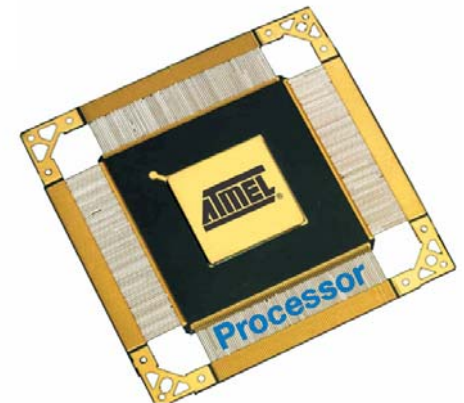
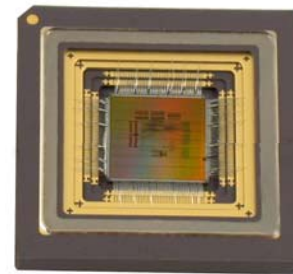
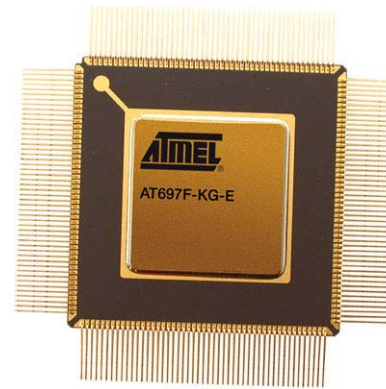




# ATMEL MICROPROCESSORS PRODUCTS FAMILY ROADMAP

ADCSS2010\_MESA



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# ATMEL microprocessor family

ATMEL works on processors for space for more than 15 years

- Existing processors for space
  - 80C32E
  - TSC21020 DSP
  - TSC695F and TSC695FL Sparc V7
  - AT7913E LEON2-FT Sparc V8
  - AT697E/F LEON2-FT Sparc V8
  - Reconfigurable Processor
- Microprocessors products family roadmap
  - B\_ LEON2-FT Sparc V8
  - S\_ LEON2-FT Sparc V8
  - DSP\_ LEON2-FT Sparc V8
  - MultiCore Sparc

## 80C32E 8-Bit Architecture

- 80C32: 8-bit ROMless microcontroller rad.tolerant
  - Side Brazed 40-pin, MQFPJ 44-pin
  - Total Ionizing dose : 30 krads (Si) according to MIL STD 883
  - No Single Event Latch up below 80 MeV/mg/cm<sup>2</sup>
  - QML Q and V with SMD 5962-00518
- 0.8μm RT CMOS technology
- End of life announcement 2010/11
- No new design based on this product

# TSC21020F DSP

- Standard 32/40-bit Floating Point from Analog Devices
  - Radiation tolerant version of ADSP-21020
  - Superscalar IEEE Floating Point Processor
  - 20 MHz max; 5V  $\pm$  0.5V
  - 40 MFlops sustained performance, 60 MFlops peak
  - Space qualified MQFPF-256 for flight models
  - Total Ionizing dose : 100 Krad
  - No Single Event Latch up below 80 MeV/mg/cm<sup>2</sup>
- 0.6 $\mu$ m RTP CMOS technology
- End of life announcement 2011/12
- No new design based on this product

# TSC695F/FL SPARC 32bit Space Processor

Flight heritage more than 1600 flight model

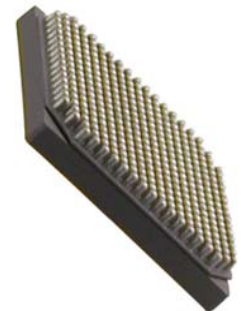
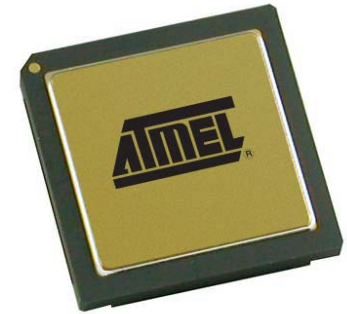
TSC695F	TSC695FL Low Power
25 MHz, 20Mips, 5Mflops @ 5V+/-0.5V	15 MHz, 12Mips, 3Mflops @ 3.3V+/-0.15V
SEU Rate Better than 1.6E-8E/d/d on GEO	SEU Rate Better than 1.2E-7E/d/d on GEO
SEU Rate Better than 8E-10E/d/d on LEO	SEU Rate Better than 4E-5E/d/d on LEO
41 mA power down current @ 25 MHz	10 mA power down current @ 15 MHz
230 mA operating current @ 25 MHz	100 mA operating current @ 15 MHz
ESCC & QML V (5962-005401)	ESCC & QML V (5962-03246)
	70% power saving at only 40% MIPs cost

- 0.5 $\mu$ m RTP CMOS Technology
- Latch up immune
- Total Ionizing dose : 300Krads (RHA=R)
- End of life announcement 2013/14

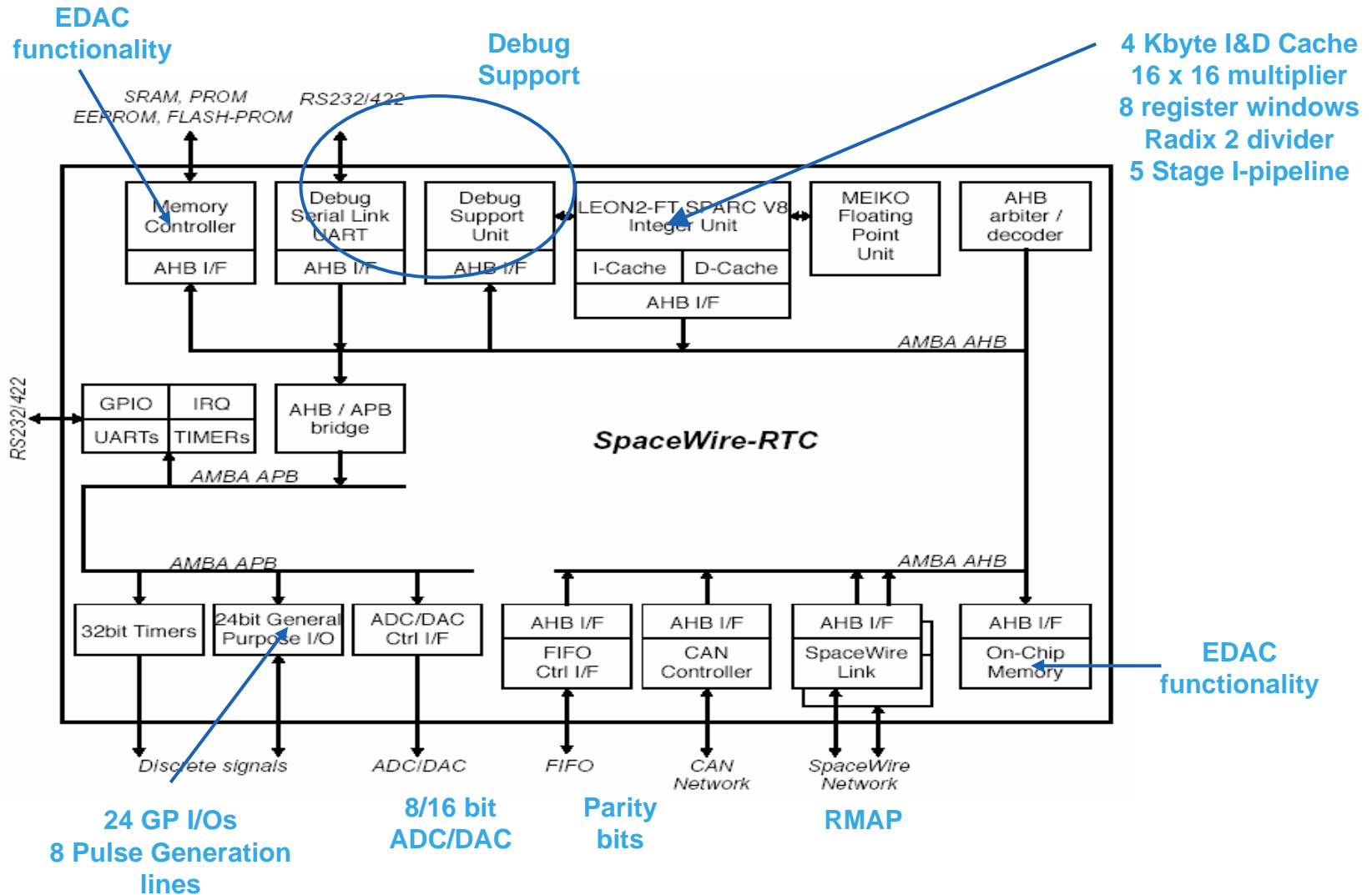
# AT7913E – LEON2FT - SpaceWire RTC 1/2

Design performed by Saab Space under ESA contract, and manufactured by ATMEL

- Sparc V8 Leon2 FT with Floating Point Unit
- AT7913E RTC (Remote Terminal Controller)
  - Two CAN interface
  - FIFO interface (parity check)
  - ADC/DAC interface
  - 2 UART interfaces
  - 2 bidirectional SPW link 200Mbit/s on chip LVDS
  - 64kB x 32 on chip memory with EDAC
  - ...
- SW can be uploaded via SpW link (RMAP compatible)
- Direct Memory and IO Access via SpW RMAP
- CMOS Technology: ATC18RHA (0,18  $\mu\text{m}$ )
- Processor performance (@ 50MHz)
  - Dhrystone 2.1 benchmark = 34,4 MIPS
  - GNC benchmark = 2,4 MFLOPS
- 1.8V core, 3.3V I/O
- Power consumption: [~0.7W@50MHz](#)
- LGA 349 and MQFPF 352 to be introduce
- SMD
  - 5962-10A0301QYC, 5962-10A0301VYC for LGA



# AT7913E – LEON2FT - SpaceWire RTC 2/2

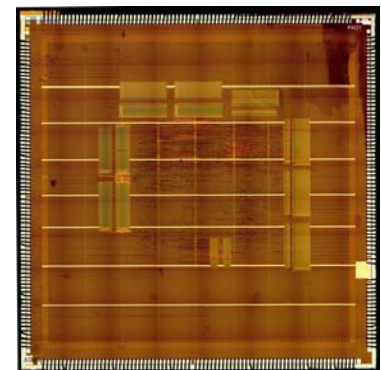


Design performed by Saab Space under ESA contract, and manufactured by ATMEL

# AT697 E/F Sparc V8 32-bit Architecture 1/2

- SPARC V8 LEON2-FT with Integer and Floating Point Unit
- ATC18RHA CMOS 0.18 micron; 1.8 V core; 3.3V I/Os
  - Fault tolerance by design
  - On chip Amba Bus
  - Embedded Instruction and Data caches
    - 16Kbytes multi-sets Data cache
    - 32Kbytes multi-sets Instruction Cache
  - Memories Interface for PROM, SRAM and SDRAM
  - PCI 2.2 interface (33 MHz)
  - Two Timers, two 8-bit Uarts and interrupt Controller
  - Debug Support Unit
    - Trace buffer 512 lines of 16 bytes
- Available package
  - LGA 349
  - MQFPF 256

**150 MIPS/W**





# AT697 E/F Sparc V8 32-bit Architecture 2/2

## AT697F development tasks

- **Electrical characterisation and validation**

- Full bias voltages and military temperature ranges

- **Application Tests**

- Update of the evaluation board

- **ESCC evaluation**

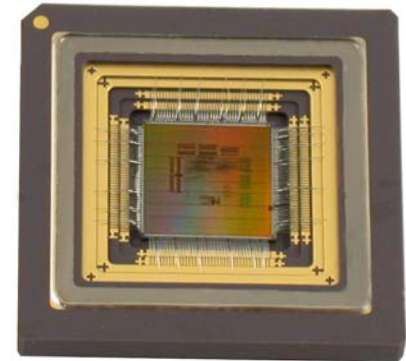
- ESCC screening on going

- **Space Qualification QML Q, QML V**

- |                   |                               |
|-------------------|-------------------------------|
| • AT697F-KG-E     | MQFPF 256 Engineering Samples |
| • 5962-0722402QYC | MQFPF 256 QMLQ                |
| • 5962-0722402VYC | MQFPF 256 QMLV                |
| • 5962R0722402VYC | MQFPF 256 QMLV-RHA            |

- **Radiation characterisation**

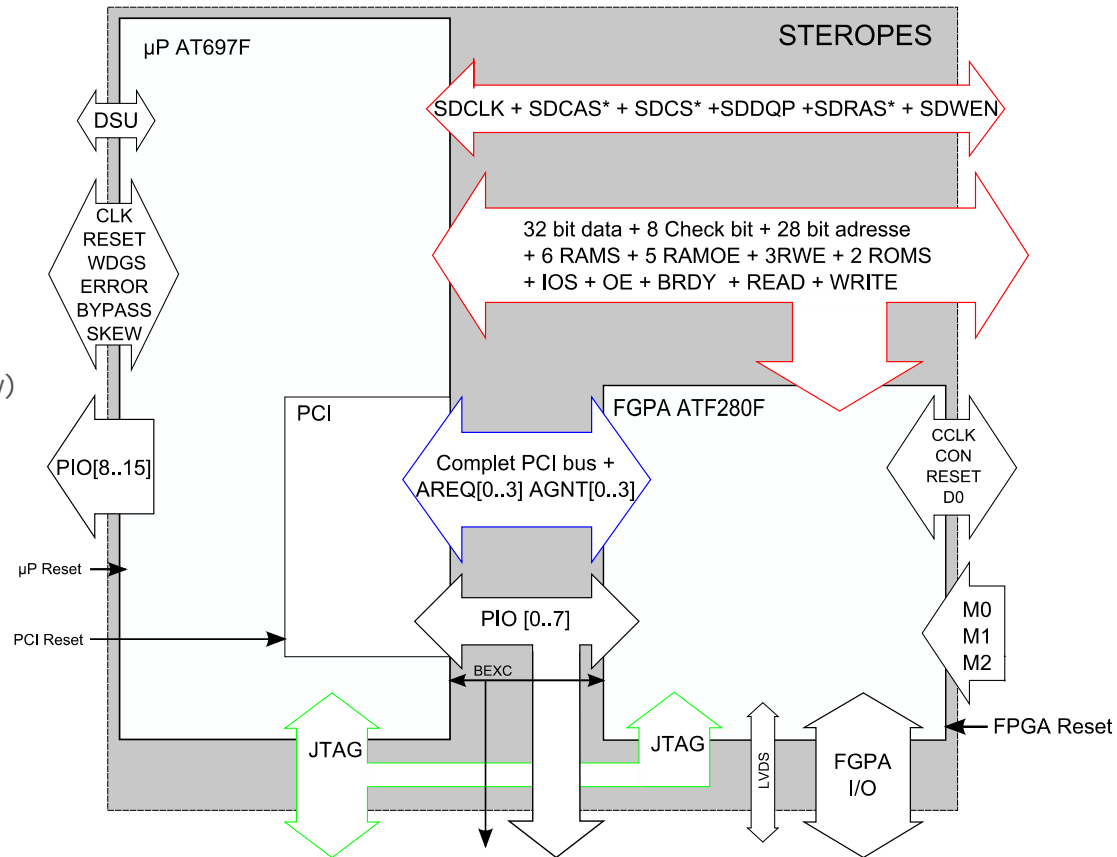
- Total dose : tested up to 300Krad(si) successfully
- SEE heavy ions and protons first run done @ UCL
  - Analysis on going
  - Next Run @ UCL end November 2010





# Reconfigurable Processor 2/2

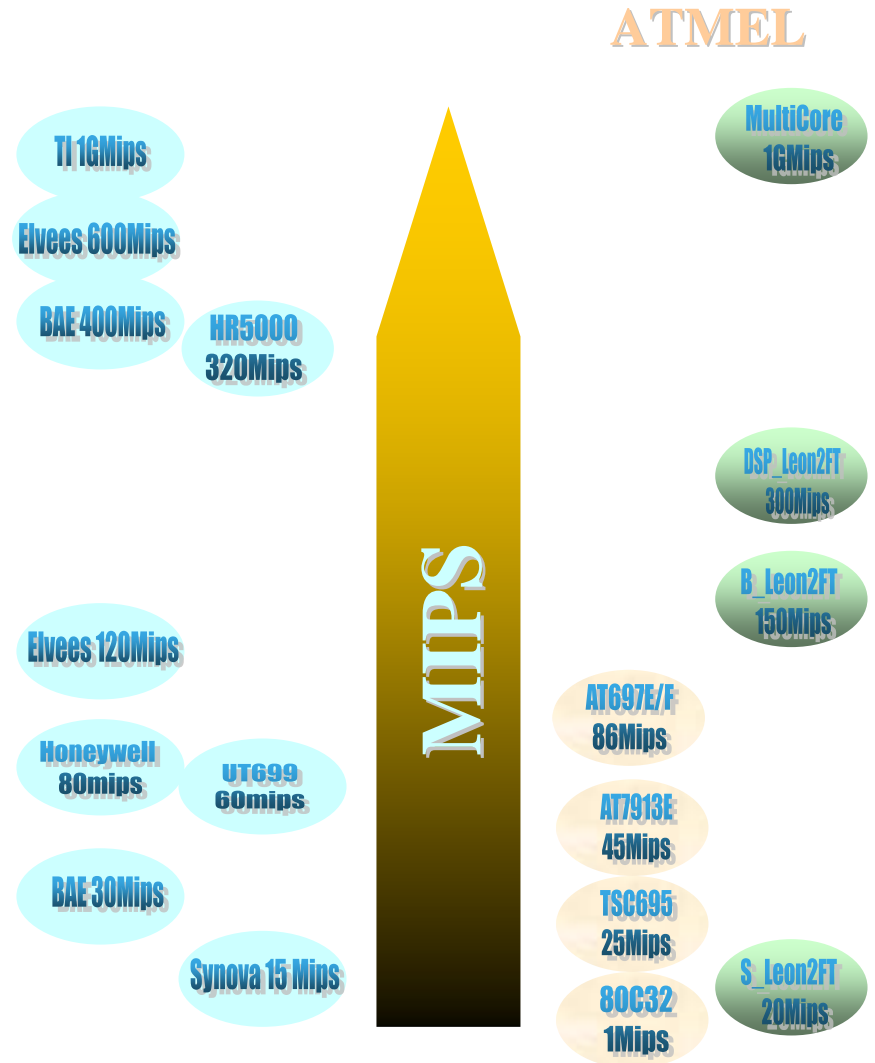
- **ATF280F FPGA**
  - 151 I/O including Clocks
  - 2 LVDS Transceivers Space Wire compliant
- **AT697F Processor**
  - SDRAM control
  - Control (reset, Watchdog, DSU, Clock, skew)
  - 8 PIO [15:8] bits (including UART)
- **SHARED**
  - Bus (32 data + 8 CB + 28 address)
  - Memory control
  - 8 PIO [7:0] bits
  - JTAG



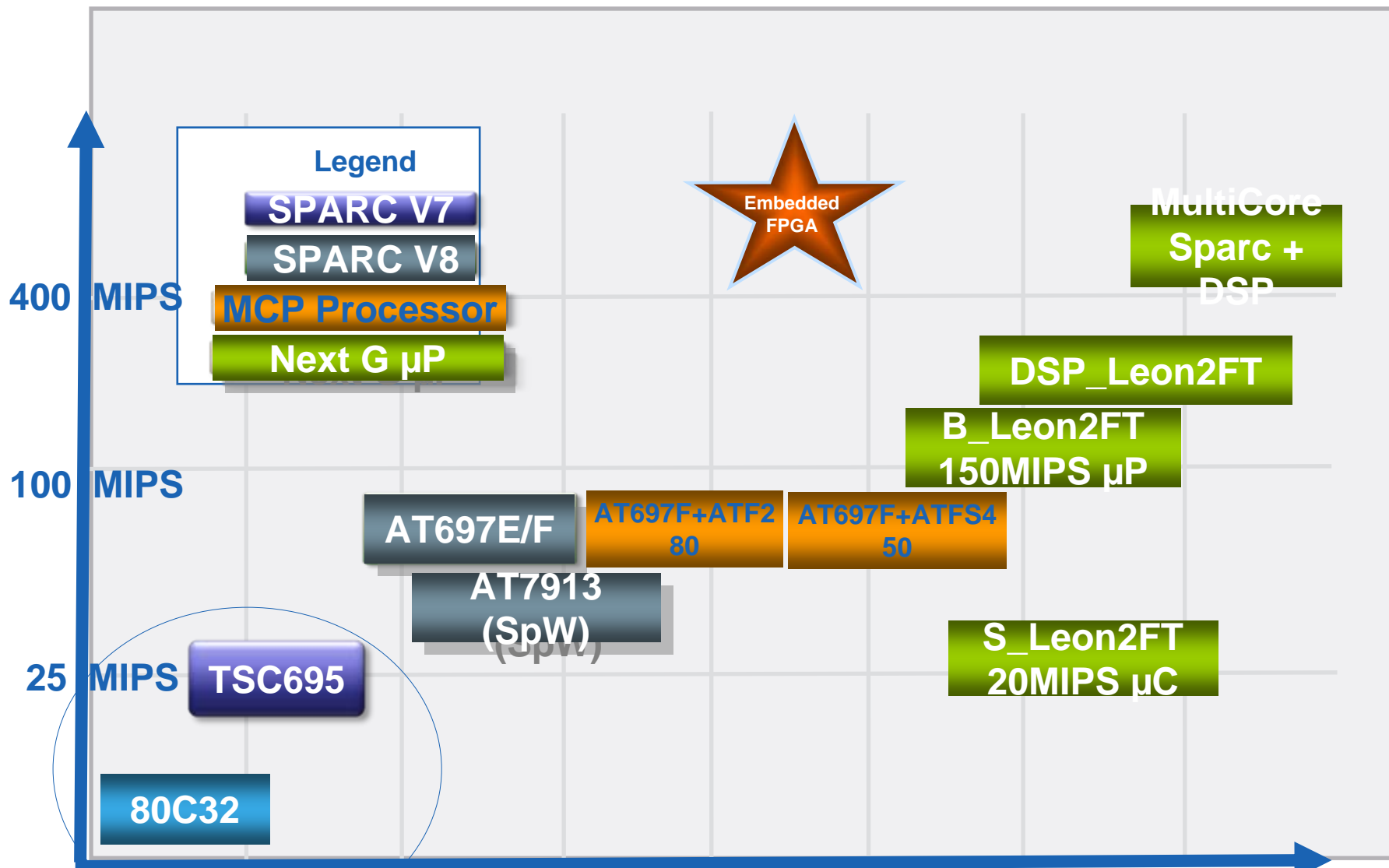
The development of the Reconfigurable Processor is funded by CNES the French space agency

# Some products on the market

- Need of a small and a mid range processor for equipments (Sensors, CCD, Star trackers ...)
- Missing Space Interface in AT697 (SpaceWire, 1553, CAN ...)
- Need Computing power At low power consumption
- **To be completed any idea?**



# Microprocessors products family roadmap



## ATMEL strengths

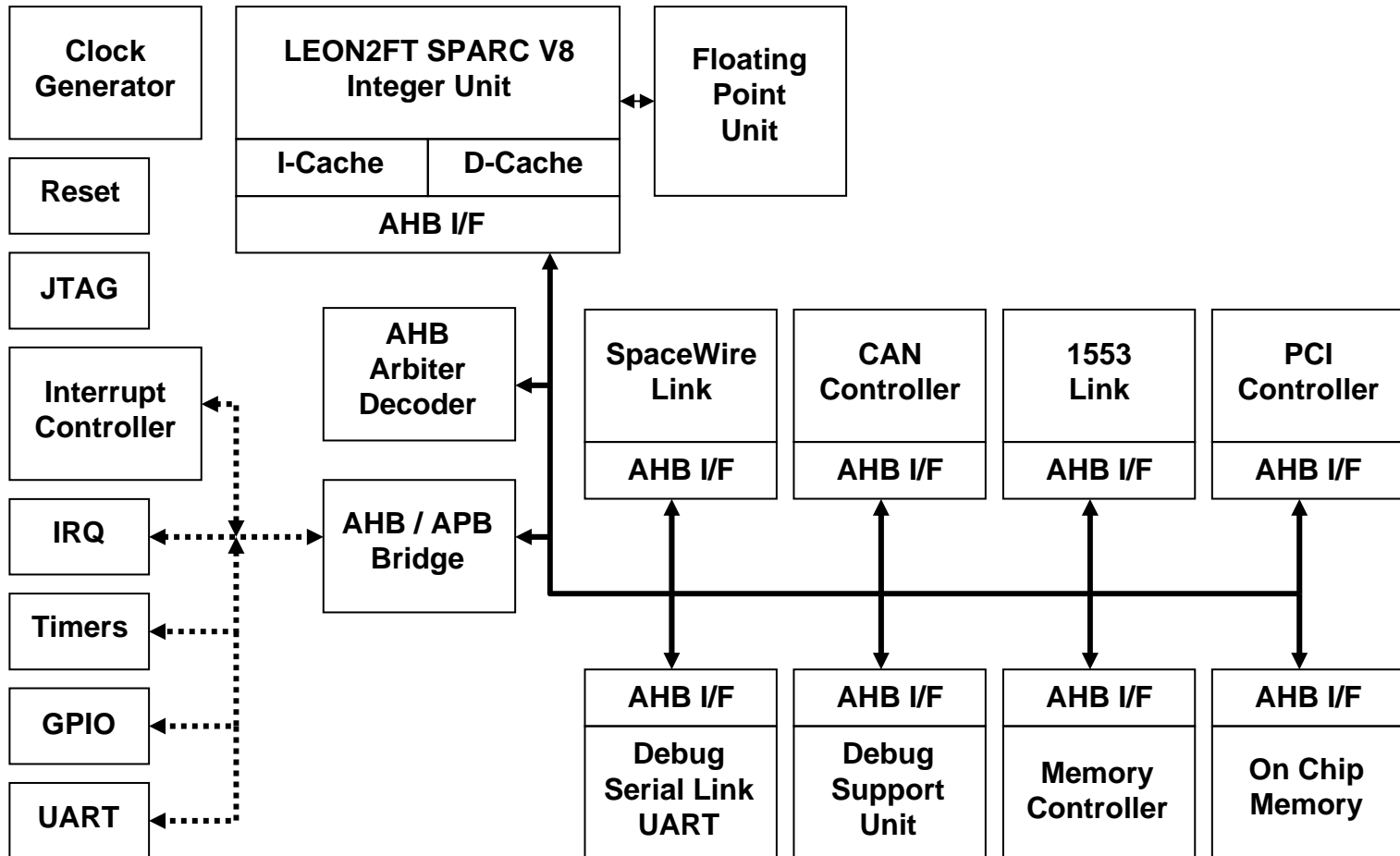
- Background ERC32, AT697E and AT697F (SparcV7, V8)
- 90nm technology retargeting
- Power consumption vs Speed Performance
  - Use of both Standard and Low leakage
- Software compatibility with Leon2FT (AT697E/F)
- Development tools and on chip debug facilities.
- Already Hardened by Design
- Flight heritage
- QML-V & ESCC QML procurements

## B\_ LEON2-FT Sparc V8 1/2

- SPARC V8 High Performance Low-power 32-bit Architecture
- 90nm Target technology
  - Voltages: 3.3V +/- 0.30V for I/O and 1.0V +/- 0.15V for Core
- Frequency from 120MHz up to 200MHz
  - Leon2FT core with Limited improvement to be added
  - Same interfaces as AT697 (Timers, Uarts, I2C, ...)
  - Same package LGA349 and QFP256
    - According to the Ips pins requirement
- Add new features
  - Memory Management Unit: MMU(?)
  - Increase Cache size
  - Internal SRAM (HRAM Hardened) and ROM (HROM) with Default Boot
  - SpaceWire, PCI interface and AHB External Bus
  - CAN interface, 1553 interface and Ethernet(?)
  - Boot capability to external serial Prom
  - Interface to external ADC/DAC
- Fault Tolerance by Design

# B\_LEON2-FT Sparc V8

2/2

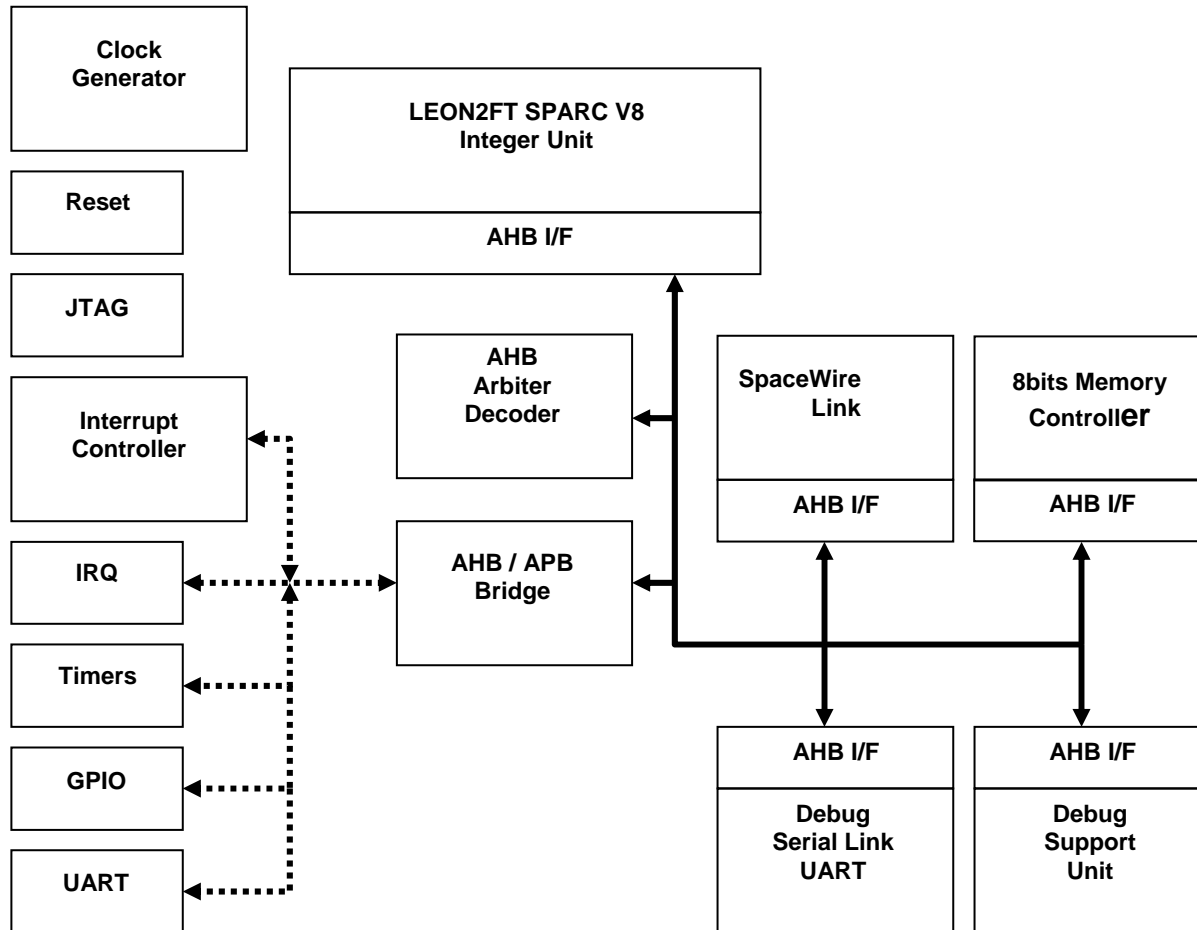




# S\_ LEON2-FT Sparc V8 1/2

- LEON2FT SPARC V8 High Performance Low-power 32-bit Architecture
- 90nm Target technology
  - Voltages: 3.3V +/- 0.30V for I/O and 1.0V +/- 0.15V for Core
- Low processing power (few 10Mips)
  - Low power single chip
  - Low end space application (Sensors,...)
  - No cache memories
  - 4 Register Windows
  - No internal Sram
  - 8 bits external memories interface
  - Limited addressing range (few Mbytes)
  - No FPU
- Add new features
  - SpaceWire (LVDS and Digital outputs)
  - ROM (HROM) with Default Boot (?)
  - Boot capability to external serial Prom (?)
  - Interface to external ADC/DAC (?)
- QFP 100 (ideally QFP64)
- Fault Tolerance by Design

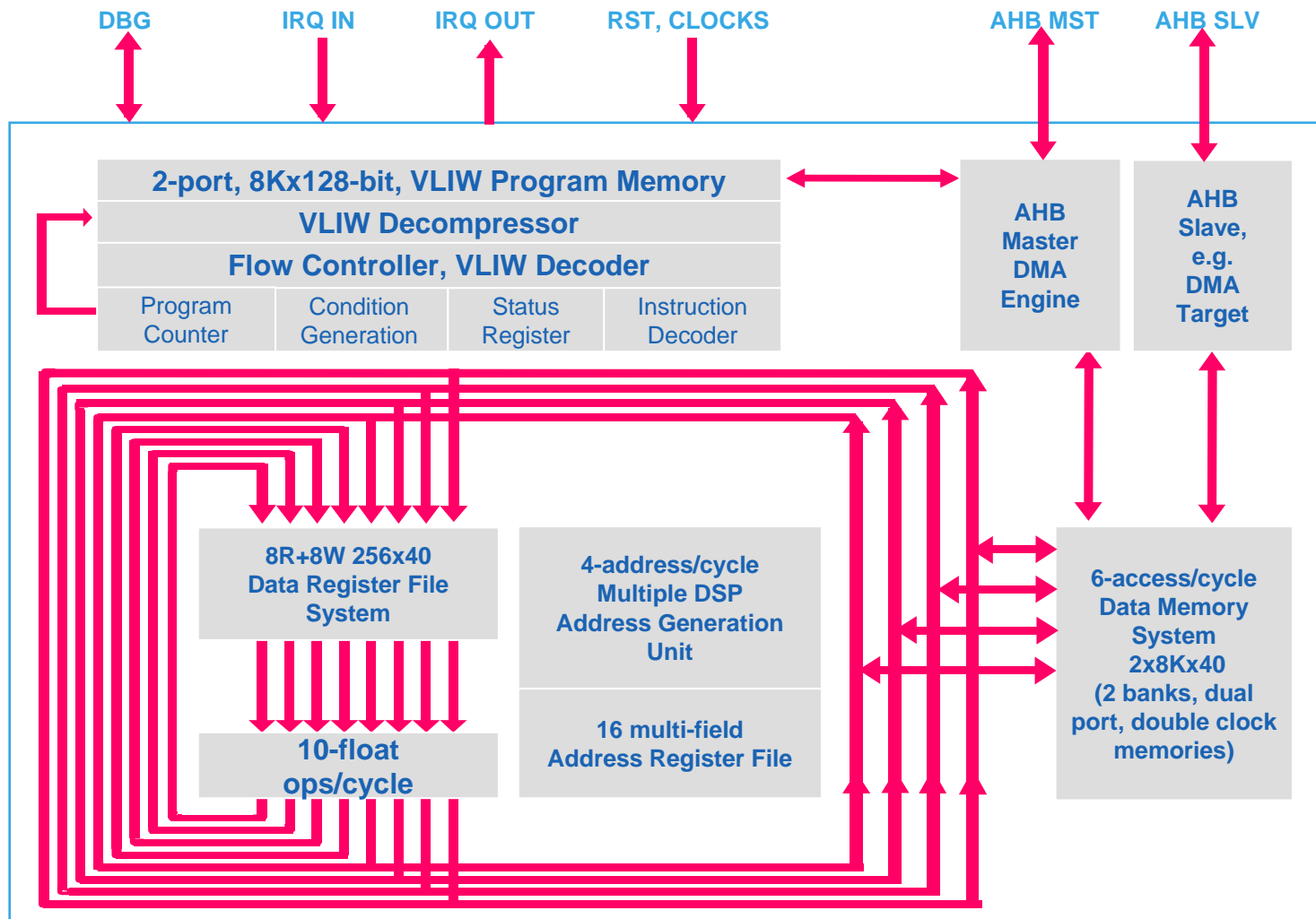
# S\_LEON2-FT Sparc V8 2/2



- C programmable VLIW DSP
- Floating point 32 / 40 bit
- Up to 10 floating point operations per cycle
  - 1.5 GFLOPS @ 150MHz in 90nm (target for DSP\_Leon2FT)
- 2 address generation units, 4 memory accesses per cycle
- 6 port memory system allowing concurrent computation and data move
- Float – vector – complex native data type support
- Program Memory Management Unit (PMU). PM cache
- DMA engine supporting stridden memory accesses
- AMBA AHB master and slave bus interface
  
- C callable optimized functions, written in C
  - Functions can be modified and adapted if needed
- More than 200 functions available, covering all the basics of DSP
- All the functions works on array

# DSP\_LEON2-FT Sparc V8

2/2



## mAgic DSP Architecture

# Product development Plan

B\_Leon2FT Sparc V8  
On-chip Amba Bus  
U to 150Mips  
Numerous Features  
and interfaces

Leon2FT Sparc V8  
+ DSP  
1.5Gflops @150MHz



S\_Leon2FT Sparc V8  
Low power few Mips  
SpaceWire Link

Dualcore Sparc V9  
Multicore Sparc V9  
+ DSP



**Thank You**