

Generic building blocks for PL in CNES based on CPUGEN / LVCUGEN / BASILES

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ADCSS 2014 – ESTEC, Noordwijk – 29/10/2014

AGENDA

- **Feedbacks from payloads developments in the last 10 years**
- **How to be more efficient ?**
- **A proactive strategy : components and tools to ease the institutes developments**
- **A HW building block for payloads : CPUGEN**
- **A OBSW building block : LVCUGEN components**
- **A test means : BASILES SVF and emulators**
- **Status and perspectives**

Lessons learnt from past decade of scientific payload software development

- Growing complexity / autonomy of payloads
- More and more on-board data processing
- Standardisation of monitoring and control (PUS) applicable down to payload / instrument software...
- Real time software engineering standards to apply (E40, Q80).
- Communication with PF to handle, FDIR, modes, ...
- Large variety of hardware architectures depending on mission needs
- Payload / instrument software are developed from scratch in the scope of each mission.
- Most of the developments are related to non-science features or tools that are present in the frame of each project (PUS, PF communication, test means).

=> Scientific institutes spend more and more efforts working out of their core speciality : science.

How to be more efficient ?

- CNES is in charge of securing the developments of French scientific institutes.
- Based on this experience, CNES decided to develop and qualify HW & SW building blocks to :
 - ◆ Ease the developments of institutes.
 - ◆ Reduce the CNES manpower on projects.
- These components are designed to be used in the frame of any project to avoid the development of an already-existing feature/product that covers the need.
 - => save costs
 - => improve maturity of recurrent functions
- This will allow scientific institutes to focus their efforts on their real added-value :
SCIENCE.

A proactive strategy : components and tools to ease the institutes developments

What are the targeted components ?

- A HW board :
 - ◆ Allowing flexibility : capability to host different types of functions
 - ◆ With generic I/O, HW processing and HK capabilities
- Some OBSW components : LVCUGEN. Supplying the generic OBSW features required by all the payload software (PUS, modes management, dataload, I/Os, FDIR, ...).
- A SVF : BASILES to communalize the developments of test means.

How to make them available to institutes ?

- CNES takes at its own charges the development and qualification of these components + their deployment and support.

A HW building block for payloads : CPUGEN

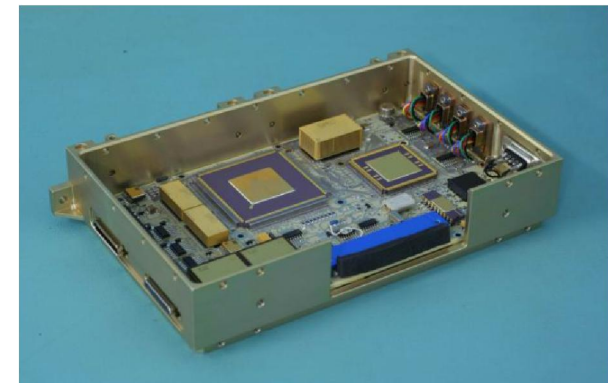
The CPUGEN is a high performance processor module, based on radiation hardened components and compliant with ECSS class 2, designed for space applications.

The CPUGEN module has been developed and fully validated.

EM available.

■ Main Features:

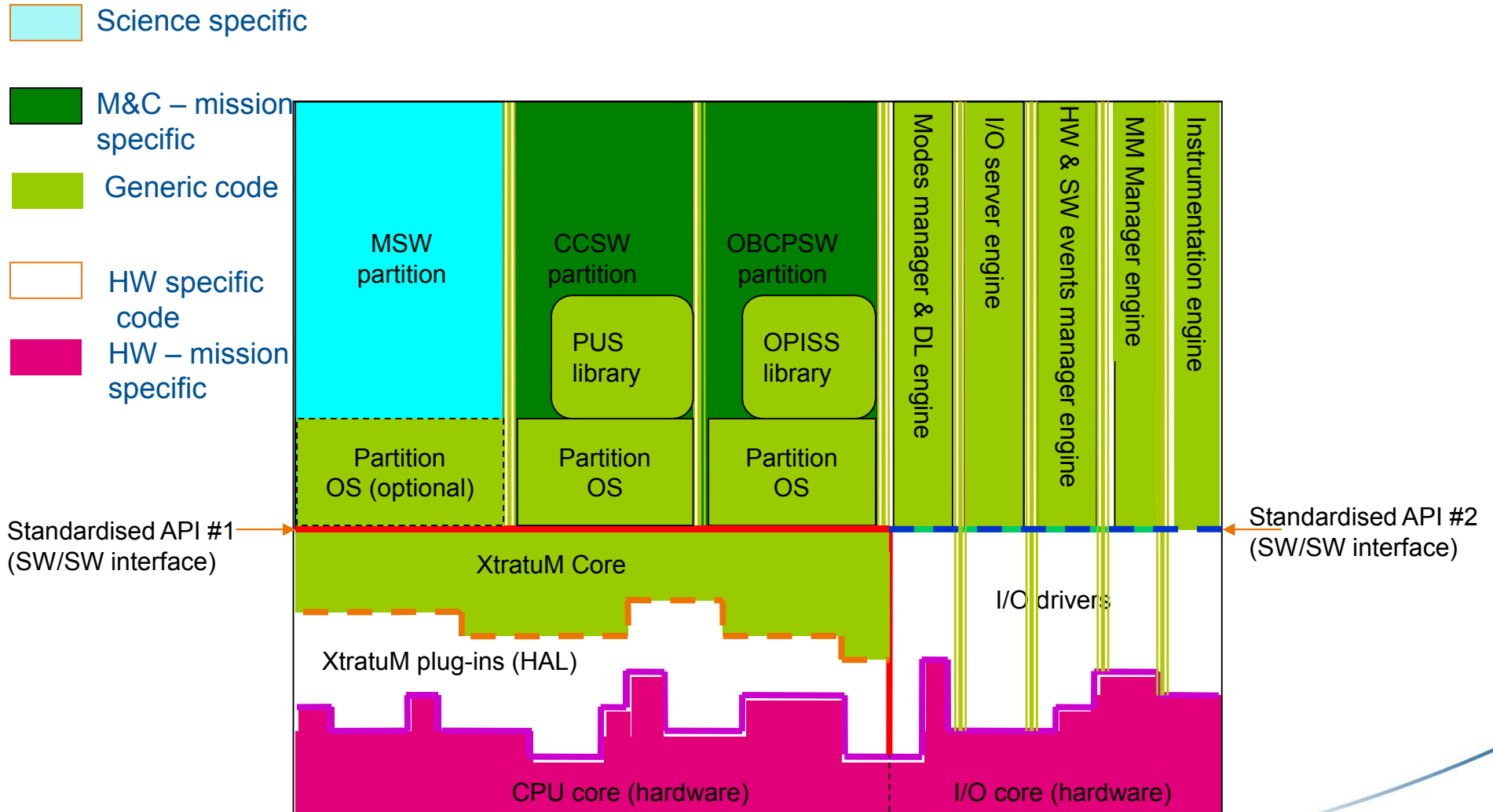
- ◆ Core : 2 LEON3 (GR712RC) at 48MHz / 64MHz / 80MHz
- ◆ FPGA :dedicated to mission pre-processing (ATF280 or ATFS450 TBC - reprogrammable)
- ◆ Validated μ P-FPGA interface (5% ATF280)
- ◆ MRAM : 16Mbytes with secured Dual boot
- ◆ RAM : 256Mbytes
- ◆ US Free
- ◆ Interface Links :
 - ◆ 4 SPACEWIRE at 160MHz
 - ◆ 2 redundant 1553 RT or BC
 - ◆ 2 redundant CAN
 - ◆ 2 UART
 - ◆ IFCU : LVDS or RS422
 - ◆ 26 GPIO signals
 - ◆ Debug



EREMS

cnes

OBSW building blocks for payloads : LVCUGEN

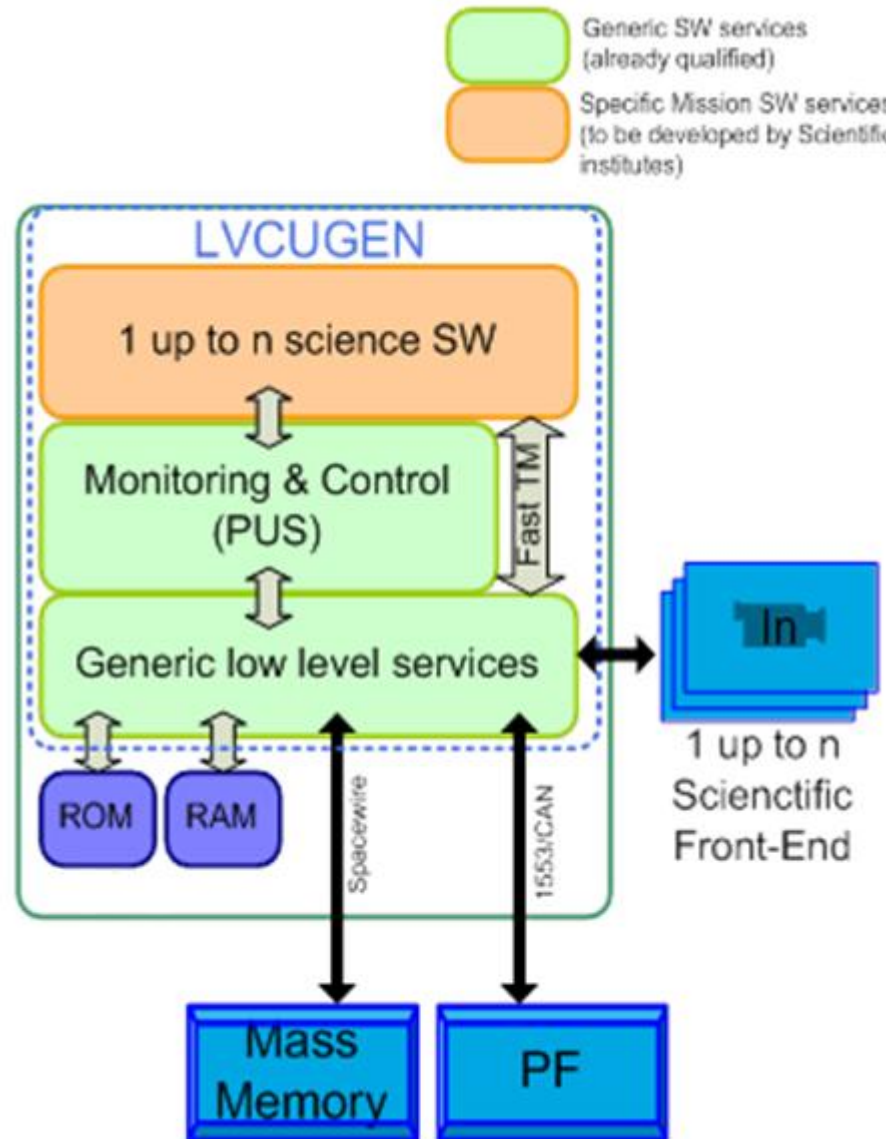


OBSW building blocks for payloads : LVCUGEN

- Use Time & Space Partitioning to decouple science functions from PF and M&C ones as if they were in different computers.
=> each function can be developed according to its own level of criticality and not according to the highest one hosted in the computer.
- Use virtualization to ease the portability of the components.
- Provide an execution framework with configurable generic subsets that virtualizes the HW (covering I/O management, FDIR, Mode Management & DataLoad, Mass Memory Management, Instrumentation) and cover Monitoring & Control services (PUS).
- The scientific processing will have the possibility, on their own board, to use one or more of these subsets and to develop their software without taking care of the other « non-science » functionalities and benefiting from the virtualization of the HW.

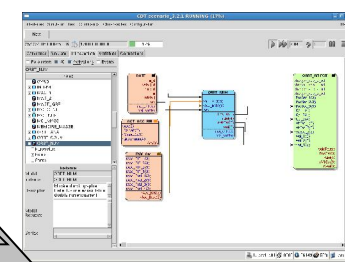
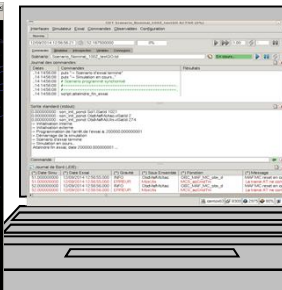
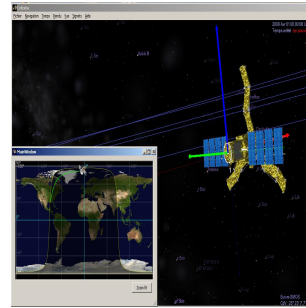
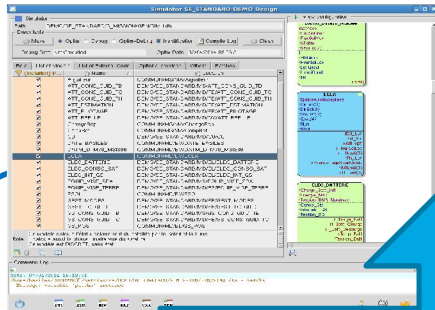
Objectives : provide to scientific institutes an off-the-shelves framework with already mature building blocks, allowing them to focus on scientific processings.

OBSW building blocks for payloads : LVCUGEN



A generic test means : BASILES SVF and emulators

Toolkit to develop & configure models and simulators.



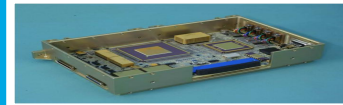
S/C simulator models
Different levels of representativity
Drivers I/O

Execution
Test language & MMI
Debug OBSW
Results Analyse

Flight Software
(LVCUGEN, other)

EMULATORS : GR712,...

HW



Status

- **CPUGEN** : already available in EM with ATF280 with its dedicated EGSE.
- **LVCUGEN** :
 - ◆ **XtratuM** : Specification & validation strategy ongoing in a GSTP5 contract. Qualification in the frame of an ESA GSTP6 to be launched. Multicore supported.
 - ◆ **GuestOS** :
 - » **RTEMS** : qualified by ESA/Edisoft
 - » **Lithos** (ARINC-653 API) : qualification ongoing by Fentiss (to be finished for spring 2015).
 - » **RTEMS multicore** : available (non qualified version).
 - ◆ **Generic partitions** : **IOServer, Modes Management & DataLoad, FDIR** : qualified for end 2014 by CNES/CSSI.
 - ◆ **OPISS library** : qualified by CNES/TAS.
 - ◆ **PUS library** : qualified for spring 2015 by CNES/CSSI.
- **BASILES** : available.

LVCUGEN runs on top of CPUGEN and Basiles will be used as test mean in the coming months.

Perspectives

- **CPUGEN - candidate for :**

- ◆ Scientific missions
- ◆ Any computer required to handle one or several instruments (Payload Management Unit).
- ◆ Any projects that wants it !

- **LVCUGEN – candidate for :**

- ◆ OBSW Mass Memory for Myriade Evolution, SWOT by STEEL Electronics
- ◆ OBSW MAJIS for JUICE by IAS
- ◆ OBSW Eyesat (nanosat) by students
- ◆ Any project that wants it !

- **BASILES** has become the base network to develop operational simulators for all CNES projects.

- ◆ Operational simulators : CSO, MYR EVOL/MERLIN (satellite simulator), SNOB and MEDON (balloon simulators)
- ◆ Simulators for SVF : LVCUGEN
- ◆ Study simulators : ARGOS 4 and SMAR (system simulator), CSO (AOCS study simulator), AGATA (OBSW simulator), electrical domain, thermal domain (study simulators)



Thanks for your attention...

Any question ?

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