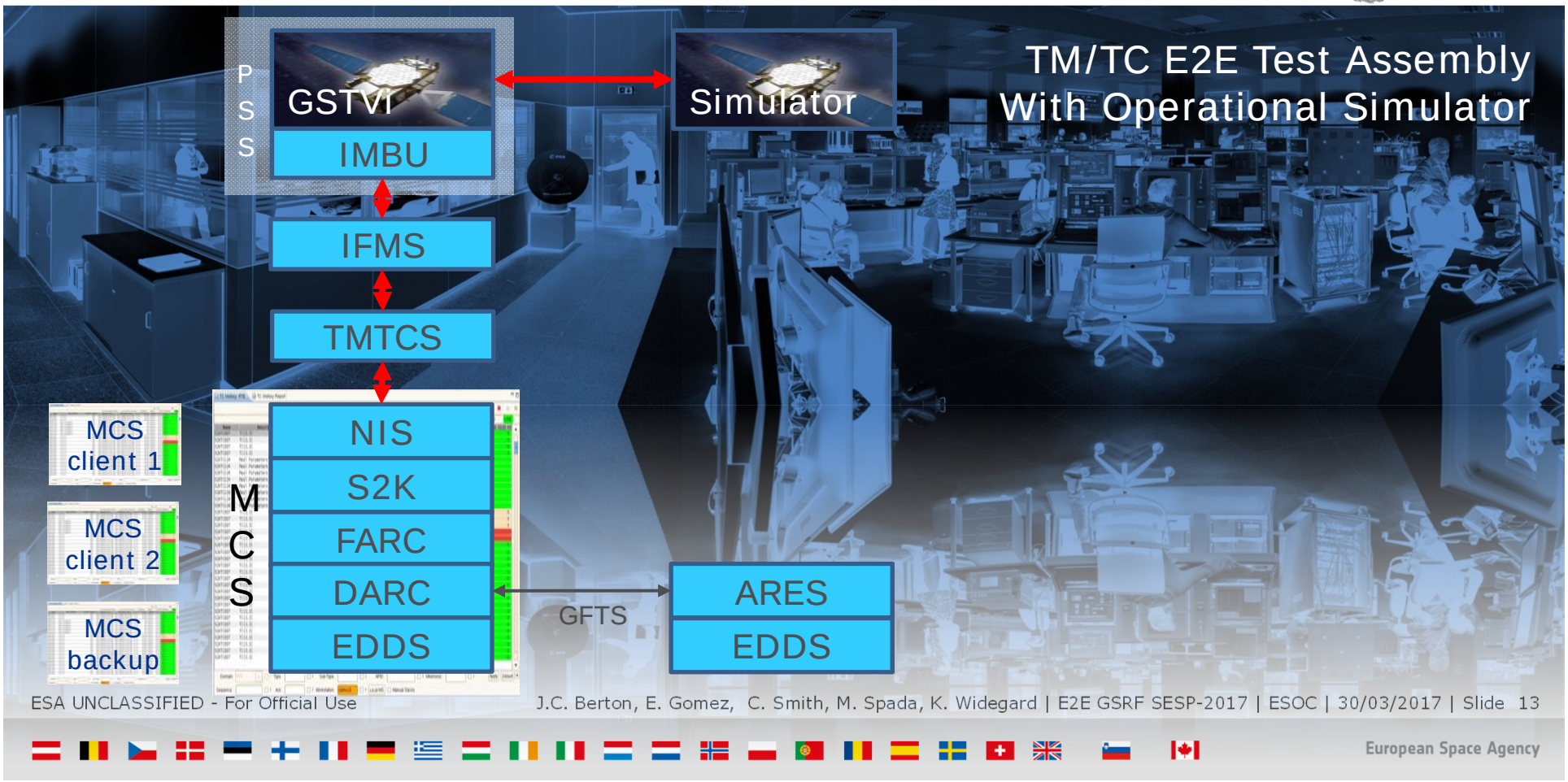

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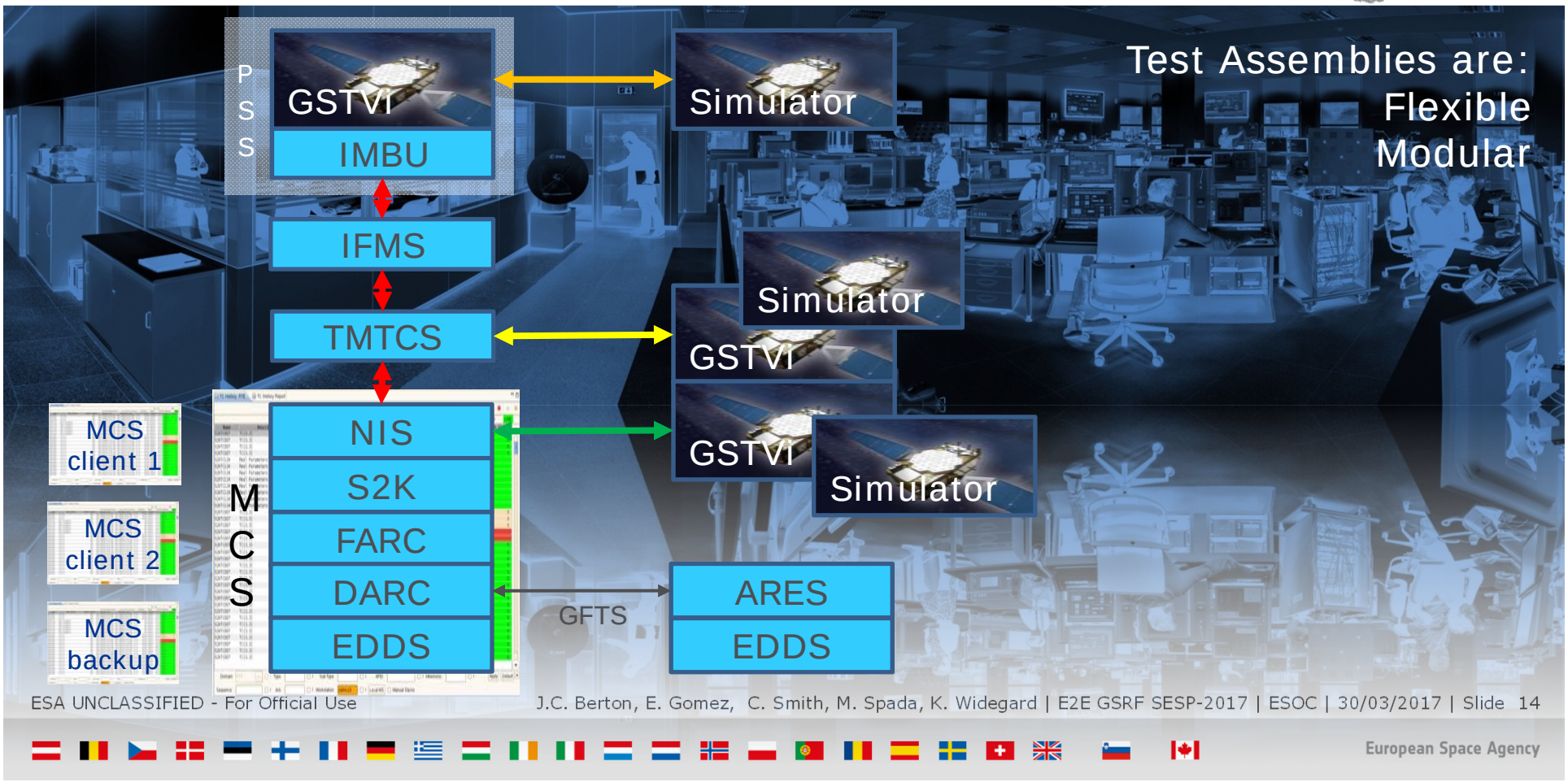
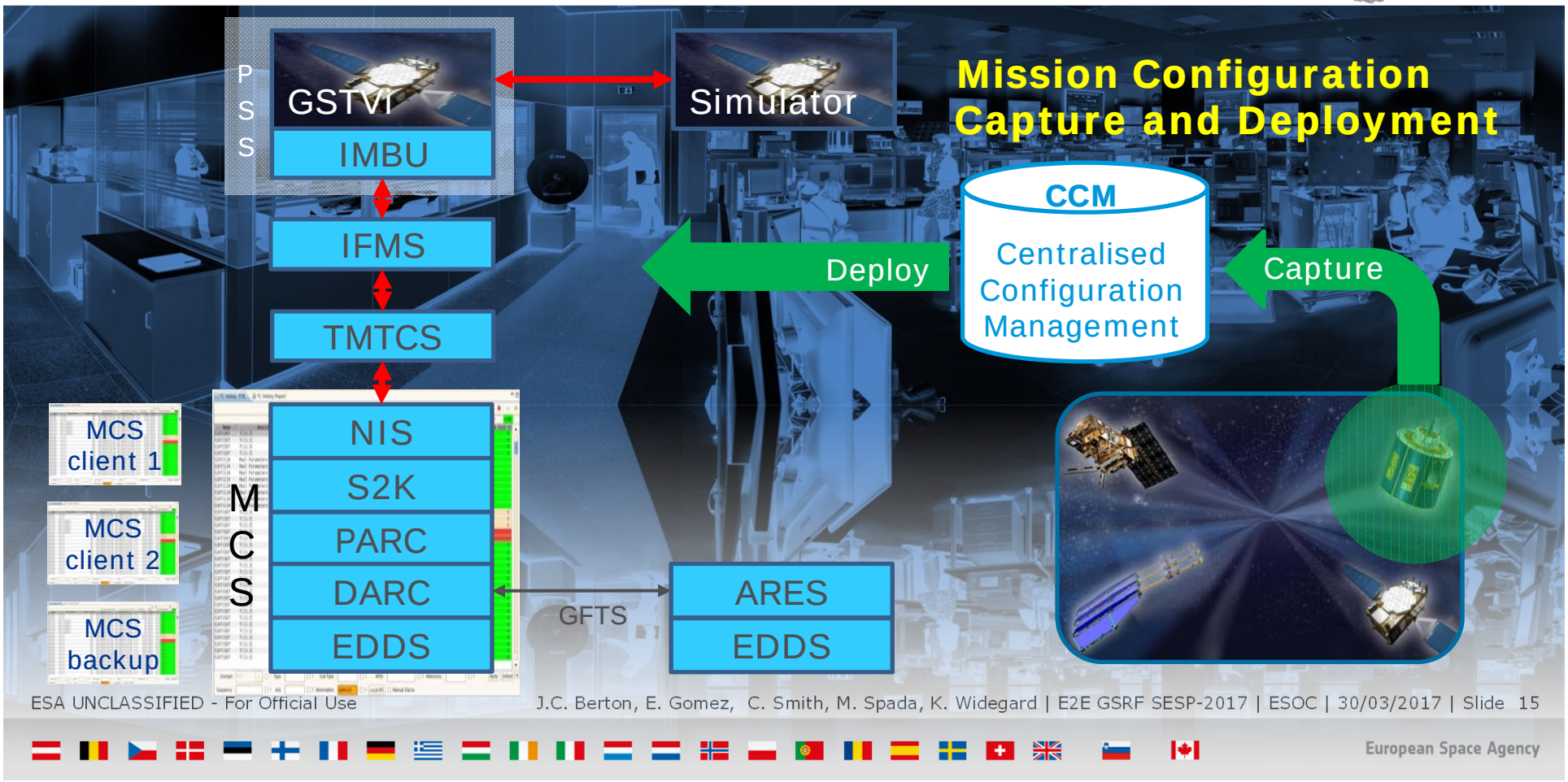


The E2E GSRF Representativeness



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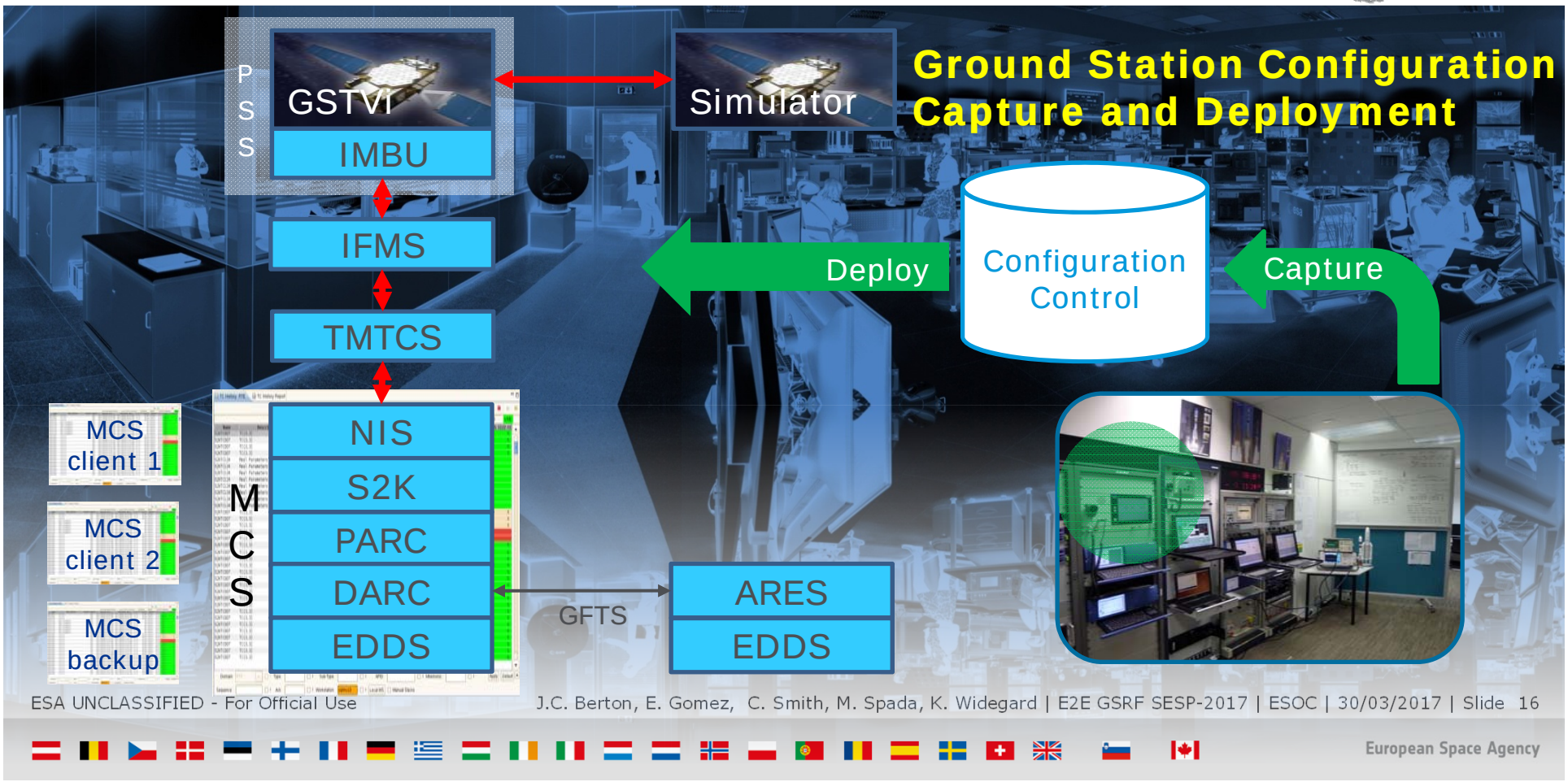
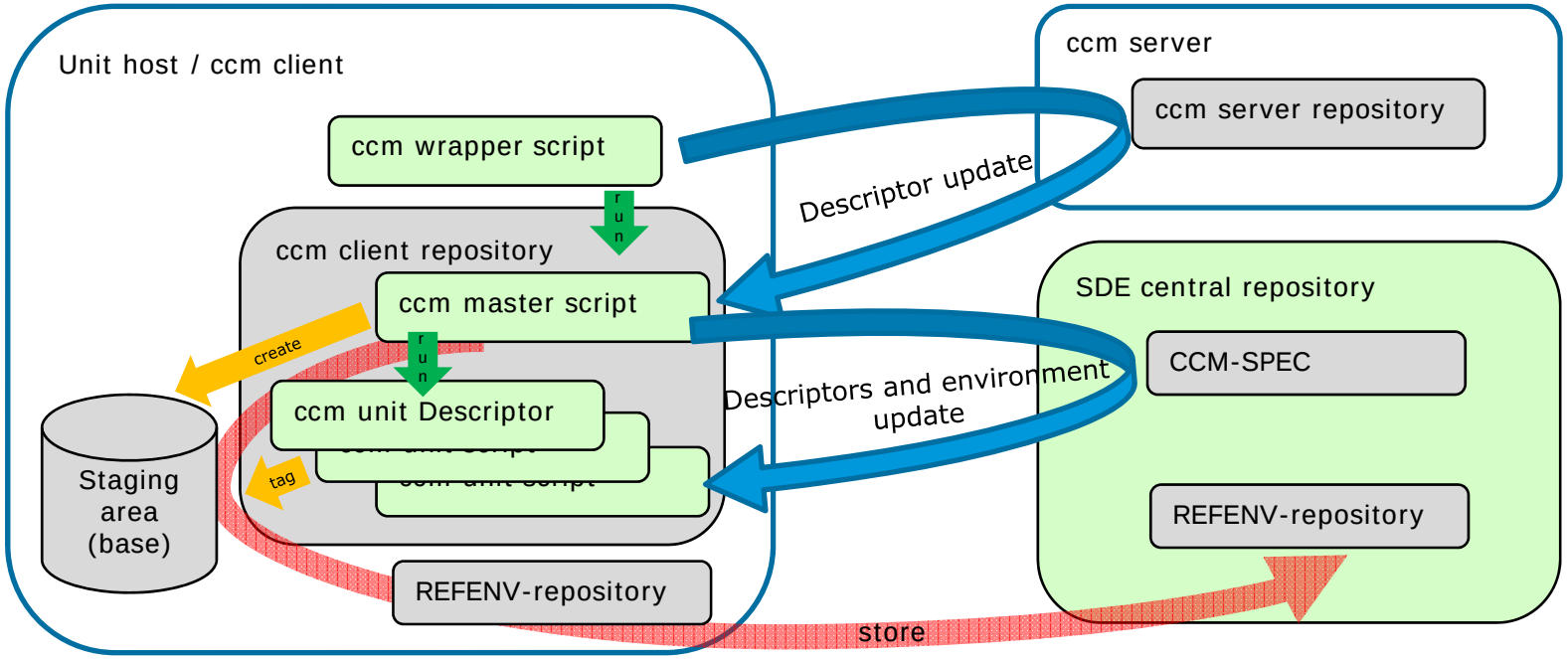


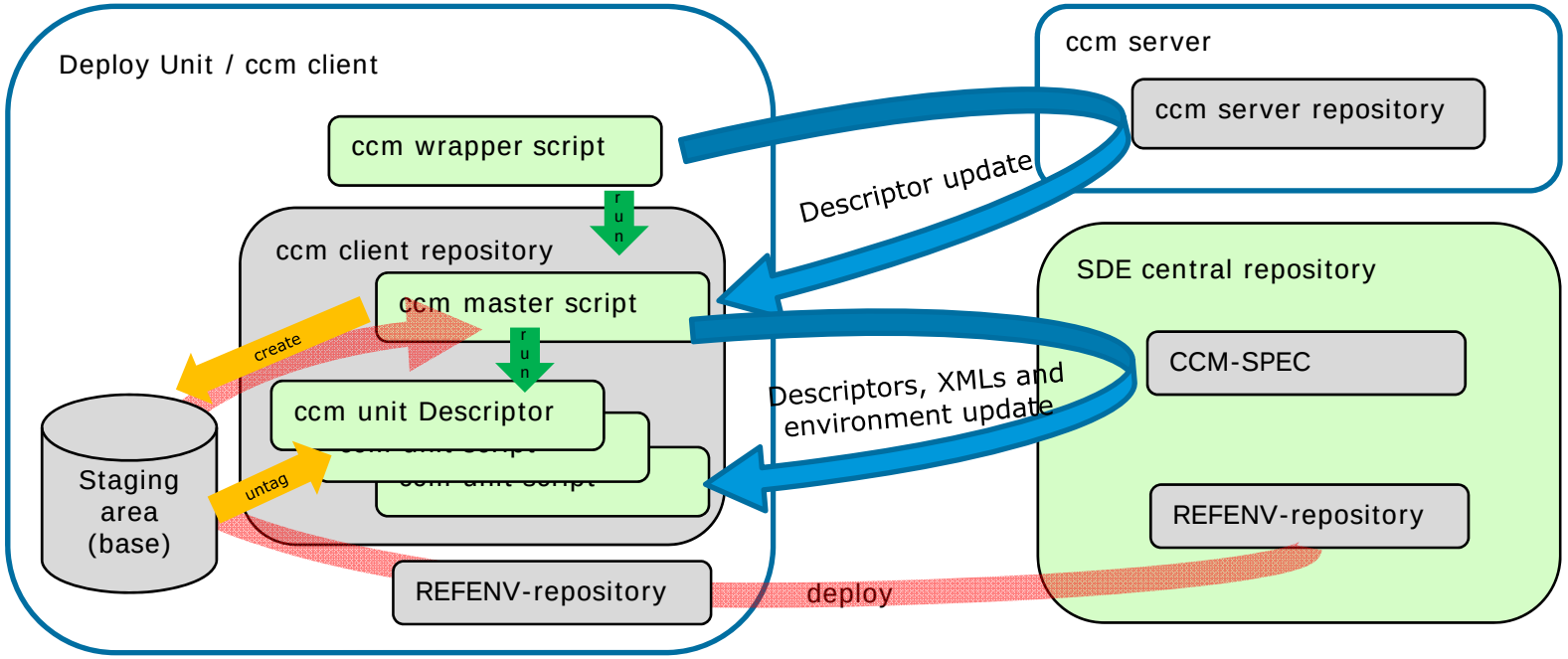
The E2E GSRF Representativeness (C'ed)

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



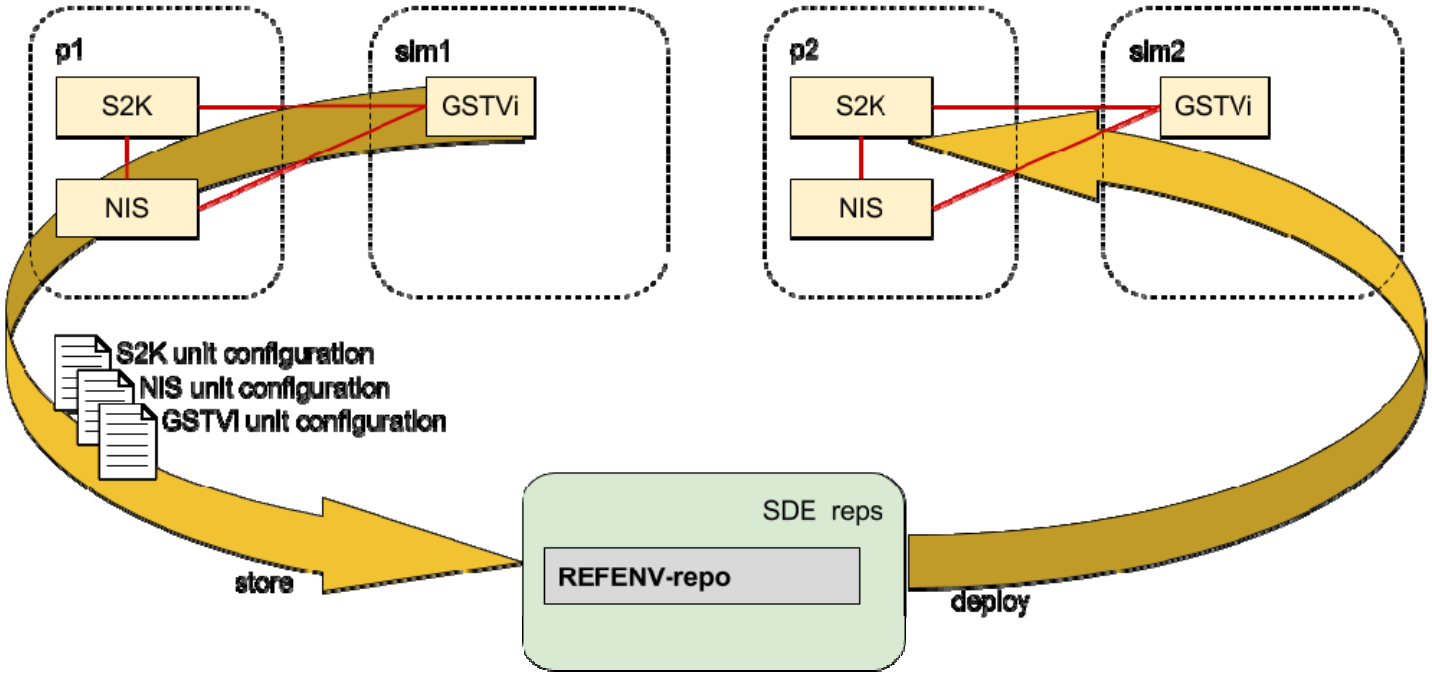
The E2E GSRF Representativeness (C'ed)

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



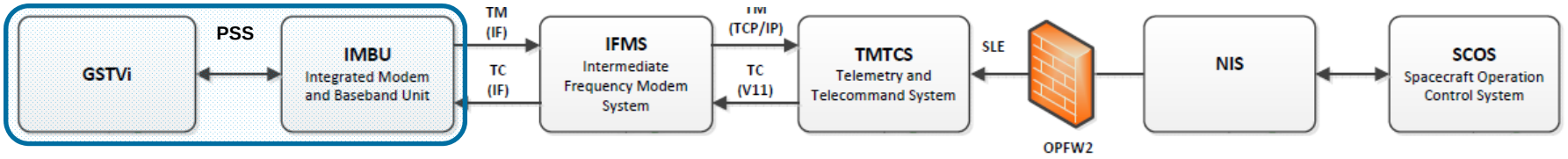
The E2E GSRF Representativeness (C'ed)

- **Centralised Configuration Management (CCM) – Test Assemblies**



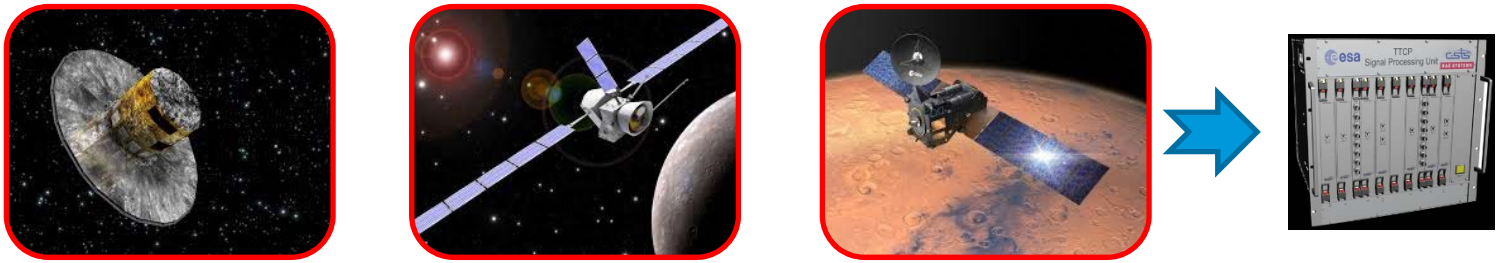
The E2E GSRF Representativeness (C'ed)

- **Test Assemblies**



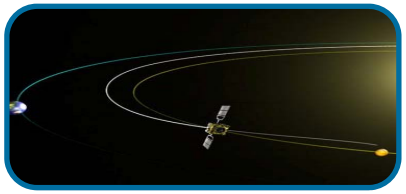
SLES11

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

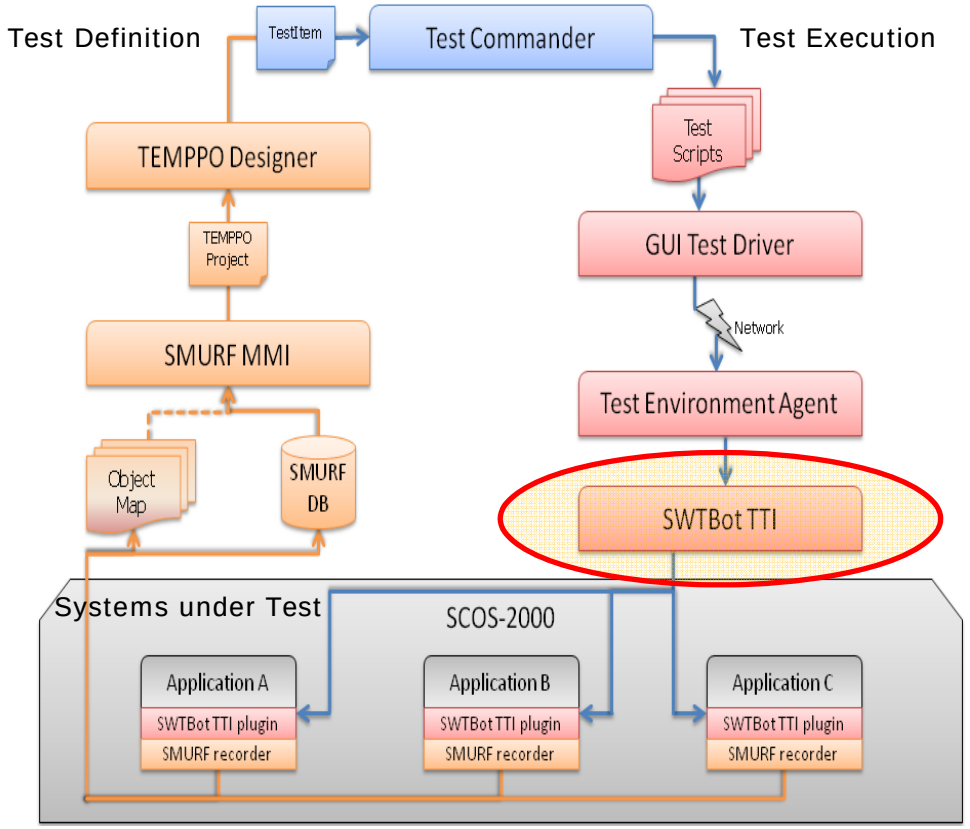
⇨ efficiency in a complex environment

- Reuse of ART/MMIT

⇨ evolve existing capabilities

- Replication of user actions

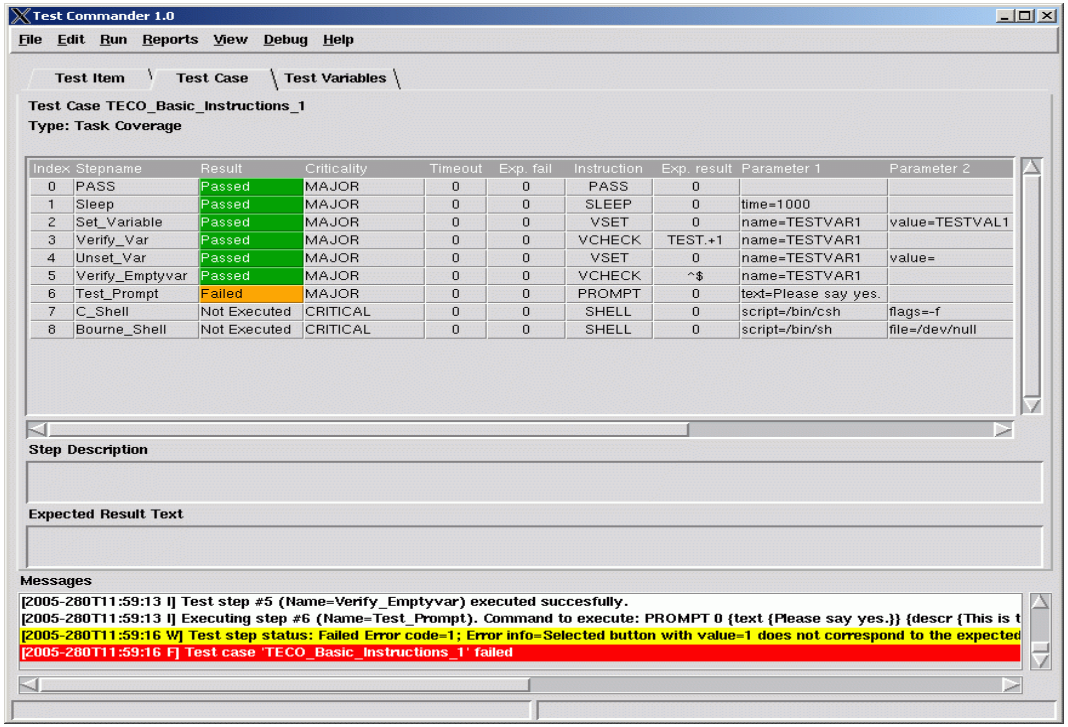
⇨ Representativeness breakthrough



Test Automation (C'ed)

- The Test Commander functionalities:

- executes commands
- provides results
- debugging capability
- production of test reports
- system state recovery



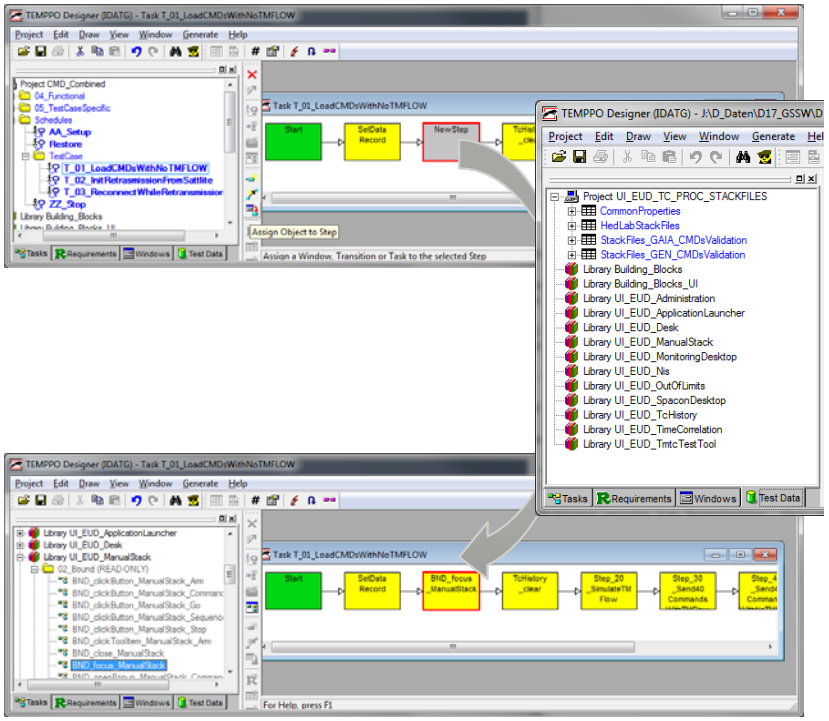
Test Automation (C'ed)

- Issues to be addressed:

1. Test abstraction
2. Test reusability
3. Mapping/recognition of controls

- The Test Management tool (TEMPPO):

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	Subsystem specific
3. Combine a set of actions into complex ones	
4. Combine complex actions to match functionalities	
5. Combine functionalities in common test sequences	Assembly specific

Test Automation (C'ed)

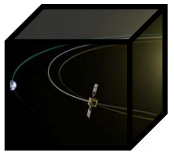
- Current status:
- 8/12 hours of automated test cases (overnight continuous testing)
- Automated tests are daily executed on different systems versions
- Provision of reassurance of non-regression, reliability, robustness

- 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

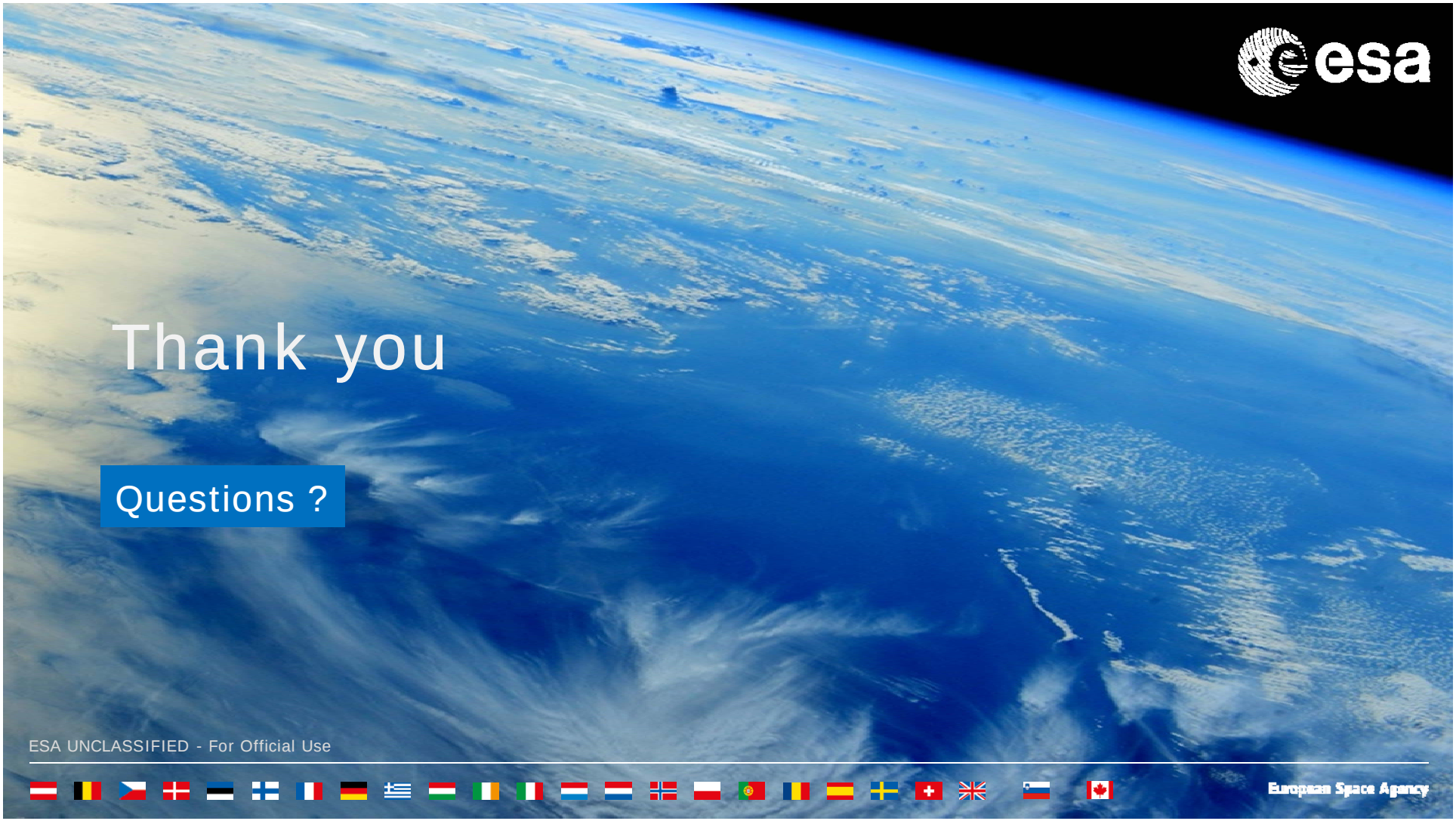
- ESOC focus on MOI **E2E** Integration & Testing
- E2E Ground Segment **Reference** Facility established
- High degree of **representativeness** and **automation**
- Offers ground segment systems **I&TaaS**
- **Throughout** systems engineering **lifecycle**
- Reproduction/troubleshooting of **complex**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



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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