

SCOE Simulation

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> Clemessy Switzerland in EGSE : A long story



Introduction of simulation in SCOE development cycle

Third generation

Power & Instrument SCOE for Sentinel-1, 2, 3, Galileo, BepiColombo, EarthCare, ...

> 2007 : SWARM Power SCOE



Second generation

Power SCOE for Rosetta, Mars Express, ATV, Cryosat, GOCE, Galileo GIOVE

> 1999 : Rosetta Power SCOE

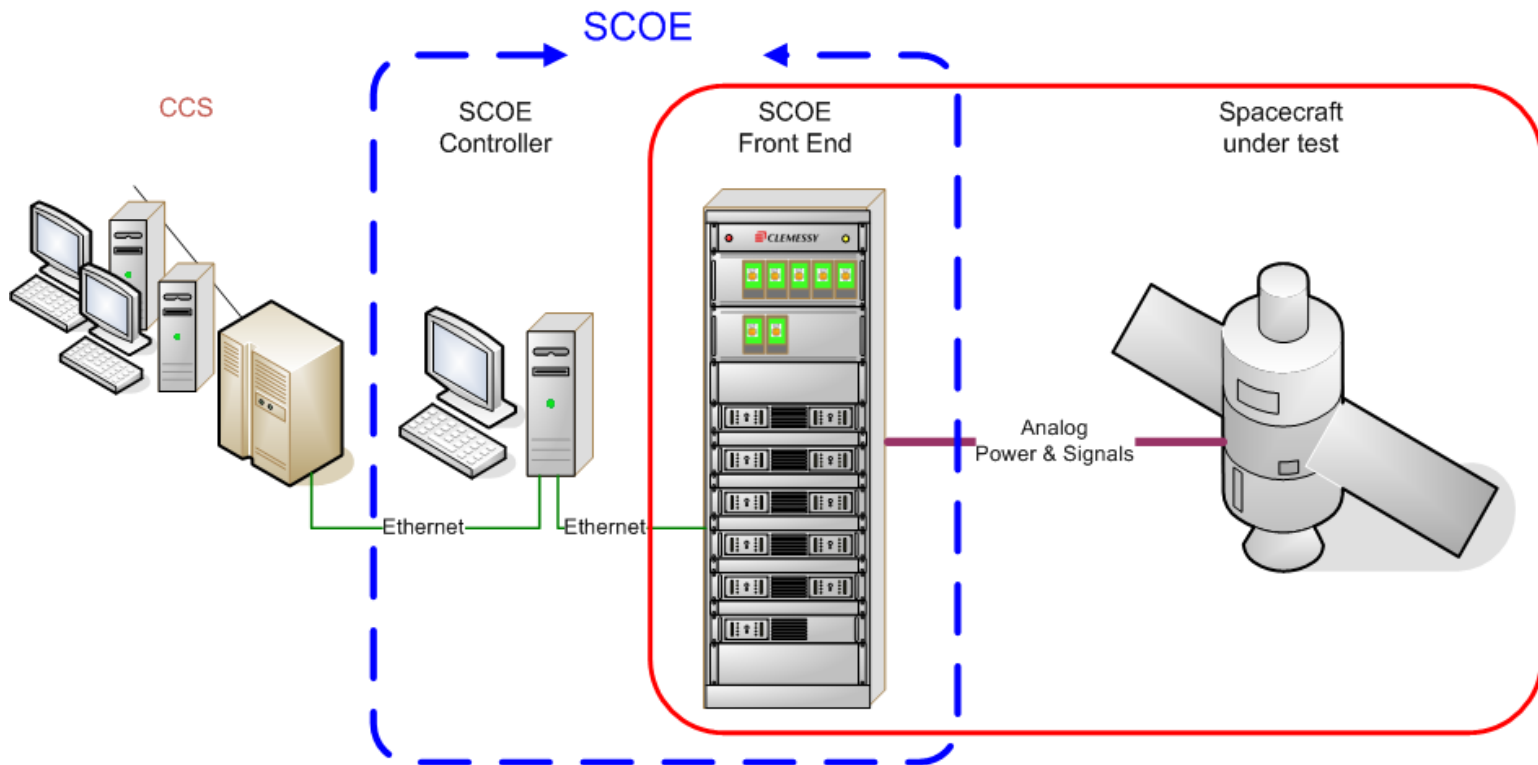
First generation

Power SCOE for XMM, Integral, METOP

> 1995 : First Power SCOE (XMM)

> What is a SCOE ?

- Part of an Ground Support Equipment (GSE)
- Special Check-Out System (not a standard commercial item)
- Used for integration and test of satellites or instruments



> Particularities of a SCOE

- Small series are produced
 - Different implementations from program to program
 - Contains commercial and custom items
 - Interfaced to a customer CCS (Central Check-out System)
 - Interfaced to flight hardware or engineering models
- ⇒ A SCOE is a prototype system often custom designed to the satellite integrator needs
- ⇒ Complete validation is required for each SCOE project

> Context of SCOE development

Constraints of the SCOE development

- Concurrent design with the item to be tested by the SCOE
- Custom or special devices are used => Important lead times for these devices
- SCOE development schedules become shorter
- Many tasks are on the critical path already at kick-off



By using simulation in some phases :

- Some tasks can be performed in advance or in parallel (removal of a constraint between tasks)
- Some final testing tasks can be shortened
=> More unit tests, less integration tests

=> The SCOE development can be optimized by using simulation

> SCOE simulation : for what purpose ?

Support design or development activities:

- For refinement of user needs (usage and behavior of the SCOE)
- For the preparation of the SCOE test procedures
- Confirmation of configuration parameters (e.g. protection levels, priorities or sequence of some events, etc.)

Reduce overall schedule

- Support to preliminary Controller SW testing
- Allows early system integration, without final hardware
- Early delivery of SCOE Controller SW + Simulator to the customer for CCS integration
 - Helps the customer for population of the CCS database and preparation of the CCS test sequences

> SCOE simulation : for what purpose ?

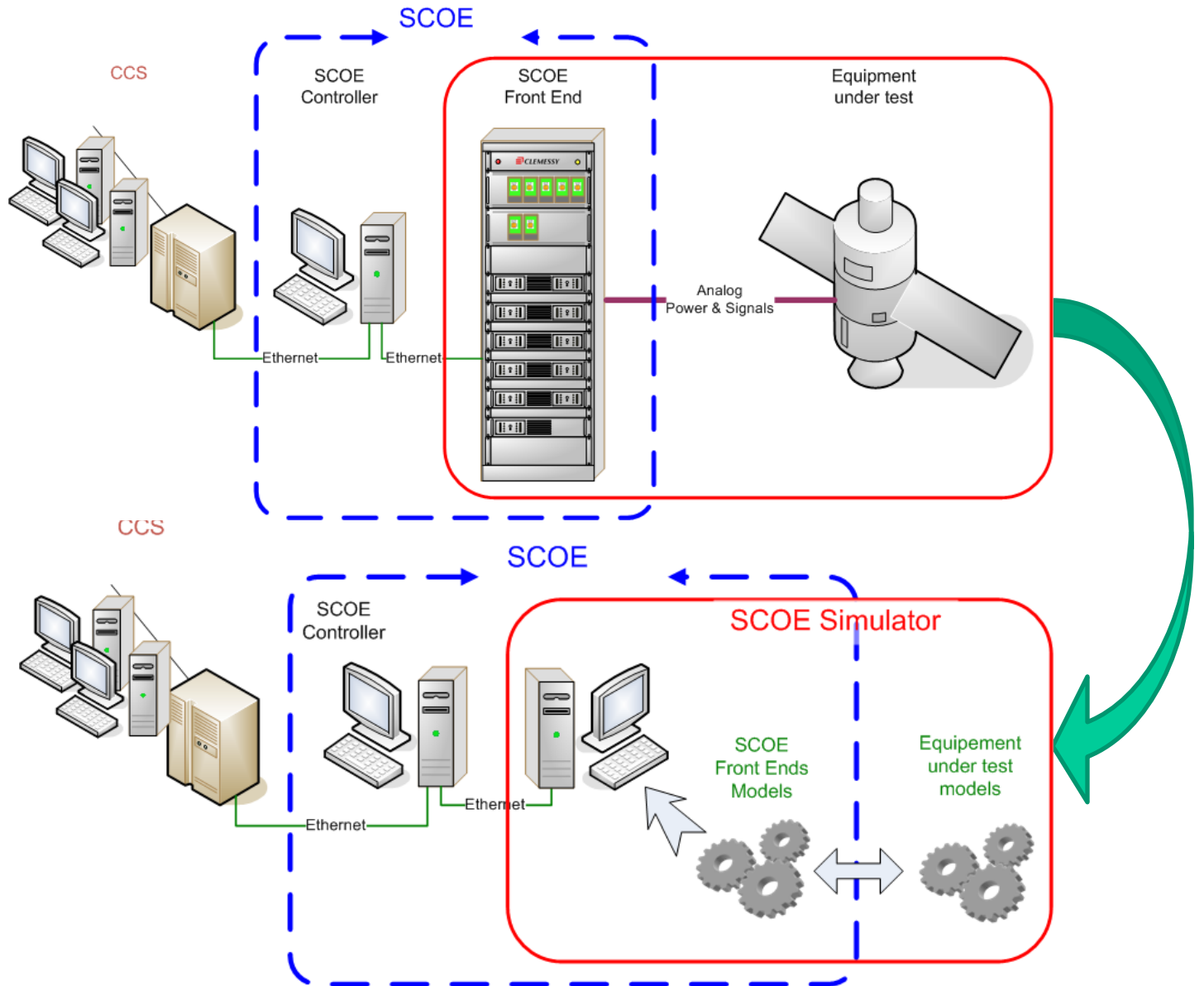
Increase test coverage

- Some devices can not be tested without risk to the S/C or SCOE
- Some test setups are not feasible or time consuming:
 - threshold beyond the operational limits of a device (eg. OVP above the max voltage of a power supply)
 - Long run system test without human intervention
- Fault injection features (broken equipment, bad measurement, error in communication packets, etc.).

Support diagnostic activities

- In case of SCOE failure, it can be useful to determine the sequence of events which has driven to the failure.

> How to perform SCOE simulation



> How to perform SCOE simulation

Software aspects and performance

- Synchronicity with the SCOE controller (and CCS)
- Communication protocols of the front-ends
- Simulator implements the front ends models
- Satellite simplified electrical model also implemented

Coverage of the simulation

- Functional simulation of the SCOE
- Simulation of events which occur during AIT
 - Power ON, Power OFF
 - Tripping of devices
 - Switching of loads
 - etc.
- No detailed simulation of electrical transients

> Benefits

Time saving

- Reduction of the project time by up to two months
- Early delivery of SCOE controller (needed for CCS integration at customer level)



> Benefits

Increased reliability of the SCOE

- Improve reliability of the SCOE (increased test coverage of borderline cases)
- Increase the number of errors managed by the system (even at CCS level)

Diagnostics help

- Replay failure scenarios while avoiding stress or even damage to the S/C
- Provider can perform internal tests without the SCOE (as far as the problem is not HW related) -> increases reactivity

> Benefits

Training improvement

- Training is possible if the SCOE is in use even in an other location
- No need to change the system configuration before the training

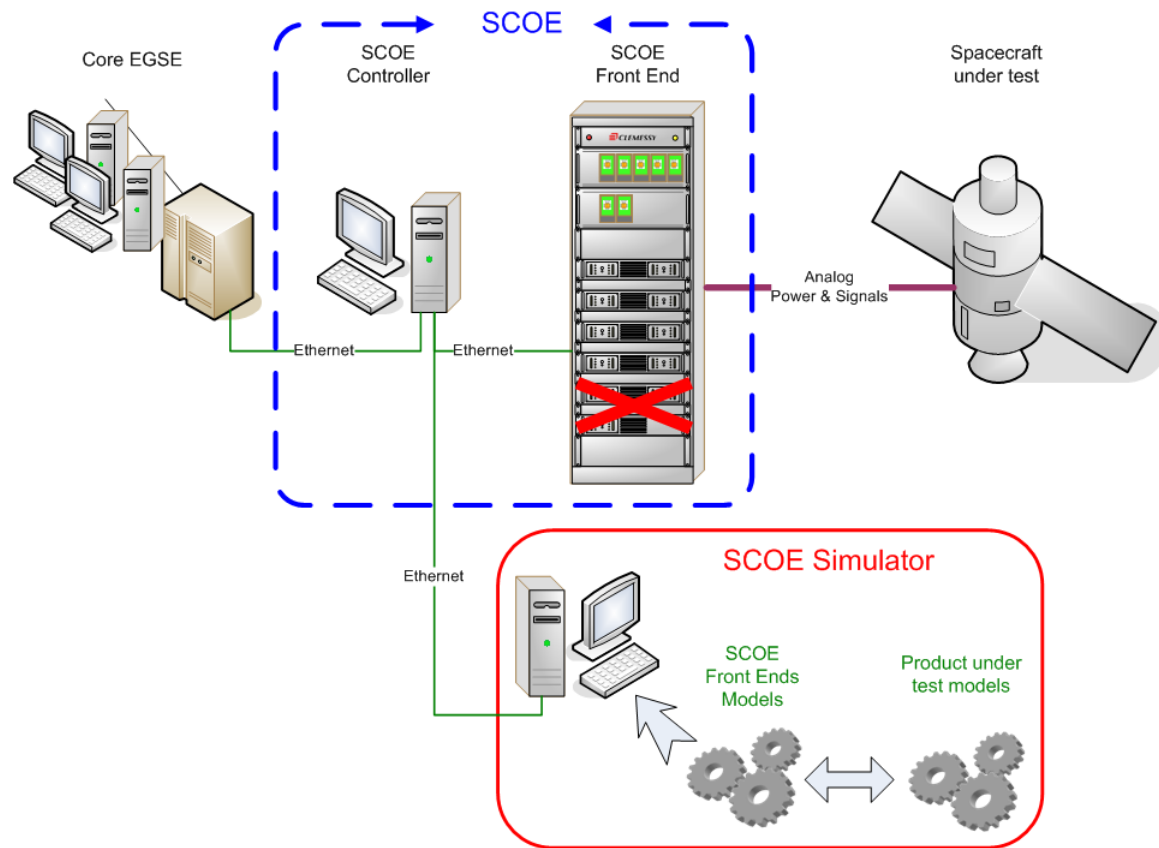
Low investment to run the simulator

- No need of specific HW to run the simulator
- SCOE Controller SW and SCOE Simulator SW run on simple PC's
- Configuration of Simulator is fast and simple

> Future evolutions

Partial hardware simulation

- Perform validation by mixing real SCOE items and simulated items



> Future evolutions

Increase performances

- Develop more realistic electrical models (transients)
- Simulate faster events (FPGA level)
- Simultaneous simulation of multiple SCOEs

Simulation languages

- Matlab / Simulink / others
- Re-use already existing models (e.g. S/C electrical model)

Thank you for your attention

Your contacts:

Pascal CONRATH	+41 61 205 31 53
Christian ABEL	+41 61 205 31 54
Romain PANNET	+41 61 205 31 55

p.conrath@clemessy.com
c.abel@clemessy.com
r.pannet@clemessy.com