"MCFlight™ - “MULTICORE” platform based chipset with SpaceWire links for distributed Aerospace systems

Tatiana Solokhina, Yaroslav Petrichkovich, ELVEES RnD Center (Moscow)

Yuriy Sheynin, St. Petersburg State University of Aerospace Instrumentation, “Microprocessing Technologies”

www.multicore.ru
AGENDA

- ELVEES’s market segments
- “MULTICORE” Platform
- MCFlight Chipset parameters
- The MCFlight on-board system example
- Conclusions
ELVEES market segments

ELVEES proprietary SOC Platform “MULTICORE” with “silver/gold” IP-cores

Embedded, space & security systems

Application specific chipsets for Telecommunications & Aerospace
ELVEES’s proprietary “MULTICORE” SOC/ASIC design Platform

Applications

Software Tools

Algorithms

SOC DESIGN TECHNOLOGY

HARD

Architecture

IP-CORES LIBRARY

6-9 MONTHLY DESIGN FLOW

Chips examples
ELVEES’s “MULTICORE” platform main differences

- **Programmability:**
  - Very short program code (in the 8-10 time (vs. ADI and TI DSP Chips);
  - Powerful module SW/HW Tools (MCStudio™);
  - 4 groups programmable IP-Cores;

- **Scalability and flexibility at the levels of:**
  - IP-cores - SIMD/MIMD/ pipeline/ superscalar IP-cores extensions;
  - Chips - multiple processors on the single silicon (nRISC + kDSP + 1 SDR-cores + m Reconfiguration-cores);
  - Systems: multidimensional systems configurations on the base SpaceWire and Serial Rapid IO standards (as RIO Trade Ass. Member);

- **Only commercial CMOS technologies** (for analog, RF - microcircuits and radiation tolerant chips);

- **Proprietary “Gold” and “Silver” IP-cores Library**
  SOC integration in Chips and World level of IC characteristics (Hundreds GOPs, Tens GFLOPs)
MULTICOR IP-Cores Library groups
(Programmable IP-CORES)

- Programmable/Innovative/Special
- Reconfigurable/DSP
- Programmable/Innovative/RF
- Programmable/Innovative/Analog

Under the Project

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### “MultiCore” - the 1-st in Russia Digital Signal Controllers (DSC) chipset

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
<th>MFLOP/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecommunication processor</td>
<td>100 MHz</td>
<td>300 MFLOP/s</td>
</tr>
<tr>
<td>Digital SDR-receiver</td>
<td>100 MHz</td>
<td>600 MFLOP/s</td>
</tr>
<tr>
<td>Multimedia processor</td>
<td>120 MHz</td>
<td>1440 MFLOP/s</td>
</tr>
<tr>
<td>LF/MF/HF/UHF transceiver</td>
<td>120 MHz</td>
<td>1440 MFLOP/s</td>
</tr>
<tr>
<td>DDS, 1 GHz</td>
<td>400 MHz</td>
<td>10 GFLOP/s (EE)</td>
</tr>
</tbody>
</table>

### “MCFlight” - the 1-st in Russia chipset with Space Wire Links (ELVEES&MiT)

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
<th>Description</th>
<th>Frequency</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC-24R, DSP-controller</td>
<td>100 MHz</td>
<td>MCB-01, 4ch SpaceWire/PCI adapter</td>
<td>100 MHz</td>
<td>600 MFLOP/s</td>
</tr>
<tr>
<td>MCK-01, 16ch Space Wire Router</td>
<td>120 MHz</td>
<td>MCT-01, SpaceWire Remote controller</td>
<td>120 MHz</td>
<td>64-bit FPU</td>
</tr>
<tr>
<td>RAM –R,</td>
<td></td>
<td></td>
<td></td>
<td>4 Mb</td>
</tr>
</tbody>
</table>
MC-24R – 600GFLOPs
DSP-controller with SpaceWire Links
MC-24R parameters (preliminarily)

- 0.25-u;
- 2 channel SpaceWire, ECSS-E-50-12° standard;
- data rate – 2 – 400 Mbps thought the cables and connectors specified by standard;
- embedded LVDS ANSI/TIA/EIA-644(LVDS) transceivers;
- two-cores MIMD architecture with the dual processor cores:
  - RISC core (MIPS32-64FP based on “MULTICORE” IP library) with 64 bit accelerator in IEEE754 FLP standard;
  - DSP ELcore18 core, 200 MHz;
- peak performance - 600 MFLOPs;
- power consumption control;
- radiation tolerant for aerospace applications;
- package - HSBGA416 (for the engineering samples)
## ELVEES “MultiCore” vs. with the TI&ADI DSP chips

<table>
<thead>
<tr>
<th>Performance description</th>
<th>ELVEES</th>
<th>Texas Instruments</th>
<th>Analog Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MC-24 100 MHz</td>
<td>MC-0226 120 MHz</td>
<td>MC-0428 400 MHz</td>
</tr>
<tr>
<td>Peak performance, formats:</td>
<td>1 600 600</td>
<td>3 840 2 880</td>
<td>28 800 10 800</td>
</tr>
<tr>
<td>• 16b FP ( MIPS)</td>
<td>99.8</td>
<td>41.6</td>
<td>5.6</td>
</tr>
<tr>
<td>• 32b FLP ( MFLOPS)</td>
<td>57.6 103.2</td>
<td>28.8 51.6</td>
<td>3.2 5.8</td>
</tr>
<tr>
<td>FIR-filter, 35 taps<em>1024 (mcs): INT 16</em>16+32</td>
<td>0.6</td>
<td>0.3</td>
<td>0.04</td>
</tr>
<tr>
<td>FFT-1024, complex (mcs):</td>
<td>200</td>
<td>480</td>
<td>3 600</td>
</tr>
<tr>
<td>• block FP(16+j16)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 32b FP (32+j32)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCT-8x8, 16b (mcs):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACS-operations, MOPS: (for Viterbi decoder, 16b)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MCT-01 (SpaceWire Remote controller)

- CPU
  - JTAG
  - On chip debugger (OnCD)
- UART
- TIMERS
  - Interrupt controller
- Flash
- SRAM
- SDRAM
- IO
- SpaceWire interface
- AMBA AHB
- Switch
  - UART
  - TIMERS
  - Interrupt controller
- Dual-port RAM
- 4 channel ADC
- 4 channel DAC
- MPORT DMA
- PLL
- SWIC
- AXI Switch
- GPIO
- 4 channel ADC
- FPU
- On chip debugger (OnCD)
- RISCorE
- PLL
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MCT-01 parameters (preliminarily)

- 0.25-μ;
- 2 channel SpaceWire, ECSS-E-50-12A standard;
- data rate – 2 – 400 Mbps thought the cables and connectors specified by standard;
- embedded LVDS ANSI/TIA/EIA-644(LVDS) transceivers;
- RISC core (MIPS32-64FP based on “MULTICORE” IP library) with 64 bit accelerator in IEEE754 floating point standard;
- peak performance - 120 MOPs in 32 bit fix point format;
- option - embedded 4 channel ADC and DAC, 1 MHz
- test examples are manufactured, tested and verified comparing with and an international implementation of SpaceWire;
- Radiation Tolerant for mass production chips samples;
- package – QFP240 (for the engineering samples)
Tools: SDK (MCStudio) for Digital Signal Controllers (DSC) – MC-24R and MCT-01

SW Tools & Application Software Library & algorithms
Experiment in compatibility European/Russian SpaceWire implementation

ELVEES SpaceWire
MCT-01 module

STAR – Dundee SpaceWire USB Brick

Up to 10m, up to 200 (400Mbps)
MCB-01 (1892XD1Я) - 4-channels SpaceWire/PCI adapter for MultiCore Chipset enhancement

1.5 GFLOPs 4-Channel Processor Element with SpaceWire Links

1.5-10 GFLOPs MultiCore DSC + MCB-01

DSC MCB-01

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MCB-01 parameters (preliminarily)

- 0.25-μ;
- 4 channel SpaceWire, ECSS-E-50-12A standard;
- data rate – 2 – 400 Mbps thought the cables and connectors specified by standard;
- embedded LVDS ANSI/TIA/EIA-644(LVDS) transceivers;
- PCI (32 bit/33-66 MHz), Local Bus Specification. Rev. 2.2.;
- 32b parallel port to Multicore chipset or others processors;
- embedded SRAM, 2Мбит (64KWх32b)
- package - HSBGA416 (for the engineering samples)
MCK-01 (1892XD2Я)-
16-channels SpaceWire Router with embedded RISC-Core

Up to 4GB SDRAM
MCK-01 parameters (preliminarily)

- 0.25-u;
- 16 channel SpaceWire, ECSS-E-50-12A standard;
- data rate – 2 – 400 Mbps through the cables and connectors specified by standard;
- support of signal, symbol exchange, packet and network stack protocols of SpaceWire;
- embedded LVDS ANSI/TIA/EIA-644(LVDS) transceivers;
- embedded MIPS32 compatible RISC core (based on “MULTICORE” IP library) used for the configurable port service and administration of communication networks;
- 32 bit parallel port for “MULTICORE” chipset connections or for the additional external memory;
- Embedded RAM (25 Kbytes): program and data memory for RISC core (16 Kbytes), packet memory (8 Kbytes), routing memory (1Kbyte);
- Radiation Tolerant for aerospace applications
- package - HSBGA416 (for the engineering samples)
RAM for MCFlight chipset applications parameters (preliminarily)

- SRAM 4 Mbit (512KW*8b); T = 15 ns
- matched to “MULTICORE” DSC chipset, including MC-24R
- radiation tolerant for aerospace applications;
- package - HSBGA416 (for the engineering samples)
Main ELVEES technologies for chips & systems

- “Soft Defined Radio” for transceivers,
- Adaptive signal processing;
- Image processing & Multimedia & 3D graphics (compression, recognition, OpenGL support);
- Multistandard reprogrammable Global positioning and telecommunications (chipset, algorithms “soft” realization);
- Cryptographic methods and units;
- Radiation tolerant chipset and technologies for aerospace on-board systems with SpaceWire Links (MCFlight)
ELVEES’s technologies (chips, SW APPS Library, application systems) for image & Signal processing as a potential for perspective MCFlight based aerospace systems.

- SDR based “MultiFlex”
- 3D graphics
- Image Processing («Orwell 2k»-Intellectual systems of video observation)
- Adaptive signal processing
- Multimedia & Telecommunications (Apps Software Lib)
- Signal Processing (ELVEES Radar)
- Networks information security
“MULTICORE” - RUSSIAN INNOVATIVE VLSI DESIGN PLATFORM
Unified aerospace board on the base of SpaceWire standard
**SMALL SATELLITE BASED RADAR WITH ON-BOARD IMAGE SYNTHESIS FOR ECOLOGICAL MONITORING**

<table>
<thead>
<tr>
<th>Mode 1: continuous very large swath width for large scale observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>Width dimension</strong> – 630 kilometers</td>
</tr>
<tr>
<td>- <strong>Linear resolution</strong> – 200 meters</td>
</tr>
<tr>
<td>- <strong>Grid step for radar image</strong> – 100 meters</td>
</tr>
<tr>
<td>- <strong>Number of non-coherent accumulations</strong> – 4</td>
</tr>
<tr>
<td>- <strong>Number of elevation rays</strong> – 8</td>
</tr>
<tr>
<td>- <strong>Number of MC-24R chips</strong> – 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode 2: separate frames, high resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>Frame dimension</strong> – 10 kilometers x 10 kilometers</td>
</tr>
<tr>
<td>- <strong>Linear resolution</strong> – 3 meters</td>
</tr>
<tr>
<td>- <strong>Grid step for radar image</strong> – 2.5 meters</td>
</tr>
<tr>
<td>- <strong>Number of non-coherent accumulations</strong> – 4</td>
</tr>
<tr>
<td>- <strong>Number of elevation rays</strong> – 1</td>
</tr>
<tr>
<td>- <strong>Period of surveying (including processing)</strong> – 25 seconds</td>
</tr>
<tr>
<td>- <strong>Number of MC-24R chips</strong> – 8</td>
</tr>
</tbody>
</table>
Conclusions

1. The engineering samples of MCFlight - “MULTICORE” platform based chipset (0.25-u) with SpaceWire links for distributed aerospace systems have been received and its functionality is proved on the HW modules;

2. ASICs and FPGA SpaceWire Links provide up to 400 Mbps and higher throughput (>5m) in the cross modules connections;

3. Chipset provides a lot of the innovational features and supports high performance, programmability, scalability, flexibility and only commercial CMOS technologies;

4. A lot of ELVEES ‘s technologies for “MULTICORE” platform (SDR, Adaptive signal/image processing, 3D graphics, Networks information security, multimedia, Intellectual systems of video observation) will be transferred on the MCFlight chipset;

5. MCFlight can be easily modified (during 6-9 months) by others platforms IP-cores (for example, for SPARC RISC core) or for others interfaces

6. Chipsets Radiation Tolerant features are measured at the present moment and will be provided for mass production MCFlight chips at the end 2007 - the beginning of 2008 years
Thanks for your interest!

Questions?
ELVEES TEAM

www.elvees.ru
E-mail: secretary@elvees.com
FAX/TEL +7(495)-913-31-88