

***SVOM mission: ATF280F/AT697F data  
processing for real-time GRB detection and  
localization  
& ATF280E SpaceWire CEA IP recent  
developments***

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*ESA, November 6 - 2012*

# SVOM: Instrument

Gamma Ray Burst (GRB) trigger

CXG (X/g camera)

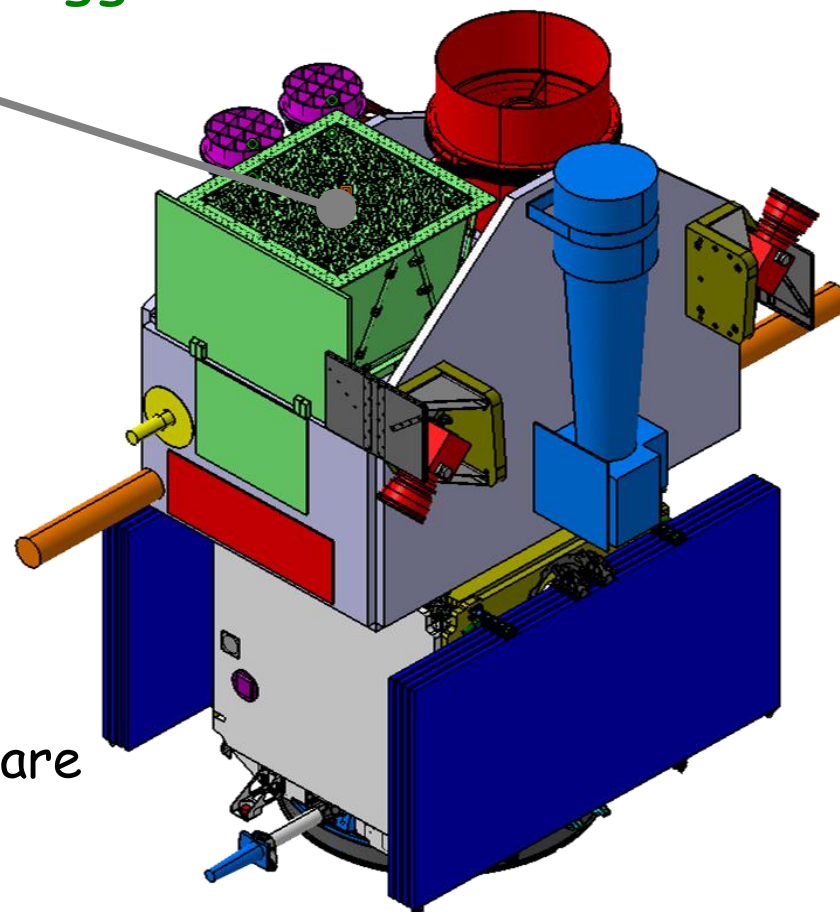
CdTe, 4-250 keV

photon timing 10  $\mu$ s

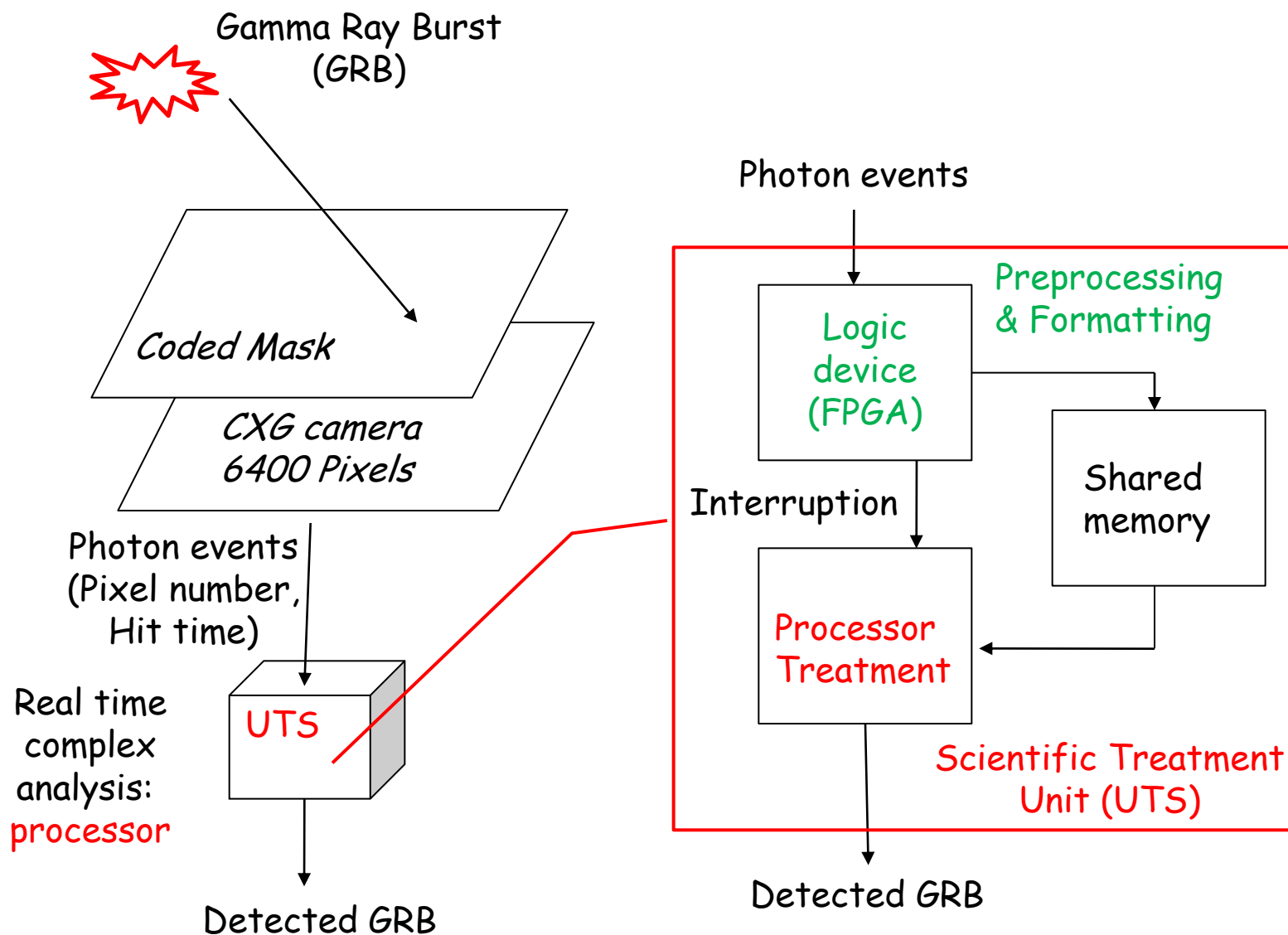
Franco-Chinese Instrument

ITAR, EAR exportation rules  
constraints

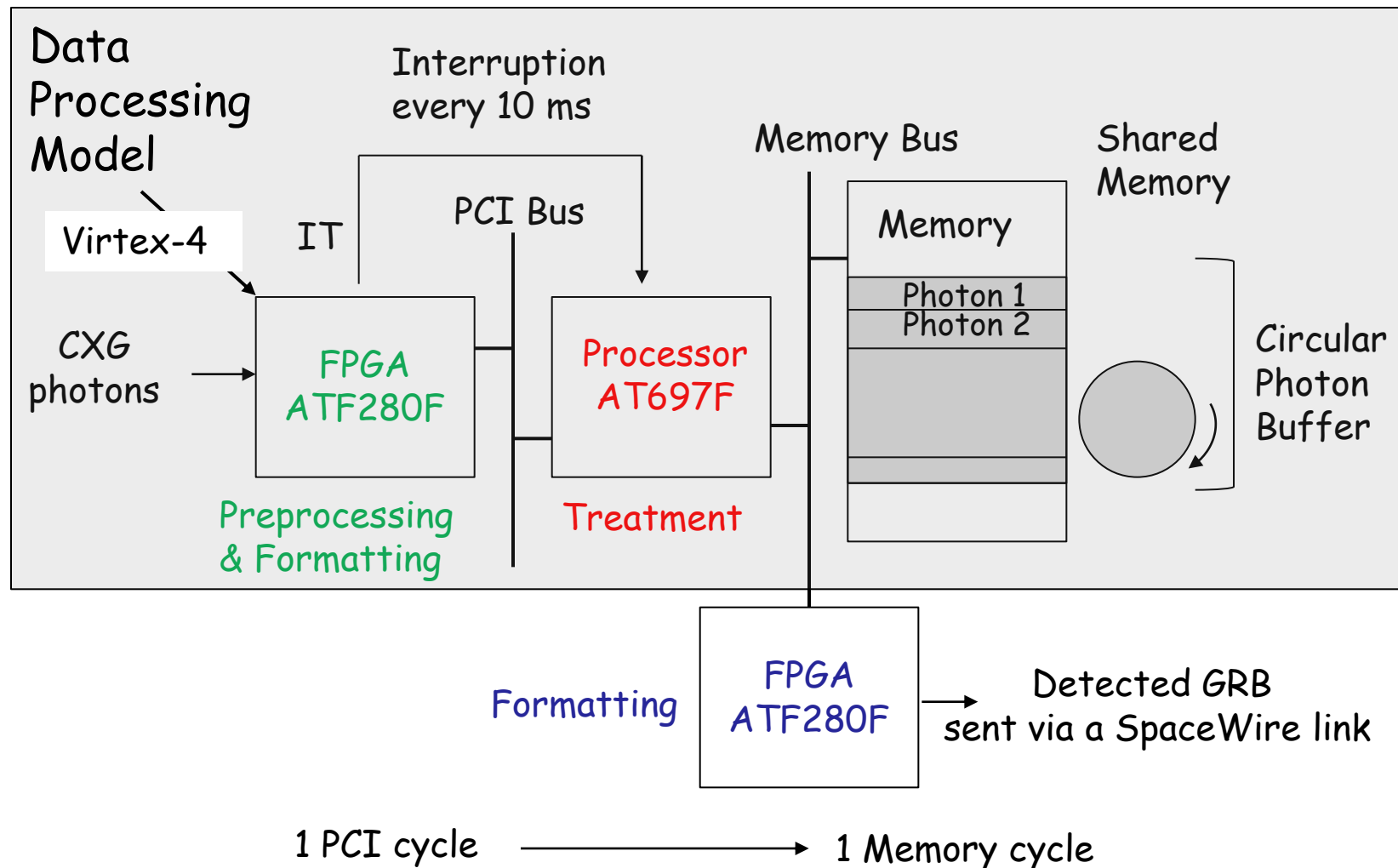
Real time GRB detection hardware  
based on  
ATMEL AT697F/ATF280F  
components



# On-board Gamma Ray Burst detection



# UTS architecture



Additional FPGA preprocessing: raw data buffers, counting per pixel (Read/Modify/Write), per camera zone, per energy. Sophisticated DMA.

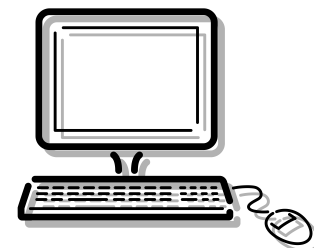
# UTS Data Processing Model

**Compact PCI  
Backplane**

**XILINX V4  
FPGA Board**

**AT697F  
CPU Board**

**PC (Host)**

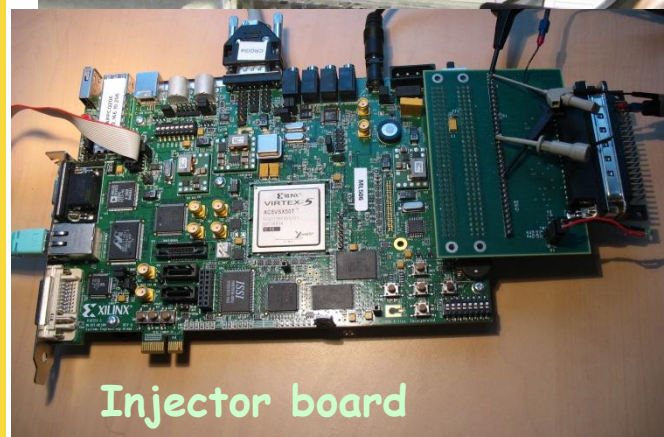
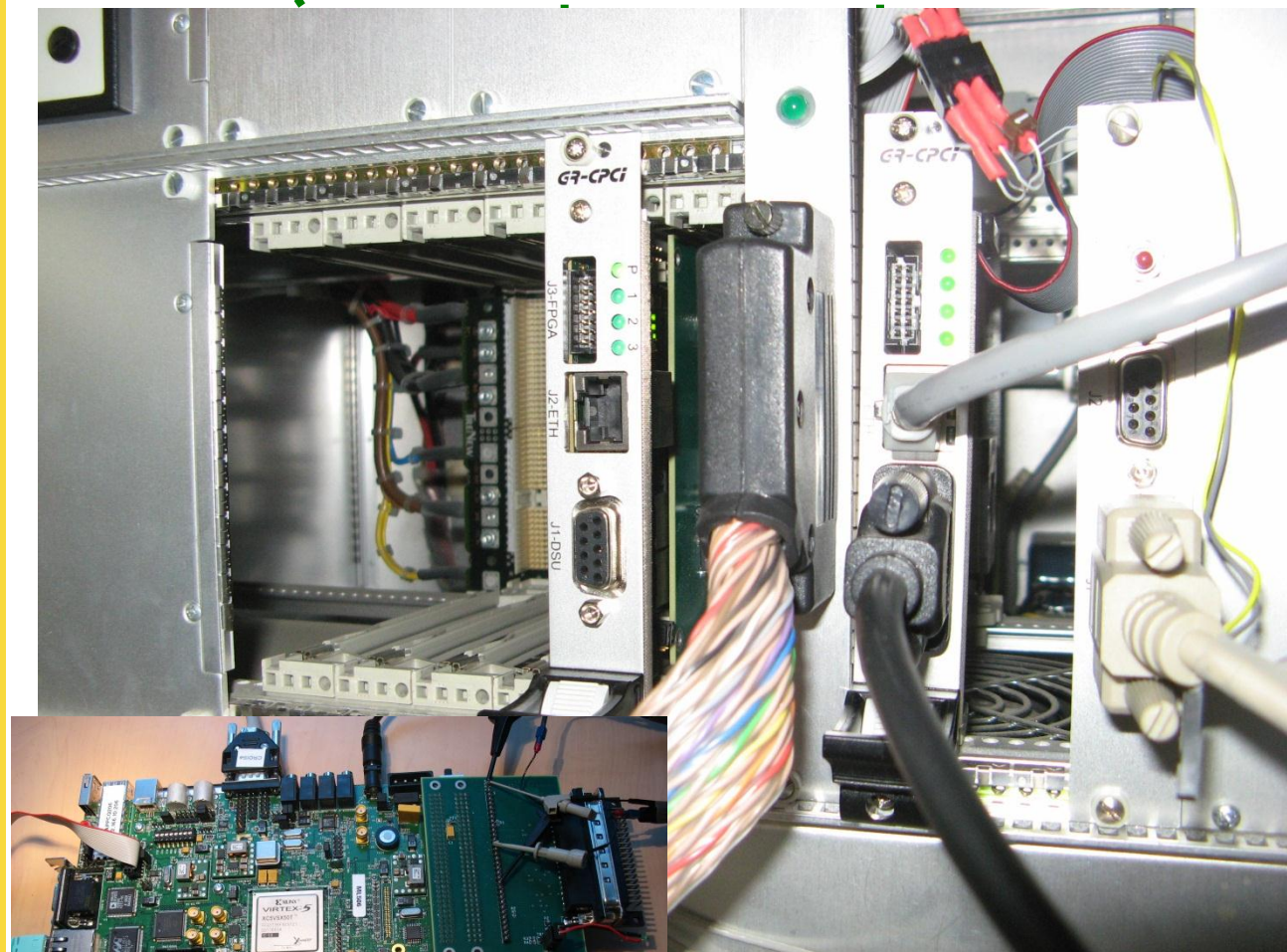


**Ethernet**  
(TFTP ou NFS)  
-Config files  
-Result files

**Console (stdout)**  
-print output

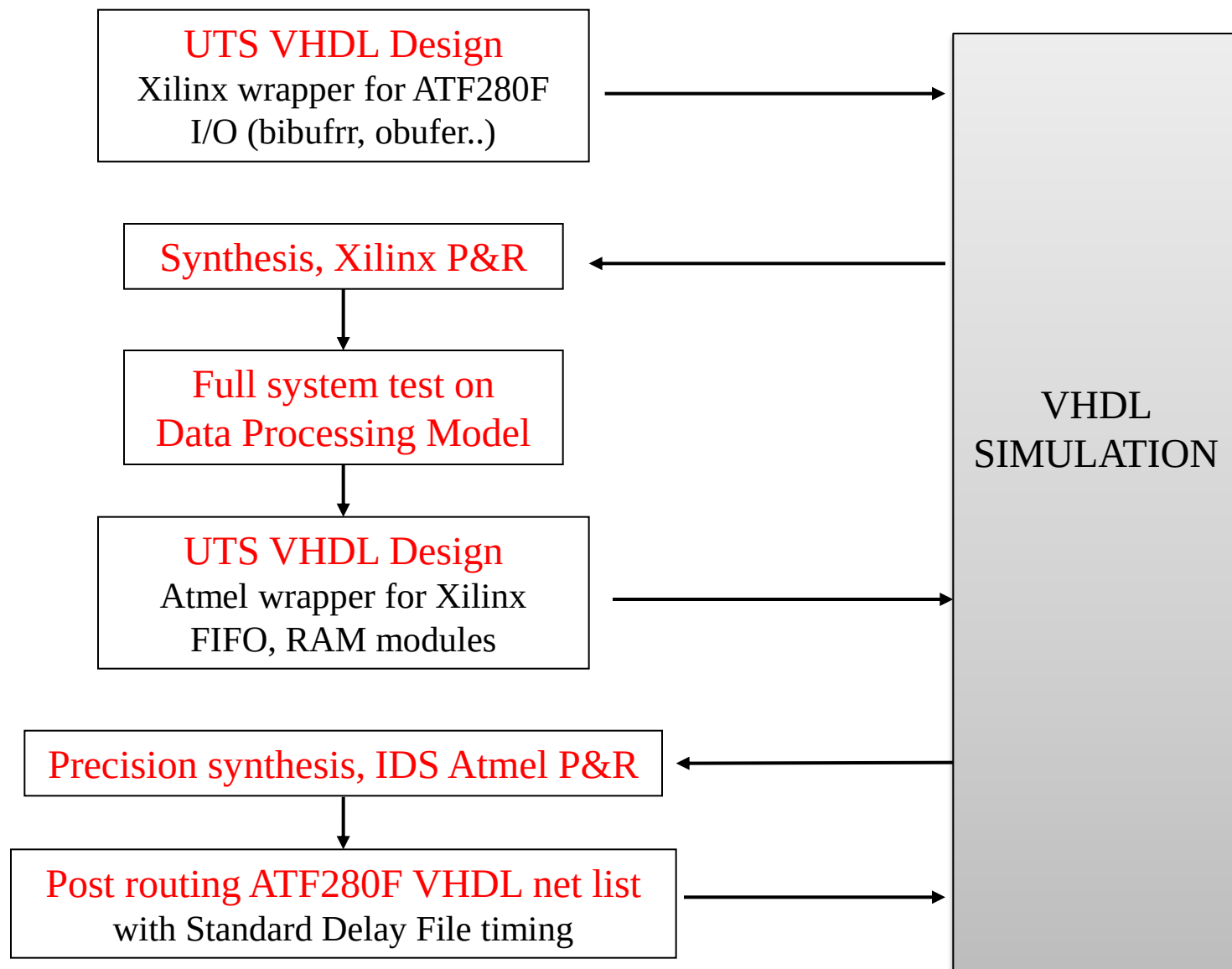
**CPU monitor (grmon)**  
-Load prog, run, status

**Photon injection  
(CXG simulator)**



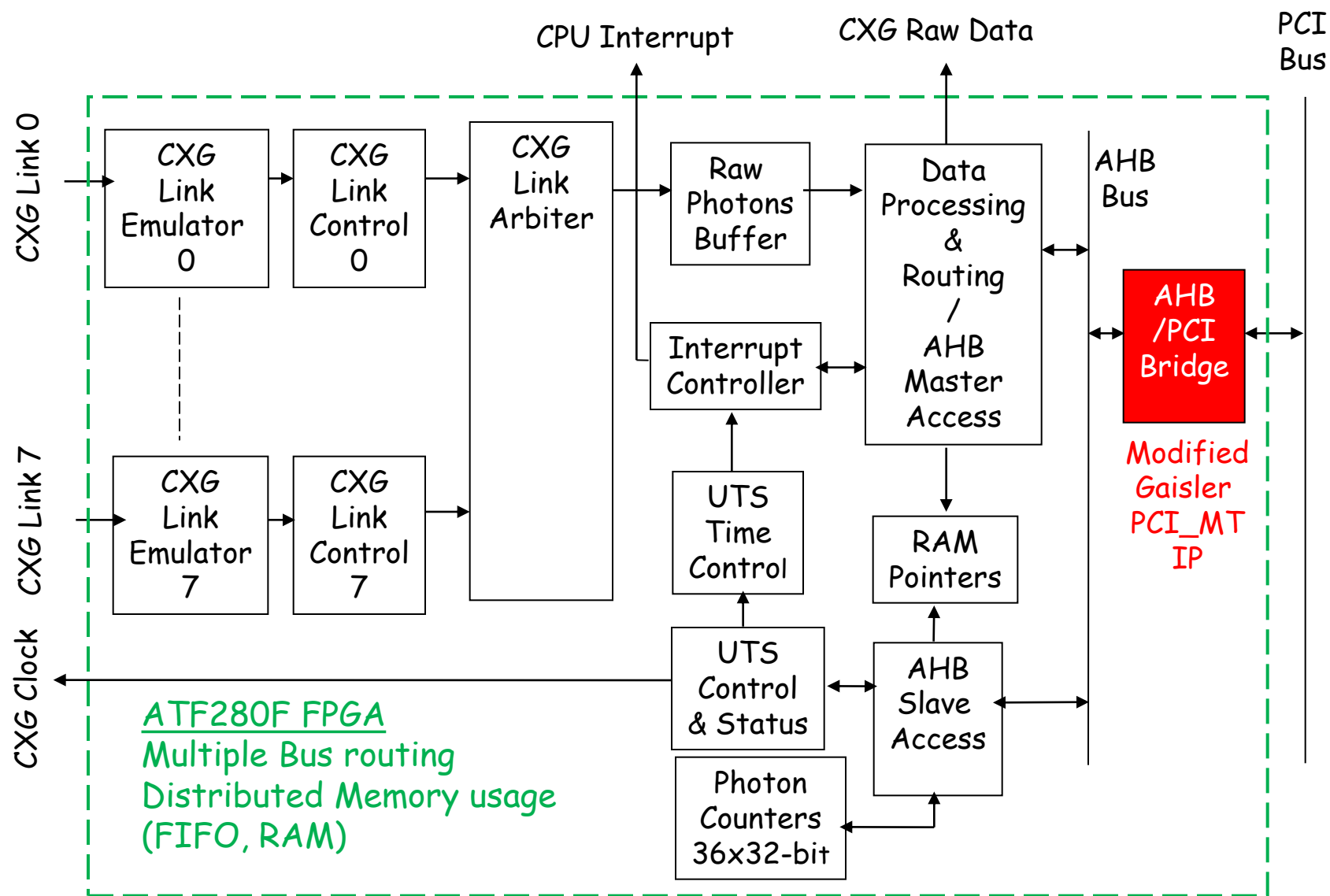
**Injector board**

# ATF280F firmware design flow





# Photon preprocessing logic



# Photon preprocessing logic

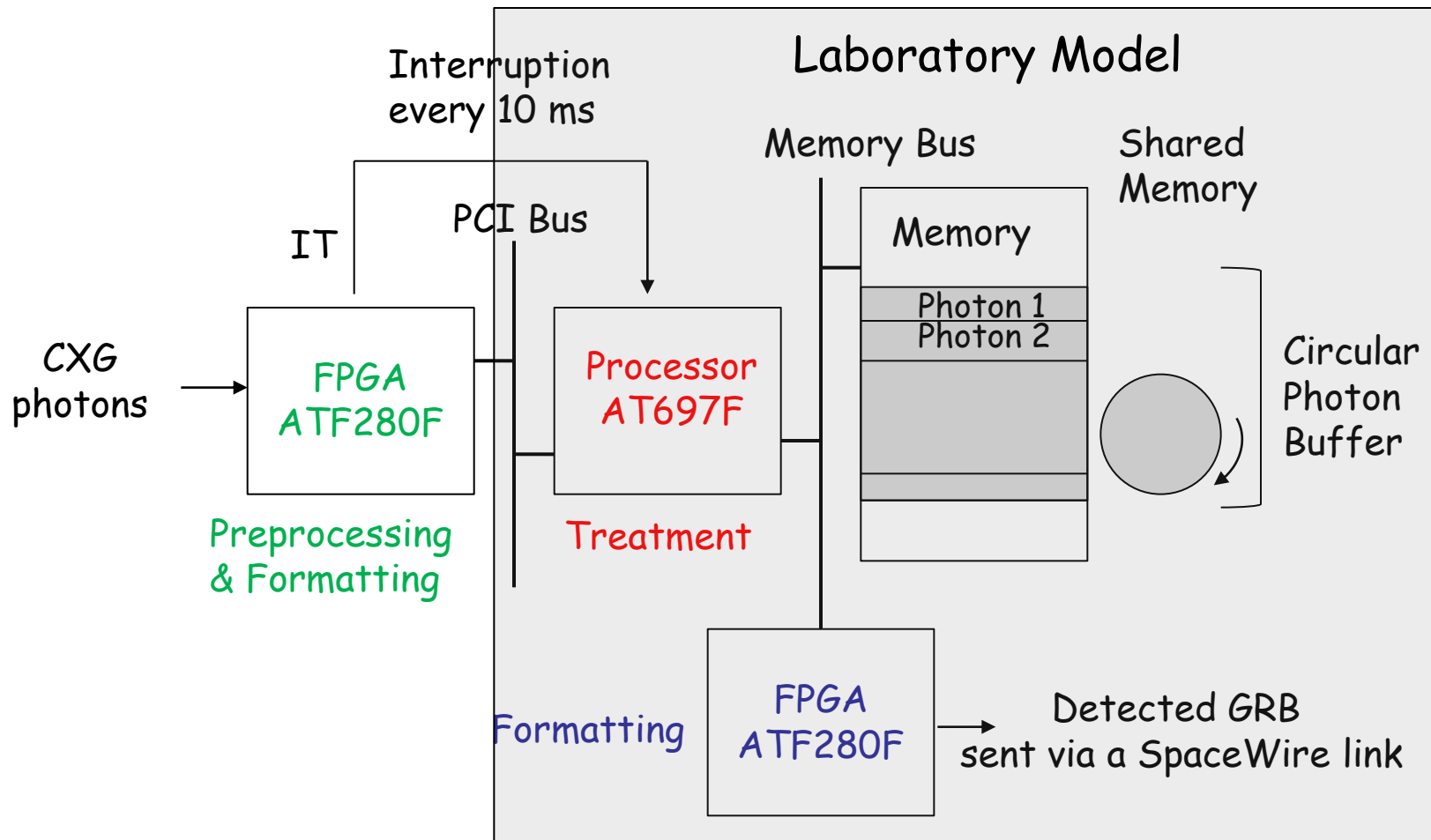
| Resources    | ATF280F-MQFP352                |            | XC4VLX100-10ff1513       |            | ATFS450-MQFP352     |           |
|--------------|--------------------------------|------------|--------------------------|------------|---------------------|-----------|
| I/O          | 115                            | 50%        | 115                      | 11%        | 115                 | 54%       |
| FF           | 3147                           | 22%        | 3551                     | 4%         | 3147                | 14%       |
| RAM          | 151 RAM Cells                  | 17%        | 11 RAMB16<br>176 RAM16x1 | 4%         | 151 RAM Cells       | 10%       |
| logic        | 8753 core cells<br>for routing | 61%<br>15% | 4337 LUTs<br>for routing | 4%<br>0,2% | 7866<br>for routing | 34%<br>6% |
| Performances |                                |            |                          |            |                     |           |
| Frequency    | 20 MHz*                        |            | 63 MHz**                 |            | 21 MHz*             |           |

Atmel P&R tool: IDS 9.1.2a    \*- 55°C to +125°C    \*\* 0°C to +85°C

Only one global clock, PCI clock slowed down from 33 MHz to 20 MHz  
 I/O registers for all external interfaces  
 ATF280F 10% logic occupancy margin for future improvements

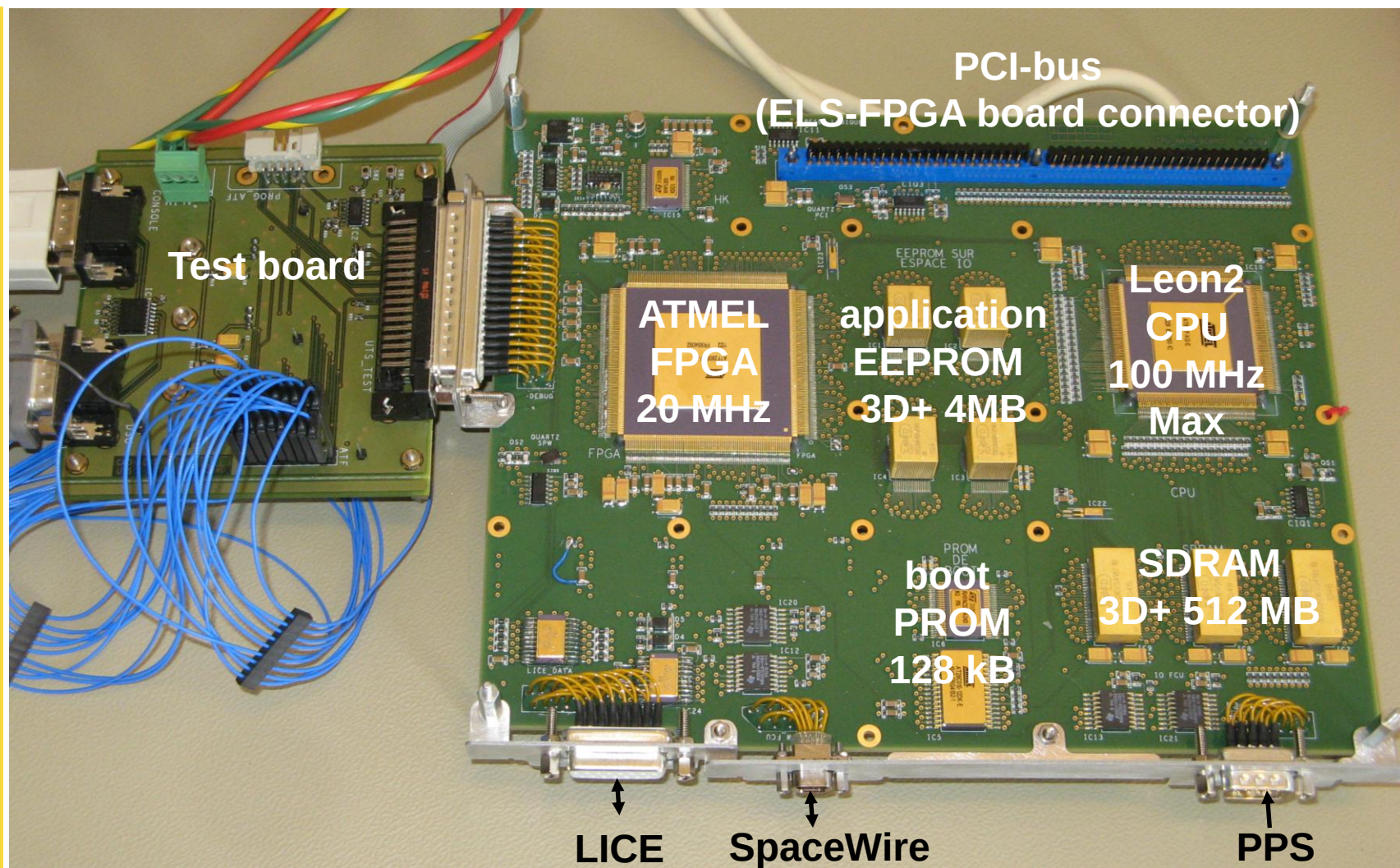


# UTS processor board



Very similar to the engineering model - mechanics, thermal, components

# UTS processor board (Laboratory Model)



# UTS processor board (Laboratory Model)

| Functionalities - processor@66 MHz                                                                                     | State                                                                               |
|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| LEON2 processor<br>(console, DSU monitor , program execution)                                                          |  |
| SDRAM                                                                                                                  |  |
| Boot EEPROM                                                                                                            |  |
| Application EEPROM                                                                                                     |  |
| FPGA ATF280F<br>(loading*, VHDL code execution)<br>*hotline ATMEL request pending for FPGA/AT17LV10 PROM compatibility |  |

Isolate application EEPROM to allow SDRAM access @100 MHz  
SpaceWire firmware to be added

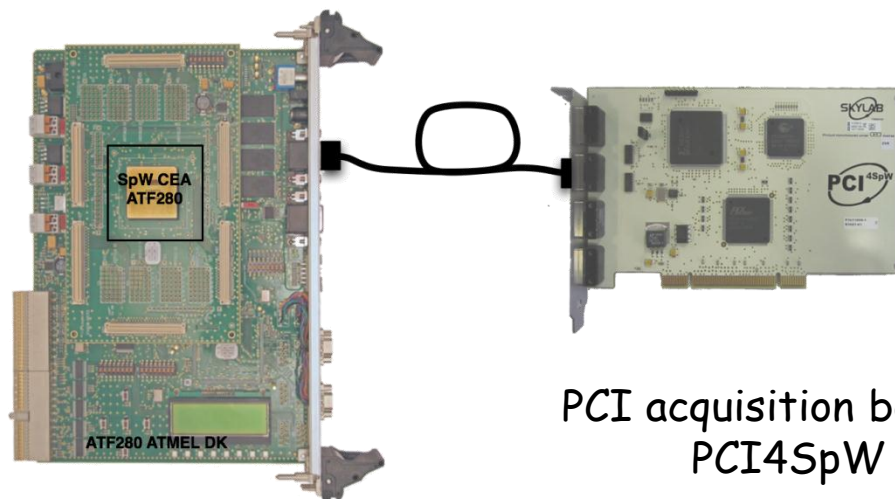
# UTS Design summary

- Full ATF280F firmware validated on the Data Processing Model - tightly coupled to the AT697F RT GRB trigger software
- Precision/IDS tool suit stable and easy to use
  - post routing simulation with modelSim SE works fine
- Major drawback of ATF280F is the final system frequency (penalties for Shadowgram RMW cycles in our application) - no major upgrade with the ATFS450



# SpaceWireCEA IP Performance tests: configuration

## Hardware:

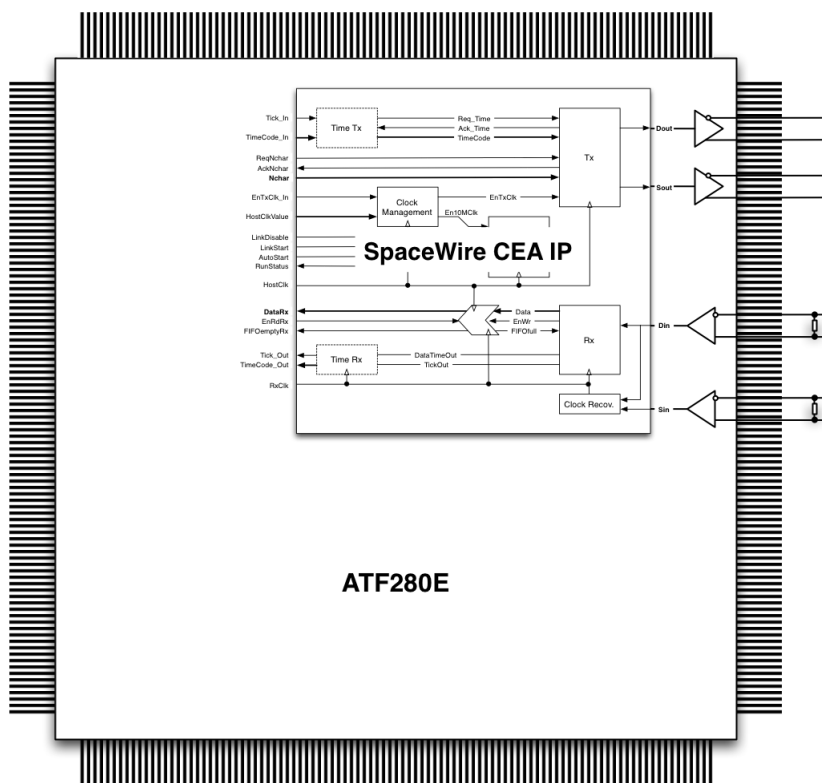


Aerospace Development Kit  
ATMEL (with ATF280E)

## Software:

- VHDL synthesiser '*Precision RTL*' 2008a1.11 OEM\_Atmel from MENTOR
- Place and Route Atmel '*Figaro IDS*' V9.0.2
- Programming tool '*SpaceProgrammer*'
- Simulator '*ModelSim*' from MENTOR
- ... and the SpaceWireCEA IP

# SpaceWireCEA IP: Footprint



**SpW IP config**

**FIFO Size**

**9 x 32**



**Resource**

**Used**

**Utilization**

**Combinational Cell**

**576**

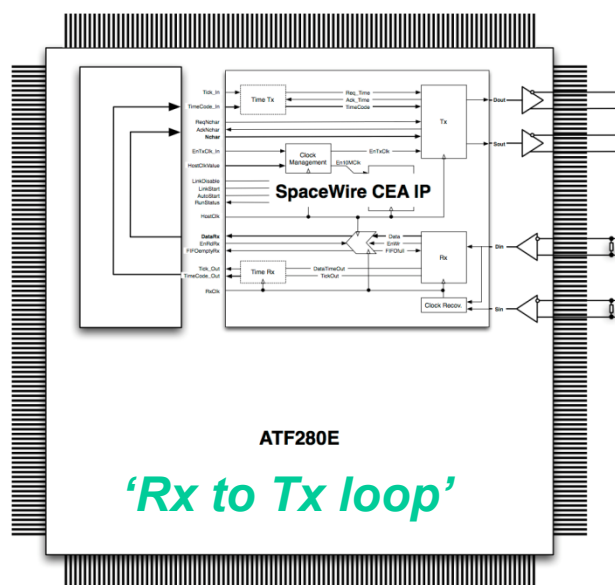
**4%**

**Sequential Cell**

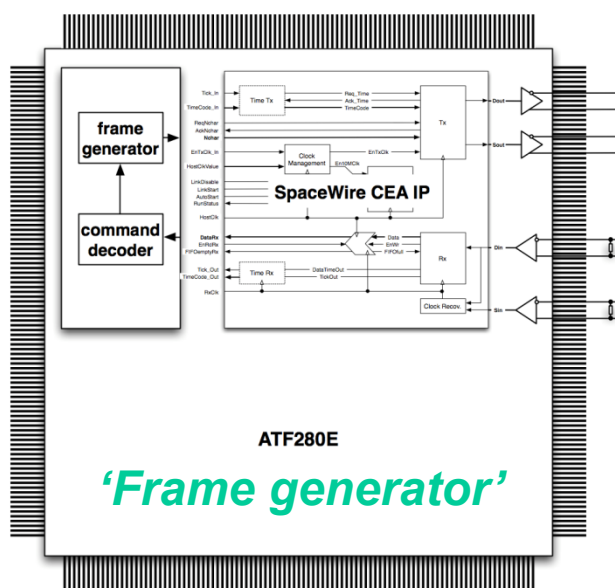
**198**

**1.4%**

# SpaceWireCEA IP: performance



| Rx \ Tx | 10 MHz * | 30 MHz ** | 50 MHz * |
|---------|----------|-----------|----------|
| 10 MHz  | Pass     | Pass      | Pass     |
| 40 MHz  | Pass     | Pass      | Pass     |
| 100 MHz | Pass     | Pass      | Pass     |
| 120 MHz | Fail     | Pass      | Fail     |
| 140 MHz | Fail     | Fail      | Fail     |



| Rx \ Tx | 10 MHz * | 30 MHz ** | 50 MHz * |
|---------|----------|-----------|----------|
| 10 MHz  | Pass     | Pass      | Pass     |
| 40 MHz  | Pass     | Pass      | Pass     |
| 100 MHz | Pass     | Pass      | Pass     |
| 120 MHz | Fail     | Pass      | Fail     |
| 140 MHz | Fail     | Fail      | Fail     |

\* Global clock input - \*\* Fast Clock



# SpaceWireCEA IP: effect of the temperature

## Rx to Tx loop with Tx=30MHz



| Rx freq |           | -20°C | 0°C  | +20°C | +50°C |
|---------|-----------|-------|------|-------|-------|
| 10 MHz  | Data      | Pass  | Pass | Pass  | Pass  |
|         | Time-code | Pass  | Pass | Pass  | Pass  |
| 100 MHz | Data      | Pass  | Pass | Pass  | Pass  |
|         | Time-code | Pass  | Pass | Pass  | Pass  |
| 120 MHz | Data      | Pass  | Pass | Pass  | Pass  |
|         | Time-code | Pass  | Pass | Pass  | Fail  |
| 140 MHz | Data      | Fail  | Fail | Fail  | Fail  |
|         | Time-code | Fail  | Fail | Fail  | Fail  |

## Frame generator with Rx=100MHz

| Tx freq |           | -20°C | 0°C  | +20°C | +50°C |
|---------|-----------|-------|------|-------|-------|
| 30 MHz  | Data      | Pass  | Pass | Pass  | Pass  |
|         | Time-code | Pass  | Pass | Pass  | Pass  |
| 50 MHz  | Data      | Pass  | Pass | Pass  | Pass  |
|         | Time-code | Pass  | Pass | Pass  | Pass  |