ALCATEL ALENIA SPACE

Next Generation Microprocessors for Space Applications

Requirements Review

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Applications and Performances

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Three categories identified:

- a) "Low" Performance (< 100 MIPS)
 - Any application fulfilled by Leon2-FT performances

b) "Medium" Performance (~ 300/400 MIPS)

- Future generation Control & Data Handling and GNSS processing
- Wide range of Payloads On-Board Processing:
 - Scientific Payloads
 - Radar Type Instruments
 - **Telecom Systems**

c) High and Very High Performances (GFLOPS Class)

- Remote Sensing Instruments On Board Processing
- Science Payloads On Board Processing
- **Telecom Payloads On Board Processing**

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General Development Guidelines

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- A common solution for C&DH and Medium performance Payloads to be pursued
- Commonality between Low and Medium Performances categories
- Commonalties with High/Very High Performances category to be investigated:
 - 1. Multiprocessing architectures based of the same Processing Core
 - 2. Alternatives based on High Performance DSPs or other CPU (e.g. COTS with fault mitigation techniques)
- Development of Memory devices (in particular high speed / high density SRAM) to be addressed in parallel to µProcessor development

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Space Application General Requirements

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- TID Tolerance
 - > 100 Krads
- LU immunity
- SEU/SET Tolerance
 - FT-Design
 - SEE circumvention techniques
- Availability at Grade-1 and Grade-2 quality level
- EUROPEAN Suppliers (HW and SW)
- Second Source Supplier highly desirable as a minimum device long term availability shall be ensured
- Low Power Consumption

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Power Consumption

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Processor	Technology	Application	D-MIPS @ MHz	Power	MIPS/W
TSC695F (ERC32SC)	CMOS-RH 0,5µm	Space	17MIPS @ 24MHz	> 1 W	~ 15 (*)
AT697E (Leon2-FT)	CMOS-RH 0,18µm	Space	85MIPS @ 100MHz	~ 1 W	~ 85
RAD750	CMOS-RH 0,25µm	Space	260MIPS @ 132MHz	~ 5 W	~ 52
PPC603e	CMOS 0,29µm	Comm.	300MIPS @ 266MHz	~ 3,5 W	~ 85
PPC7410	CMOS 0,18µm	Comm.	917MIPS @ 500Mhz	~ 5,3 W	~ 173
PPC7447A	CMOS-SOI 0,13µm	Comm.		- 10 W	- 220
PPC7448	CMOS-SOI 0,09µm	Comm.	2310MIPS @ IGHZ	~ 10 W	~ 230

(*) Actual ratio is much worse, considering Power Consumption due to continuous external RAM accesses (no Caches)

Goals for Next Generation Processor could be set to:

- Performance: up to 400 MIPS/MFLOPS @ tbd MHz
- Technology: CMOS-RH (0,13 μm or less)
- Power Consumption: < 2 W at full speed (package with low thermal resistance)</p>

\rightarrow MIPS/Watts ratio: > 200

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Architecture and Features

Based on a Standard, consolidated and popular, architecture
Features to improve performances:
 Superscalar implementation
 Pipelined / Superpipelined implementation
Large Caches
High Performance FPUs
 Fast trap handling and context switching
 Interface to external co-processors
High Speed Serial Links
•
Debug Support features (including caches visibility)
Other e.g.
• MMU / BPU
 Supervisor protected mode for OS support
• possibility to reduce external memory bus size (e.g. 32 to 16) to save memory
costs where possible (especially in view of 16Mbits SRAM)
DDR/DDR2-3 Controller
Flash Controller

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Software Development Issues

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- Development to be phased with Hardware Development, to ensure availability in correspondence to hardware
- Tools Qualification and Maintenance shall be foreseen
- Qualification according to Space Projects Requirements
- ARINC-653 Compliance
- Fully comprehensive set of tools to be made available and maintained:
 - Compilers
 - Simulators
 - Debuggers
 - Operating Systems
 - ...
- Ease porting of Software from previous applications
- Compilers Optimised to exploit Hardware capabilities
- Comprehensive environments to support different applications
 - Control & Data Handling (considering also combined C&DH and GNSS processing)
 - Pure Processing (e.g. PL Processing)



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Hardware Availability

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Monolithic Device

- Embedding widely used Interfaces (e.g. SpaceWire, including Routing)
- Extension bus through High Speed Serial links preferred to parallel solution (like PCI)

■ IP Core:

- Soft and Configurable
- All Building Blocks Options shall be available and certified (including test benches)



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