CloudBEAR
Processor IP product line
## Products

Configurable and extensible 32/64-bit RISC-V cores

<table>
<thead>
<tr>
<th>BM Series</th>
<th>BI Series</th>
<th>BR Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM-310 RV32IMC</td>
<td>BI-350 RV32IMAC[F]</td>
<td>BI-651 RV64GC</td>
</tr>
</tbody>
</table>

**BM Series**
- Microcontroller core
- 500MHz@28nm HPC
- 250MHz@40nm LP

**BI Series**
- Linux capable application cores
- Multi-core support
- Instruction/Data caches
- 1.5 GHz+@28nm HPC+
- 1 GHz+@40nm G

**BR Series**
- Compute/real-time cores
- Instruction/Data caches
- I-TCM and D-TCM
- Fast context switch
- 1.5 GHz+@28nm HPC+

**IoT SoC**
- Sensors
- Smart Meters
- Accelerator control
- Wearables

**Advanced IoT nodes, gateways**
- Automotive
- Artificial intelligence
- Industrial automation
- Storage applications
- Networking applications

**High performance ctrl**
- Baseband control
- Modem L2/L3 processing
- Low latency networking
- SSD controllers
- Compute/Accelerator
BM-310
Embedded microcontroller core

- Small, Low power microcontroller
- RV32IMC
- Machine/User privilege levels
- 3-stage pipeline
- Interrupt controller (default 31 int, 8 prio)

Performance using GCC 8.2 (per MHz)

<table>
<thead>
<tr>
<th>Coremark</th>
<th>GHz</th>
<th>SiFive E21</th>
<th>CloudBEAR BM-310</th>
<th>ARM Cortex-M4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhrystone</td>
<td>MHz</td>
<td>CloudBEAR</td>
<td>SiFive E21</td>
<td>ARM Cortex-M4</td>
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<tr>
<td></td>
<td></td>
<td>BM-310</td>
<td>E21</td>
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<table>
<thead>
<tr>
<th>AMBA interface</th>
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</thead>
<tbody>
<tr>
<td>TSMC 40LP, 9t</td>
</tr>
<tr>
<td>Frequency @ worst</td>
</tr>
<tr>
<td>Complex area (w/o TCM)</td>
</tr>
<tr>
<td>Worst setup corner</td>
</tr>
</tbody>
</table>

Crossbar
System Port
Debug
PLIC
CLINT
I-TCM
D-TCM
BM-310 core
iOS
JTAG
IRQs
Debug tools

- Eclipse IDE
- Open OCD
- RISC-V

Digilent JTAG-HS3

Open-source

LAUTERBACH DEVELOPMENT TOOLS

SEGGER

TRACE32 Debugger for RISC-V

CloudBEAR
BI series
Linux capable application cores

**BI-350**
RV32IMAC[F]
32-bit Tiny Linux capable core targeting IoT applications
Compares with ARM A5, A7

**BI-651**
RV64GC
64-bit Linux capable core targeting high performance in power constrained environment
Compares with ARM A53, A55

**BI-671**
RV64GC
64-bit Mid-range application core for maximum single thread performance
Compares with MIPS P5600
BI series core complex
Linux capable application cores

- RV64GC
- 10 stage pipeline
- Multi-core fully coherent configuration
- Machine/User/Supervisor modes
- 32 KiB 8-way I/D caches
- L2 cache 1-2 MiB
- Debug module
- Platform Level Interrupt Controller (default 128 int, 8 prio)
- Coherency controller for maintaining coherency with peripherals and accelerators
Preliminary data collected on FPGA prototype

SPEC2006 INT

CloudBEAR

Baikal-T1

BI-671@1.5GHz

MIPS P5600@1.2GHz
BI-671 customer design win

- SoC targets industrial applications and IoT gateways
  - PCIe, Camera, LCD, Eth, CAN, UART, SPI, GPIO, I2C, I2S, NAND
- Optimized for licensed by customer memory compiler and standard cells
- CloudBEAR is providing design services for the customer SoC integration
Preliminary data collected on FPGA prototype.
Area efficiency

Core relative area

<table>
<thead>
<tr>
<th></th>
<th>Single issue</th>
<th>BI-651</th>
<th>BI-671</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>1.12</td>
<td>1.34</td>
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</table>

Relative performance

<table>
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<tbody>
<tr>
<td>1</td>
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<td>1.4</td>
<td>1.79</td>
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</table>

Dual core + L2 1 MiB relative area

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<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1.06</td>
<td>1.16</td>
</tr>
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</table>

Legend:
- Dhrystone
- Coremark
- SPEC2006 INT GEOM
Customization and services

• Baseline cores could be customized according to customer needs
• Support SoC integration
• Adding custom instructions to improve performance on specific workload