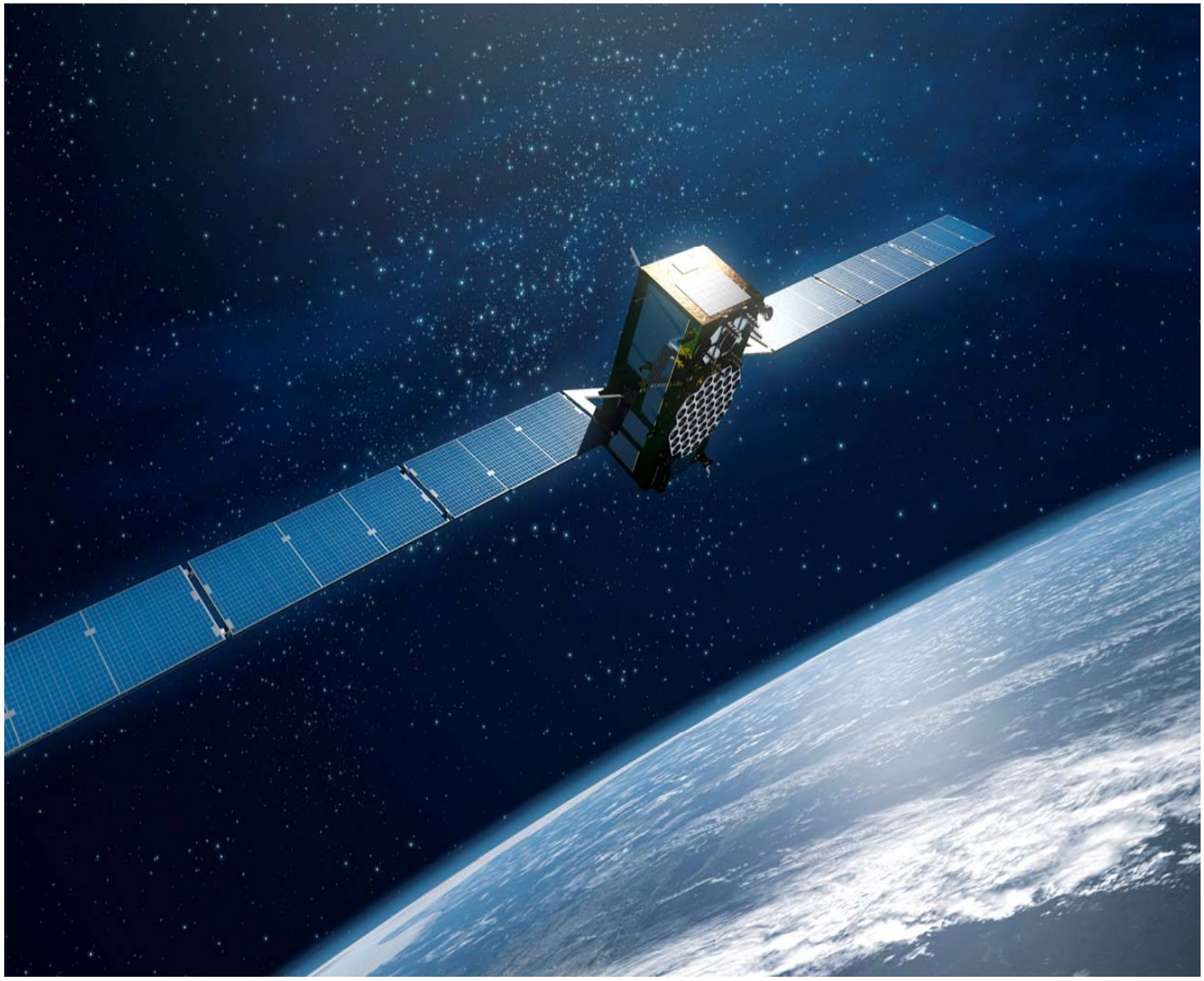


EADS ASTRIUM

Database-centric Test and Verification Approach for Embedded Systems in Space Applications

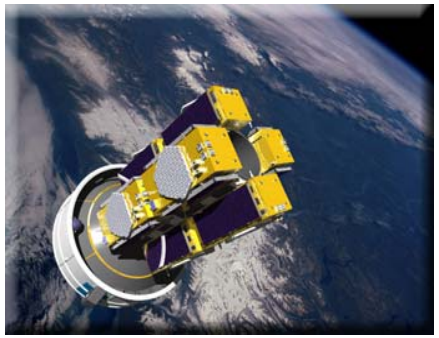
Oct. 7, 2008

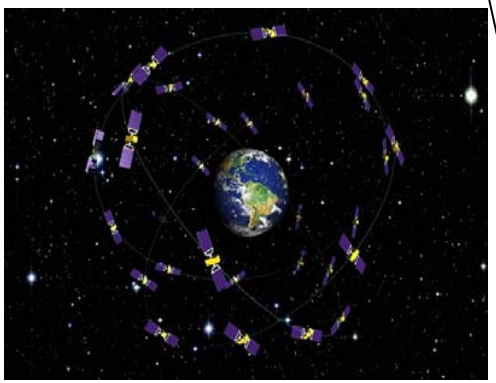
Outline

1. Problems
2. Typical Target Architecture
3. The Model Based Approach
4. The Database-Centric Extension
5. MDVE Verification Environment
6. Conclusions

Problems

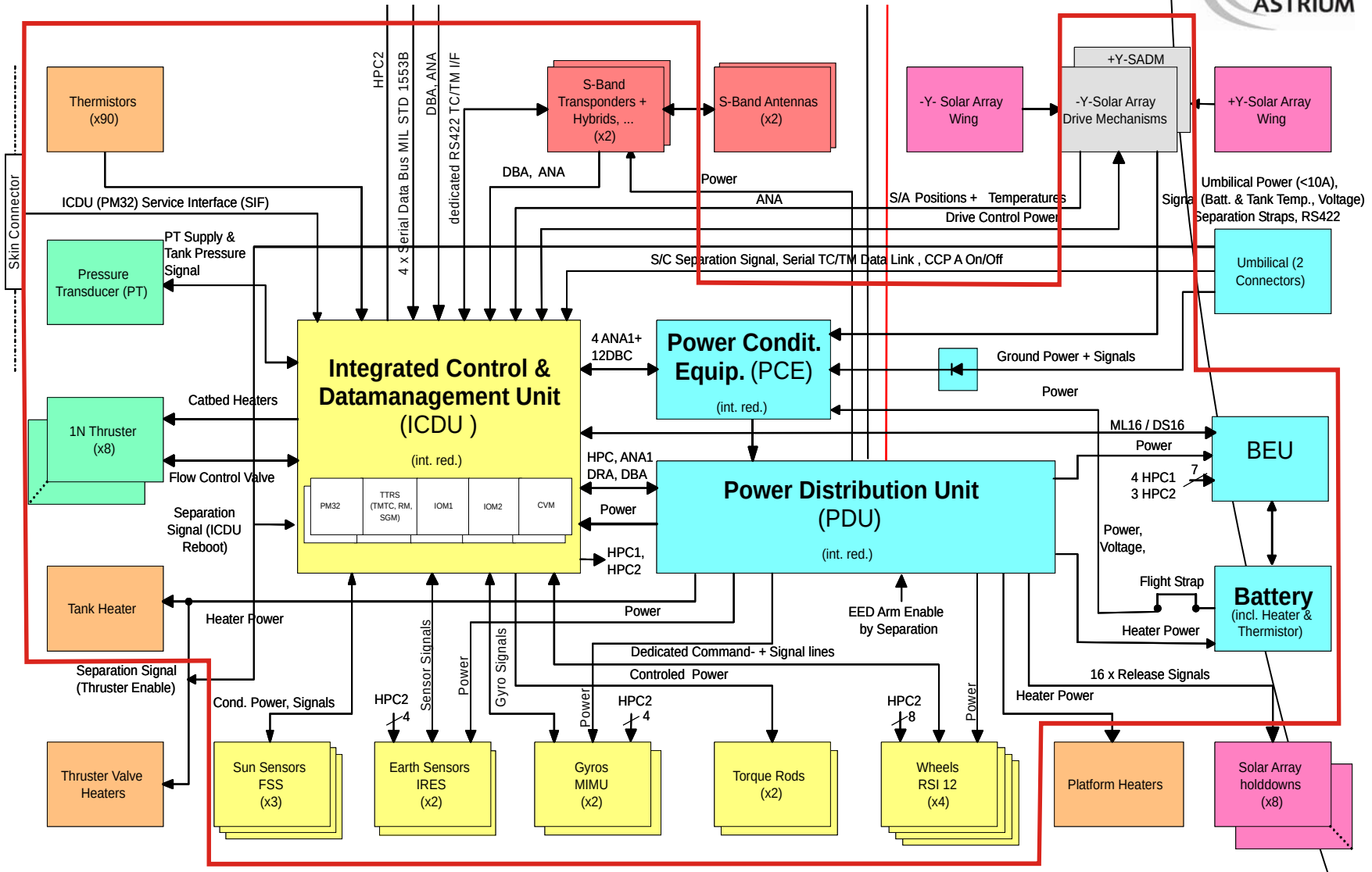
- Overall constraints
  - Increasing technical complexity
  - Increasing complexity through multi-national development approach
  - Limited budgets
  - Shorter schedules
- Observations
  - Several design iterations through inconsistent information





⇒ Further optimization of design and verification process

Typical Target Architecture (Galileo Avionics)

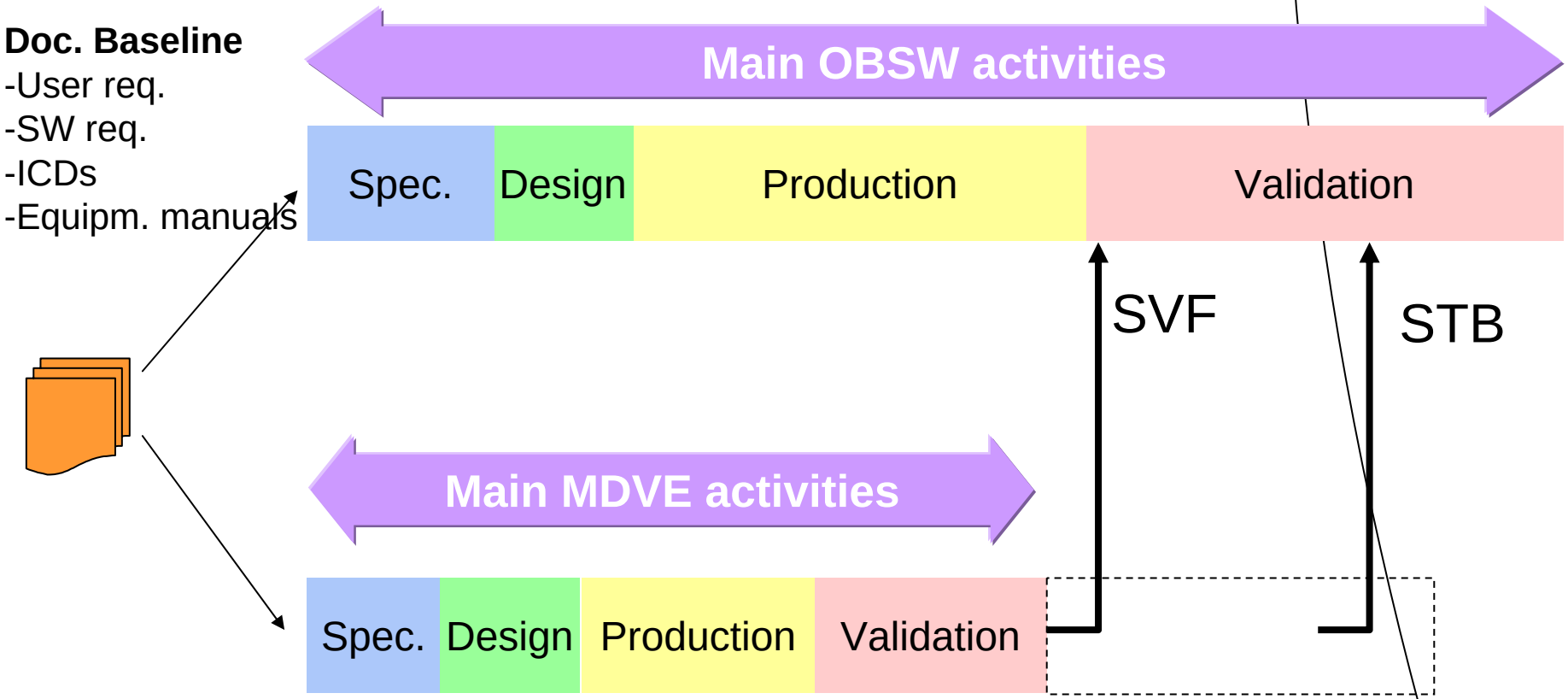


Items covered by list

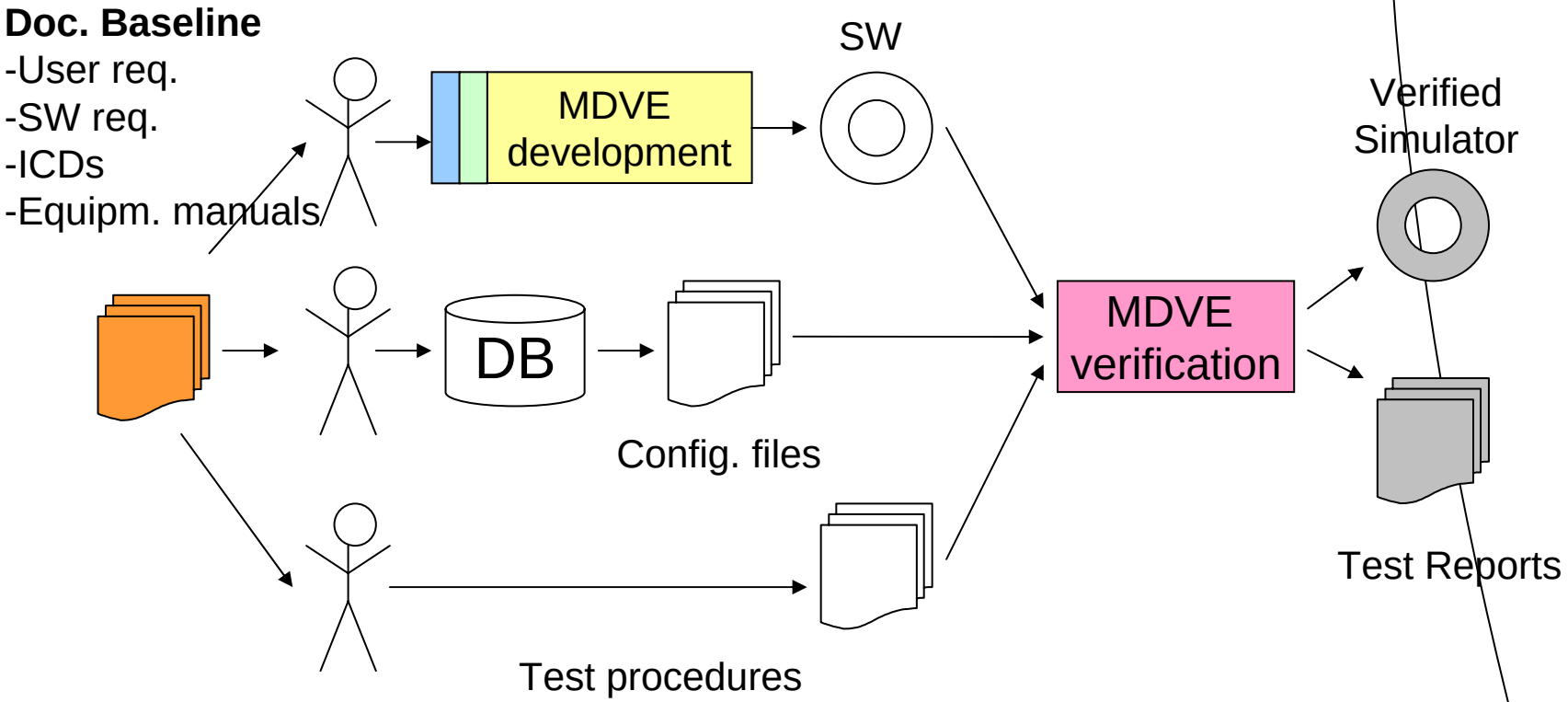
The MDVE Approach

- Replace the traditional EM with a high fidelity software simulator for ASW validation
  - Increase flexibility compared to traditional engineering model
  - Shorten the validation phase

MDVE Approach (cont'd)



MDVE Development Flow



MDVE Infrastructure Overview (trad.)

Analysis Tools

Verification Tools

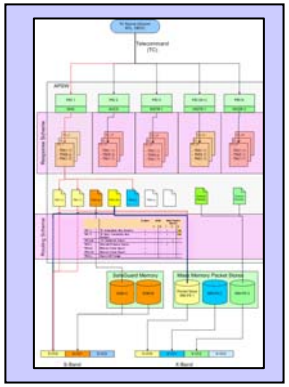
AOC Ctrl. Design

AOC Ctrl. Algos

Equipm.

Equipm. Algos

Tool Kernel



FVB

Coded AOC Ctrl. Algos

Equipm.

Equipm. Models

Sim. Kernel

Ctrl. Console

SVF

OBC Sim.

Equipm.

Equipm. Models

Sim. Kernel

Ctrl. Console

STB/EFM

OBC HW

Equipm.

Equipm. Models

Sim. Kernel

Ctrl. Console

SatSim f. Ops

OBC Sim.

Equipm.

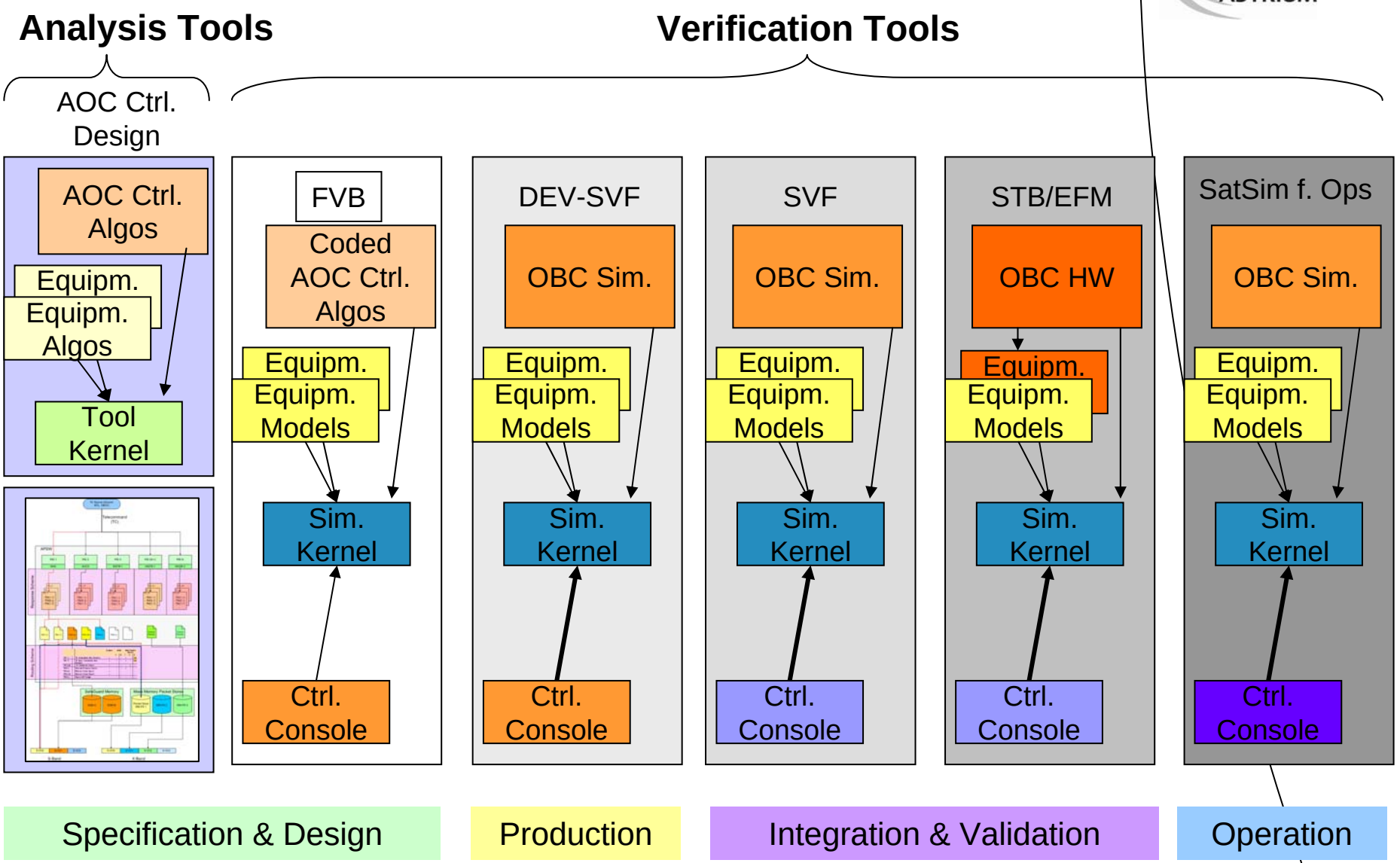
Equipm. Models

Sim. Kernel

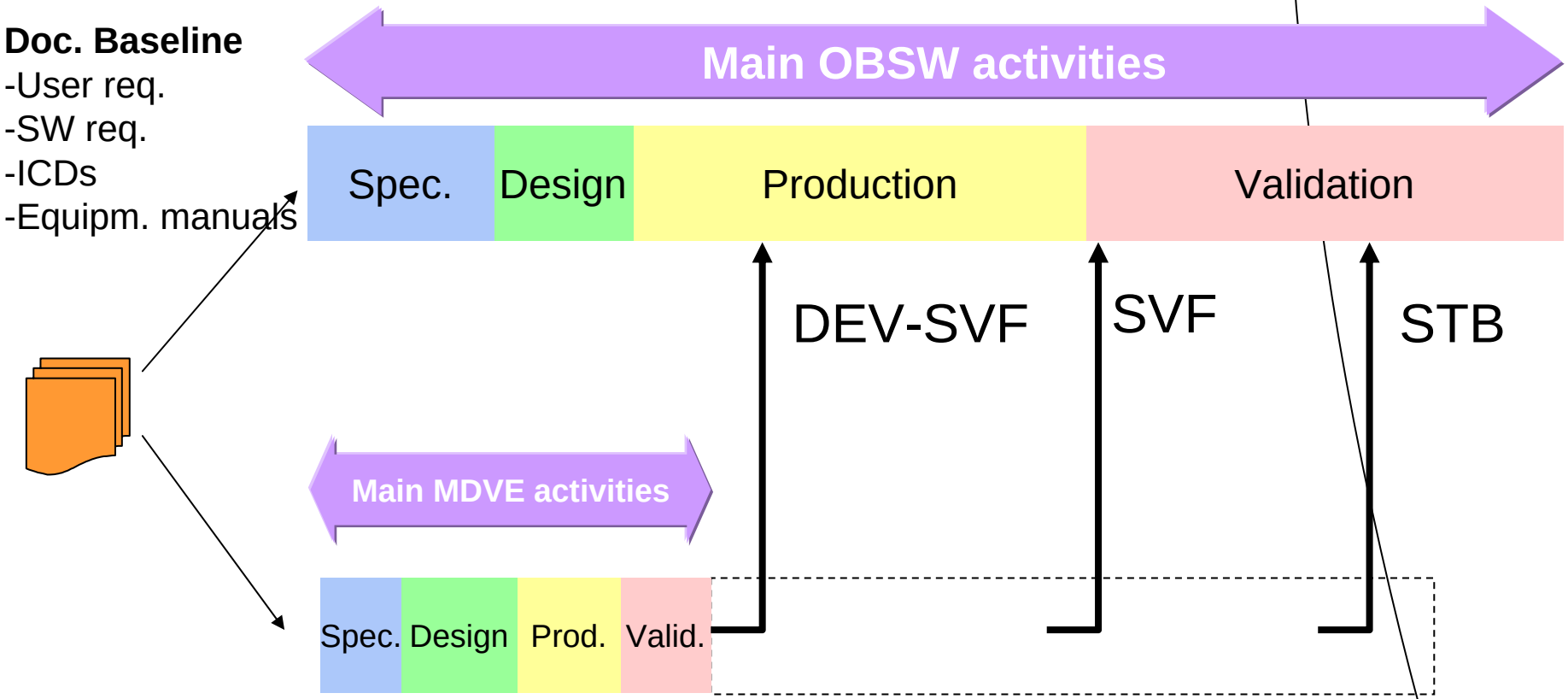
Ctrl. Console

Specification & Design | Production | Integration & Validation | Operation

MDVE Infrastructure Overview (Galileo, …)



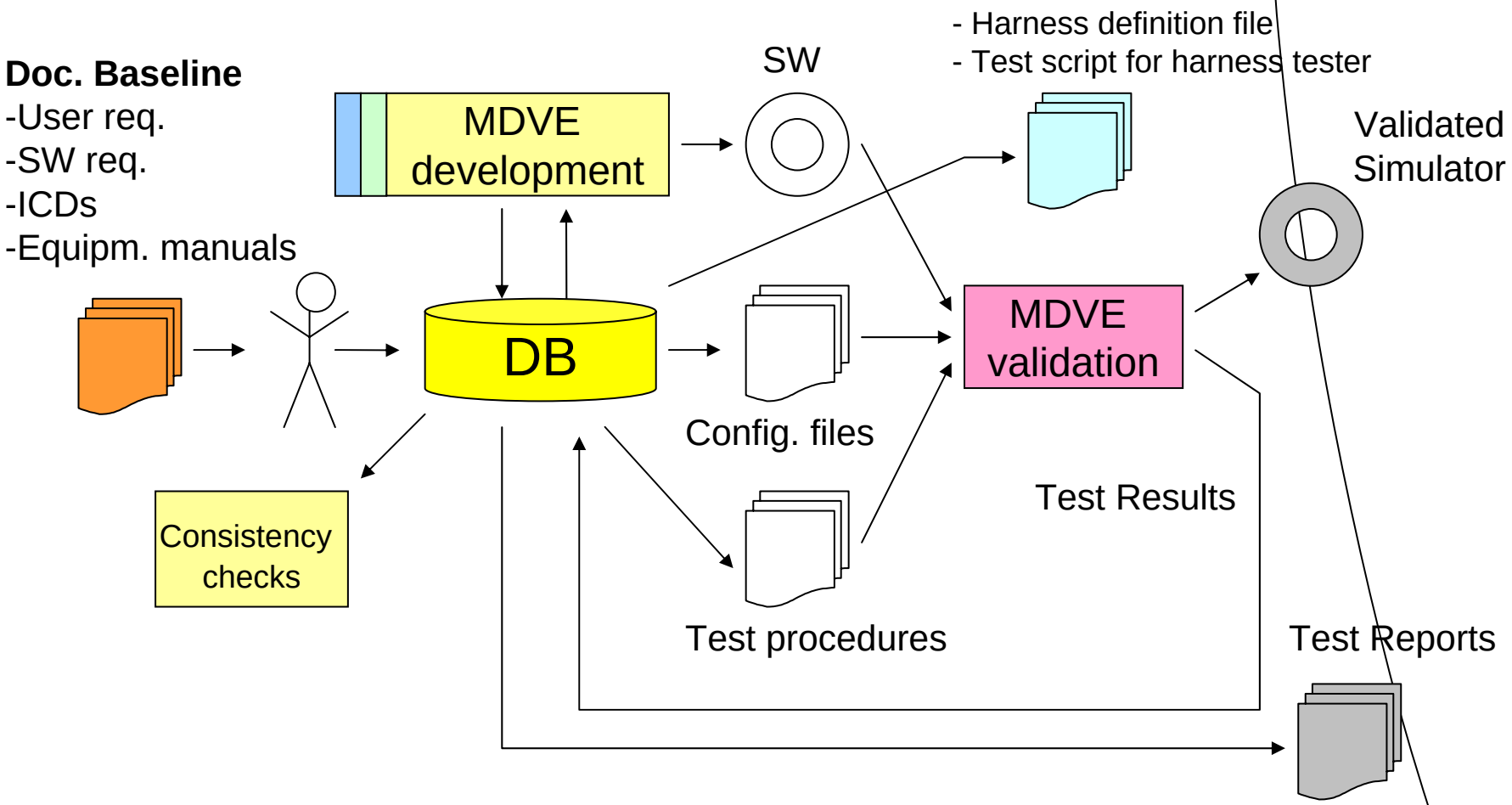
MDVE Approach (cont'd)



The Database-Centric Extension

- Avoid design iterations induced by inconsistent information
  - Formal collection of information
  - Formal checks of consistency and completeness
- Ensure high model quality
  - Testing at different levels (unit, integration, system level)
  - good test coverage through a large number of test vectors
- Improve productivity during software validation
  - Generate test scripts from database
  - Store test results in database
  - Generate test reports from stored test results

The Database-Centric Extension



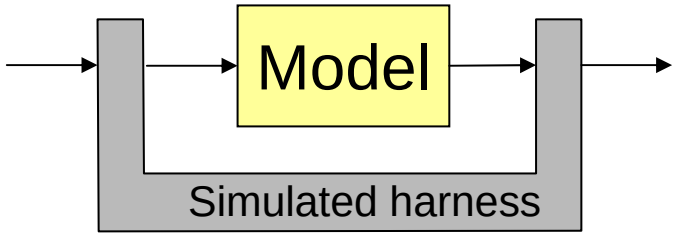
Information to be collected

- System specifications
  - requirements
- System design document
  - Product tree
- ICD's:
  - Ext. signal name, type of signal, range, default value, pin assignment, …
- Equipment manuals
  - Modes
  - transitions

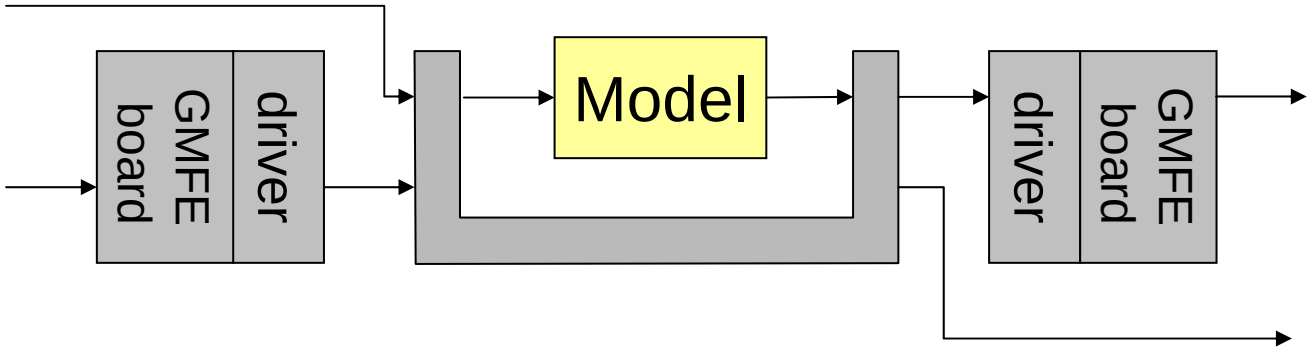
Model Verification Level

Unit test level: direct stimulation of the model interfaces

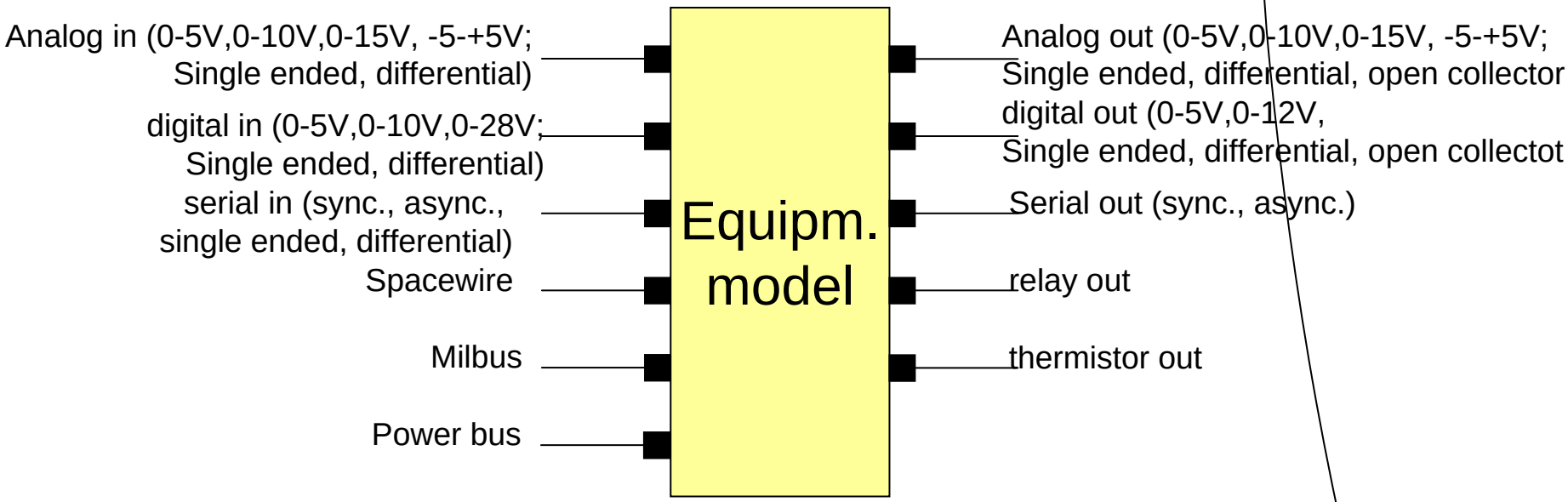
Integration/system test level (DEV-SVF): direct stimulation of simulated harness



Integration/system test level (RTB): direct stimulation of electrical interfaces



Equipment model interfaces

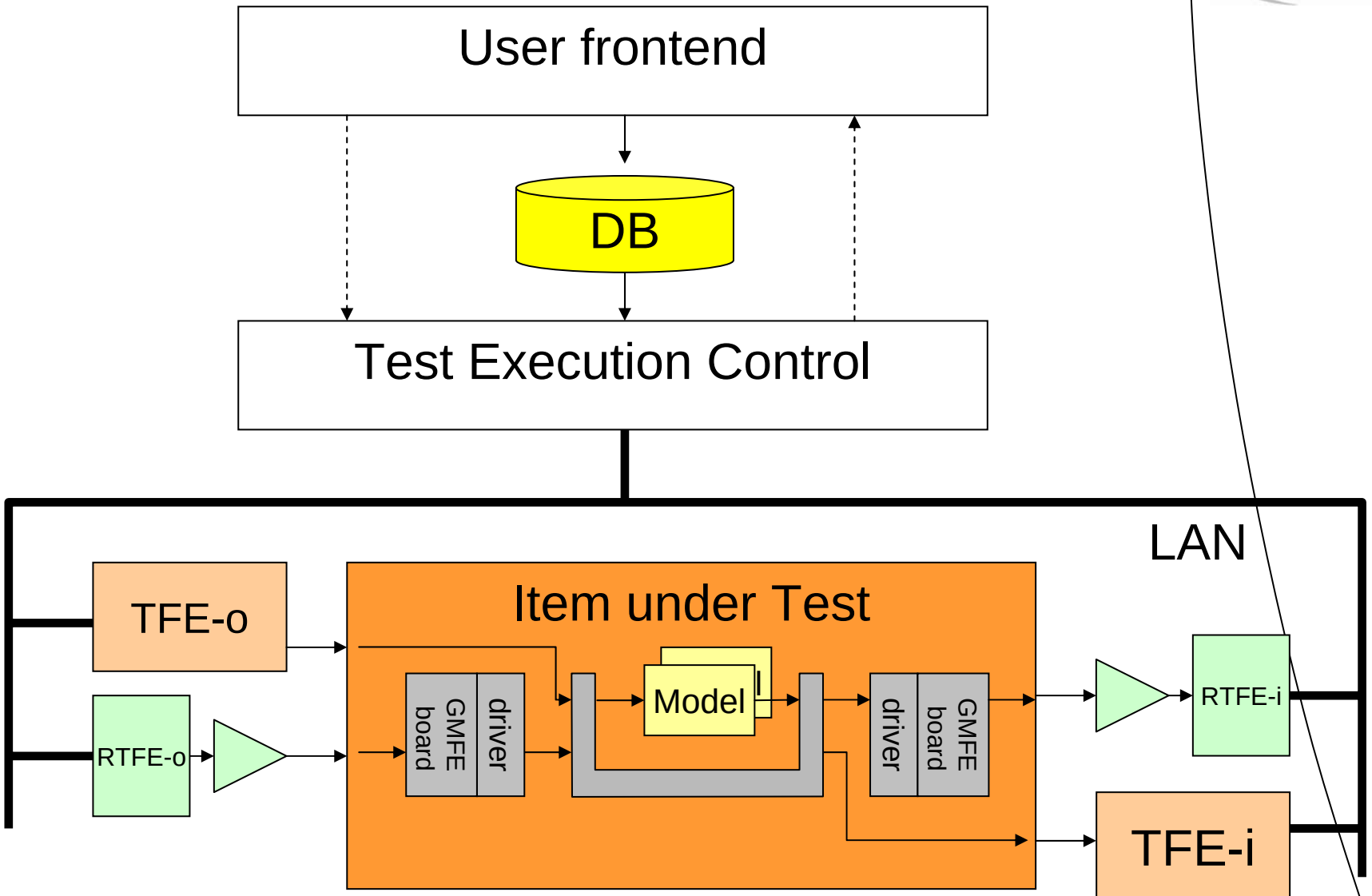


- I/Os for Galileo MDVE
  - Total 1196 signals
  - Total 180 commands

Integration tests : lab setup

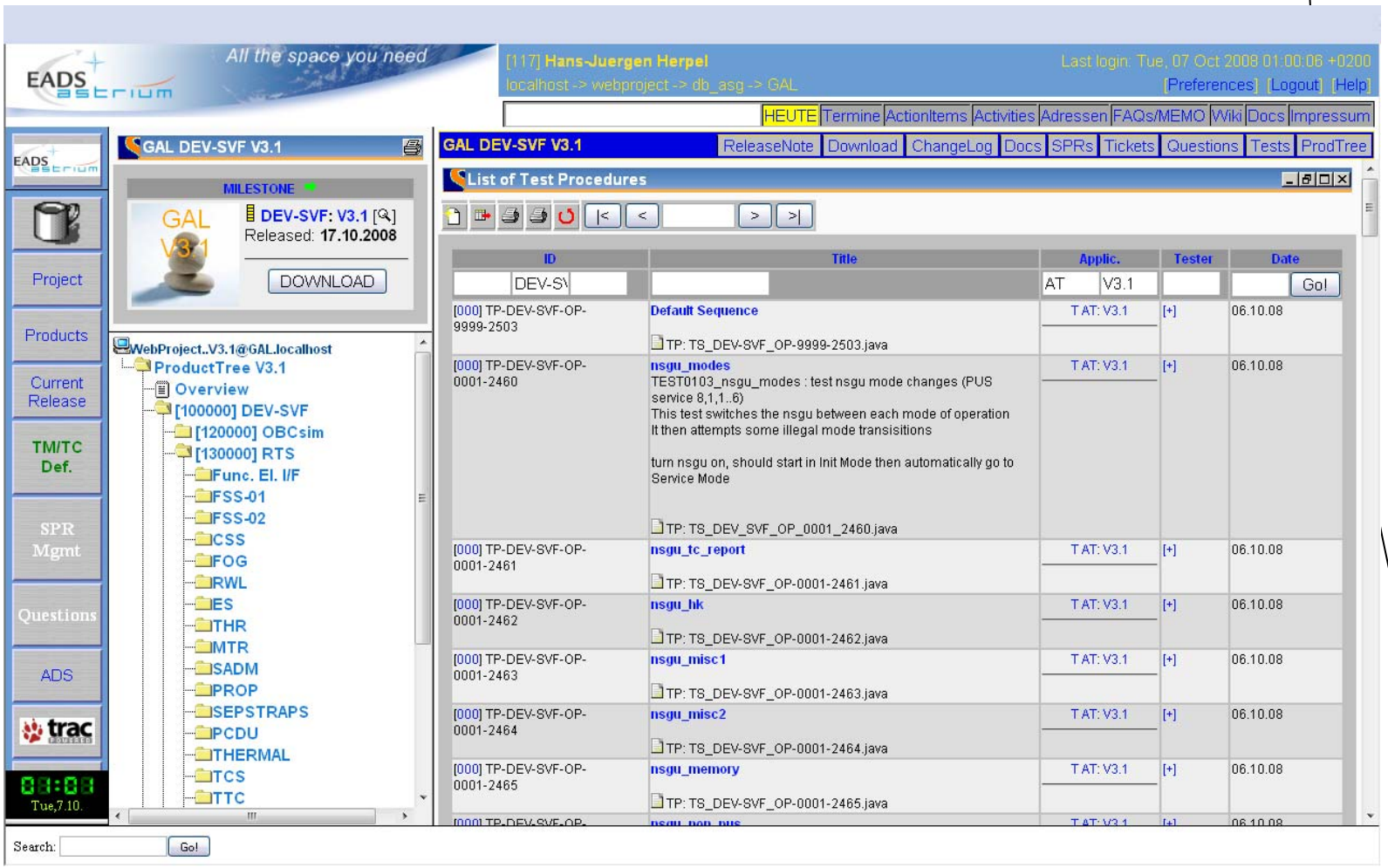
- Test environment with ICDU and test bench

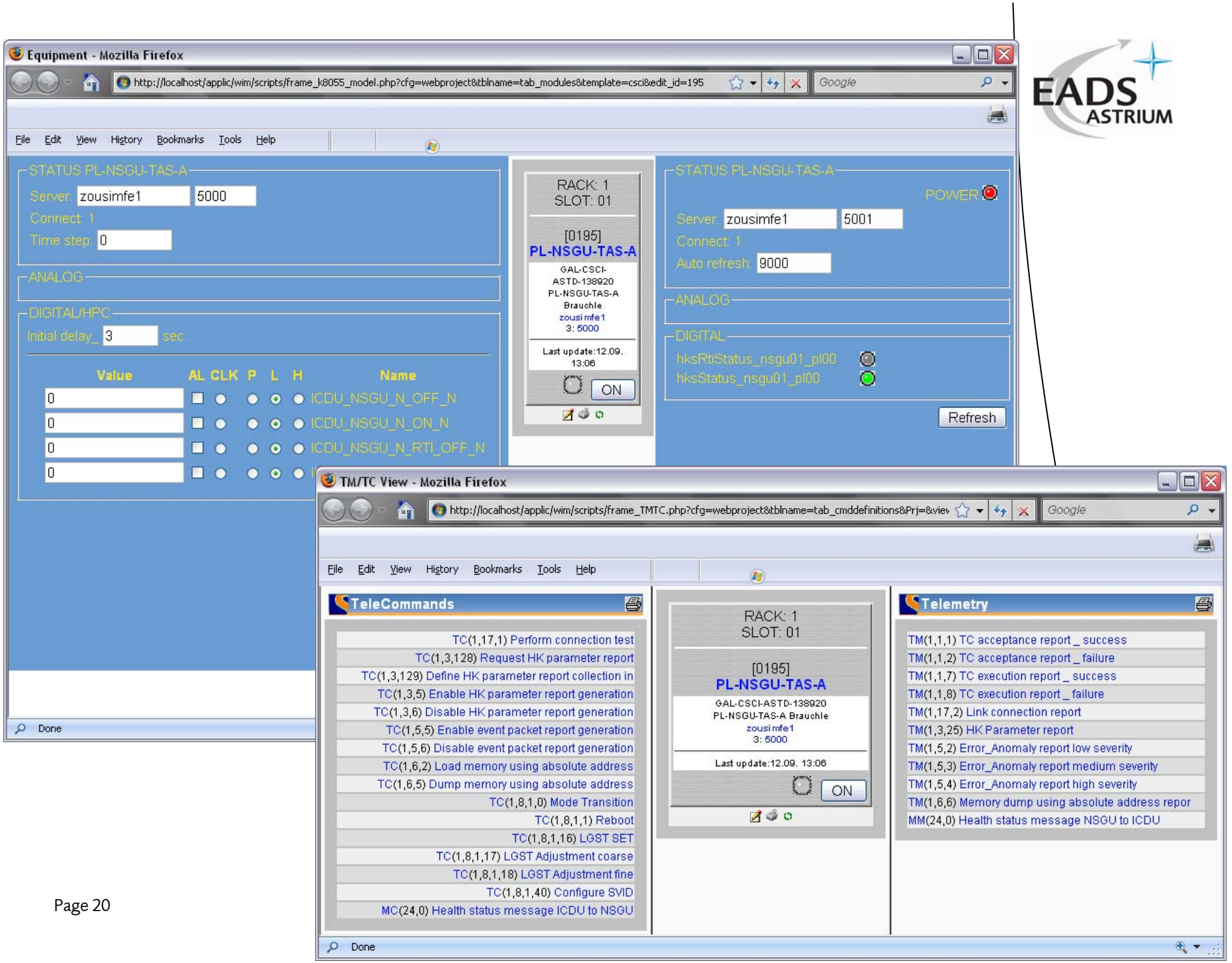
MDVE Verification Environment



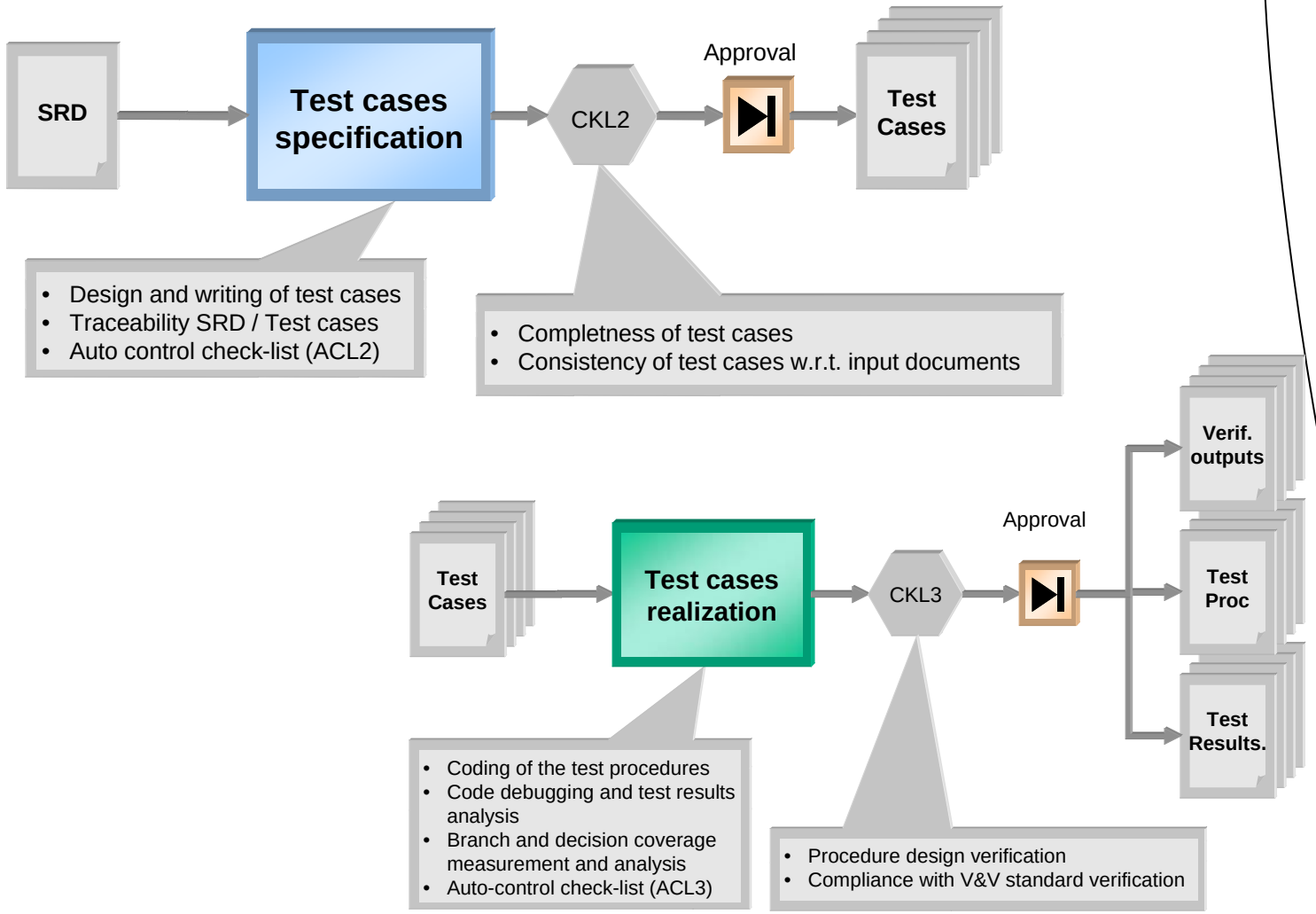
Conclusion

- Database approach partly implemented
- Test effort for unit/integration tests could be reduced significantly
- Highly flexible w.r.t. changes of the interfaces

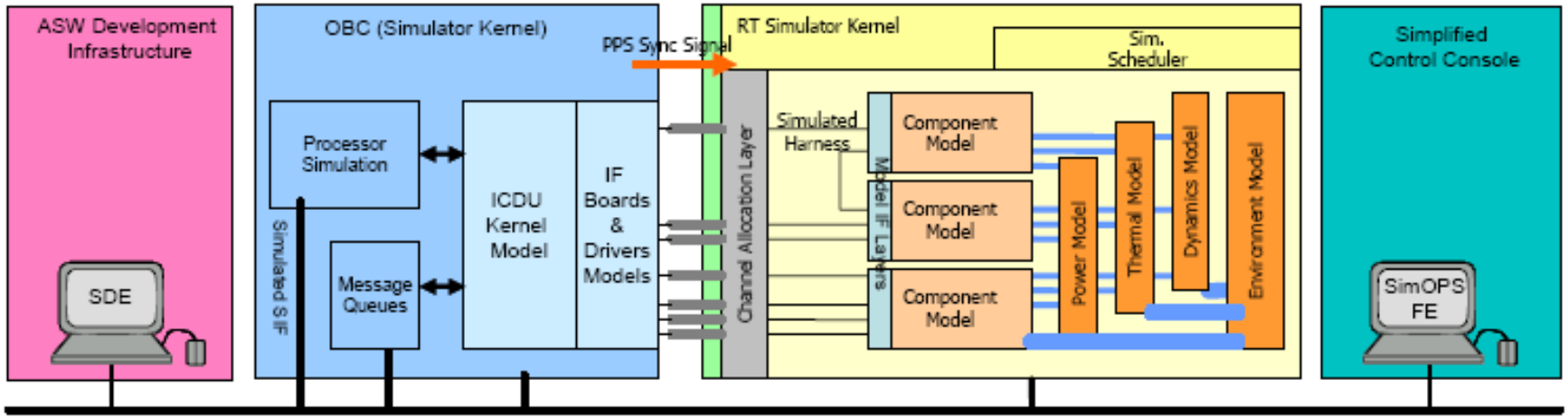

All the space you need
[117] Hans-Juergen Herpel
localhost -> webproject -> db_asg -> GAL
Last login: Tue, 07 Oct 2008 01:00:06 +0200
[Preferences] [Logout] [Help]
HEUTE Termine ActionItems Activities Adressen FAQs/MEMO Wiki Docs Impressum
GAL DEV-SVF V3.1
ReleaseNote Download ChangeLog Docs SPRs Tickets Questions Tests ProdTree
Project
Products
Current Release
TM/TC Def.
SPR Mgmt
Questions
ADS
MILESTONE
DEV-SVF: V3.1
Released: 17.10.2008
DOWNLOAD
WebProject..V3.1@GAL.localhost
ProductTree V3.1
Overview
[100000] DEV-SVF
[120000] OBCsim
[130000] RTS
Func. El. I/F
FSS-01
FSS-02
CSS
FOG
RWL
ES
THR
MTR
SADM
PROP
SEPSTRAPS
PCDU
THERMAL
TCS
TTC
List of Test Procedures
ID
Title
Applic.
Tester
Date
Go!
[000] TP-DEV-SVF-OP-9999-2503
Default Sequence
TP: TS_DEV-SVF_OP-9999-2503.java
[000] TP-DEV-SVF-OP-0001-2460
nsgu_modes
TEST0103_nsgu_modes : test nsgu mode changes (PUS service 8,1,1..6)
This test switches the nsgu between each mode of operation
It then attempts some illegal mode transisitions
turn nsgu on, should start in Init Mode then automatically go to Service Mode
TP: TS_DEV_SVF_OP_0001_2460.java
[000] TP-DEV-SVF-OP-0001-2461
nsgu_tc_report
TP: TS_DEV-SVF_OP-0001-2461.java
[000] TP-DEV-SVF-OP-0001-2462
nsgu_hk
TP: TS_DEV-SVF_OP-0001-2462.java
[000] TP-DEV-SVF-OP-0001-2463
nsgu_misc1
TP: TS_DEV-SVF_OP-0001-2463.java
[000] TP-DEV-SVF-OP-0001-2464
nsgu_misc2
TP: TS_DEV-SVF_OP-0001-2464.java
[000] TP-DEV-SVF-OP-0001-2465
nsgu_memory
TP: TS_DEV-SVF_OP-0001-2465.java
T AT: V3.1
[+]
06.10.08
Search:
Go!


Equipment - Mozilla Firefox
http://localhost/applic/wim/scripts/frame_k8055_model.php?cfg=webproject&tblname=tab_modules&template=csci&edit_id=195
File Edit View History Bookmarks Tools Help
STATUS PL-NSGU-TAS-A
Server: zousimfe1 5000
Connect: 1
Time step: 0
ANALOG
DIGITAL/HPC
Initial delay_ 3 sec.
Value AL CLK P L H Name
0 ICDU_NSGU_N_OFF_N
0 ICDU_NSGU_N_ON_N
0 ICDU_NSGU_N_RTI_OFF_N
0
RACK: 1
SLOT: 01
[0195]
PL-NSGU-TAS-A
GAL-CSCI-ASTD-138920
PL-NSGU-TAS-A Brauchle
zousimfe1
3: 5000
Last update:12.09. 13:06
ON
STATUS PL-NSGU-TAS-A
POWER
Server: zousimfe1 5001
Connect: 1
Auto refresh: 9000
ANALOG
DIGITAL
hksRtiStatus_nsgu01_pl00
hksStatus_nsgu01_pl00
Refresh
Done
TM/TC View - Mozilla Firefox
http://localhost/applic/wim/scripts/frame_TMTC.php?cfg=webproject&tblname=tab_cmddefinitions&Prj=&viev
File Edit View History Bookmarks Tools Help
TeleCommands
TC(1,17,1) Perform connection test
TC(1,3,128) Request HK parameter report
TC(1,3,129) Define HK parameter report collection in
TC(1,3,5) Enable HK parameter report generation
TC(1,3,6) Disable HK parameter report generation
TC(1,5,5) Enable event packet report generation
TC(1,5,6) Disable event packet report generation
TC(1,6,2) Load memory using absolute address
TC(1,6,5) Dump memory using absolute address
TC(1,8,1,0) Mode Transition
TC(1,8,1,1) Reboot
TC(1,8,1,16) LGST SET
TC(1,8,1,17) LGST Adjustment coarse
TC(1,8,1,18) LGST Adjustment fine
TC(1,8,1,40) Configure SVID
MC(24,0) Health status message ICDU to NSGU
RACK: 1
SLOT: 01
[0195]
PL-NSGU-TAS-A
GAL-CSCI-ASTD-138920
PL-NSGU-TAS-A Brauchle
zousimfe1
3: 5000
Last update:12.09. 13:06
ON
Telemetry
TM(1,1,1) TC acceptance report _ success
TM(1,1,2) TC acceptance report _ failure
TM(1,1,7) TC execution report _ success
TM(1,1,8) TC execution report _ failure
TM(1,17,2) Link connection report
TM(1,3,25) HK Parameter report
TM(1,5,2) Error_Anomaly report low severity
TM(1,5,3) Error_Anomaly report medium severity
TM(1,5,4) Error_Anomaly report high severity
TM(1,6,6) Memory dump using absolute address repor
MM(24,0) Health status message NSGU to ICDU
Done

Validation process



Configuration during SW development



Typical configuration during system integration