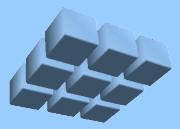
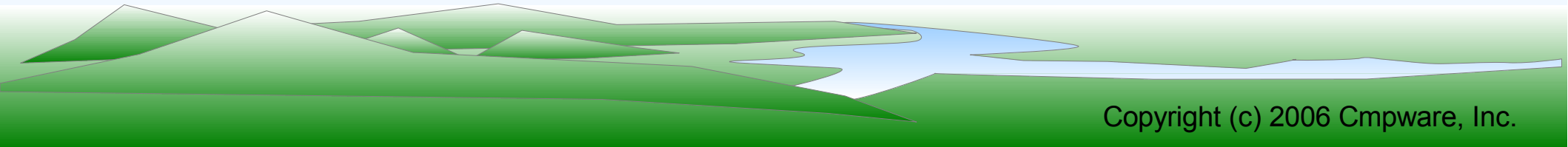
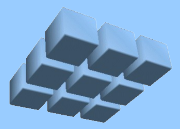


Extending Processor Models in the *Cmpware CMP-DK*

Steven A. Guccione
Cmpware, Inc.

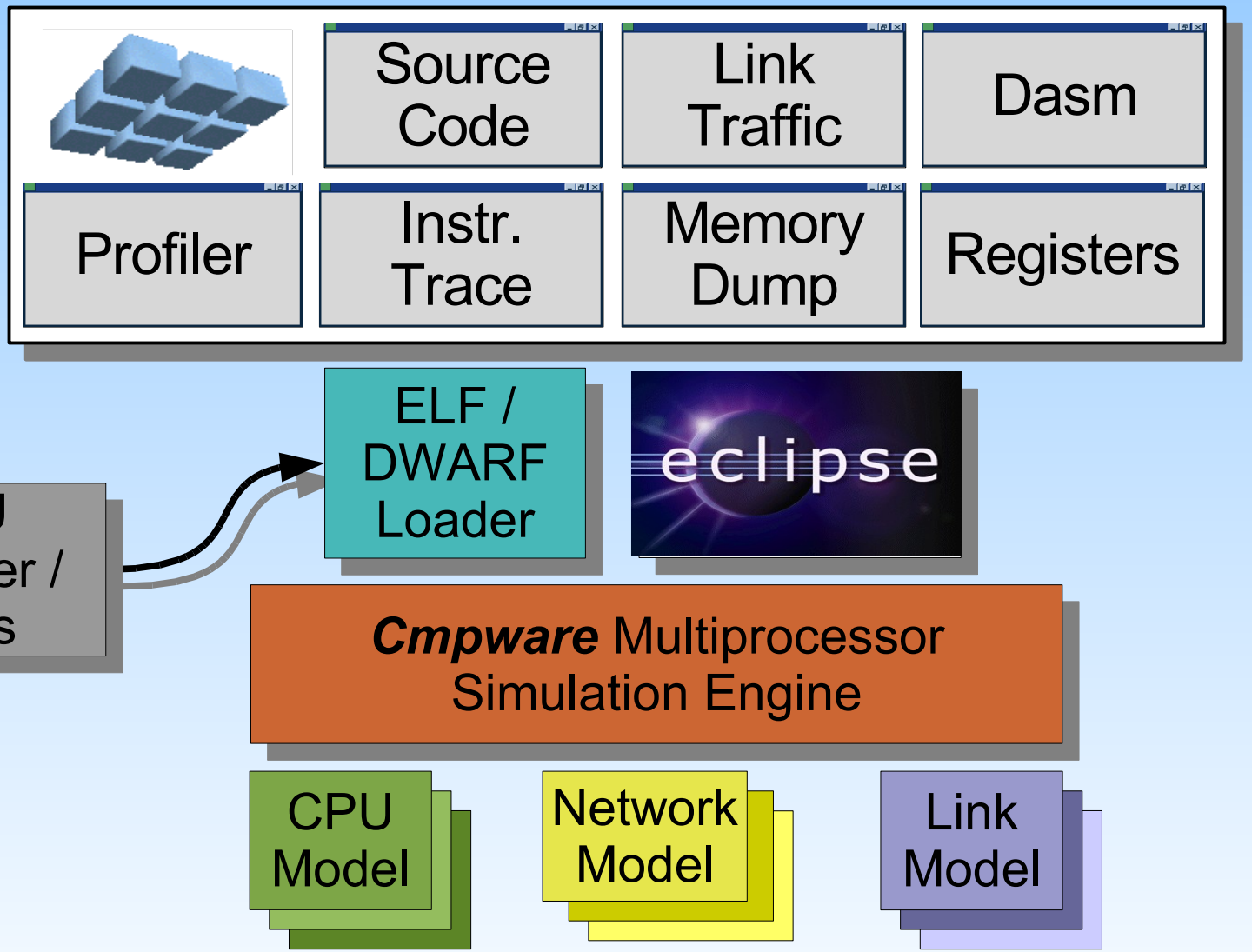


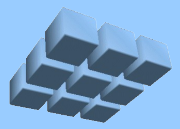


The *Cmpware CMP-DK*

- Multiprocessor / multicore software and architecture development environment
- A powerful interactive software development
- Fast, flexible modeling
- CPU model 'plugs in' to provide rich set of displays and tools
- Integrates with existing compilers (gcc)
- Eclipse based

The *Cmpware CMP-DK*

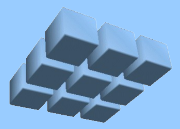




Extending the *Processor* Model

- New models can ***'inherit'*** existing models
- New instructions easily added
- Other functionality easily added, too
- A new model with new instruction in approximately 5 lines of code (;)
- Models can be mixed (heterogeneous)

==> *A powerful way to explore customized processors / multiprocessors*



The *MIPS32EX* Extended Model

```
public class MIPS32EX extends MIPS32 {

public static void main(String[] args) {
   AutoModel.main(new MIPS32EX(), args);
   }  /* end main() */

/** The constructor */
public MIPS32EX() {
   defineName("MIPS32EX");
   defineInstructions(newInstructions);
   reset();
   }  /* end MIPS32EX() */

/** The XNOR instruction */
private final class XNOR implements Function {
   public void exec(Processor p) {
      r[rd] = ~(r[rs] ^ r[rt]);
  }  /* end exec() */
}  /* end class XNOR */

/** The XNOR instruction decode information */
private final static Decode newi_decode = Decode.primary(op, 0x18);

/** The new XNOR instruction definition */
private final Instruction newInstructions[] = {
   new Instruction("xnor", regToReg, newi_decode, new XNOR())
   };

}  /* end class MIPS32EX */
```

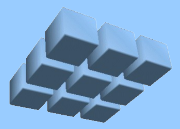
MIPS32EX '**extends**' *MIPS32*

Add new instruction(s)

Define new XNOR instruction

Define XNOR decode

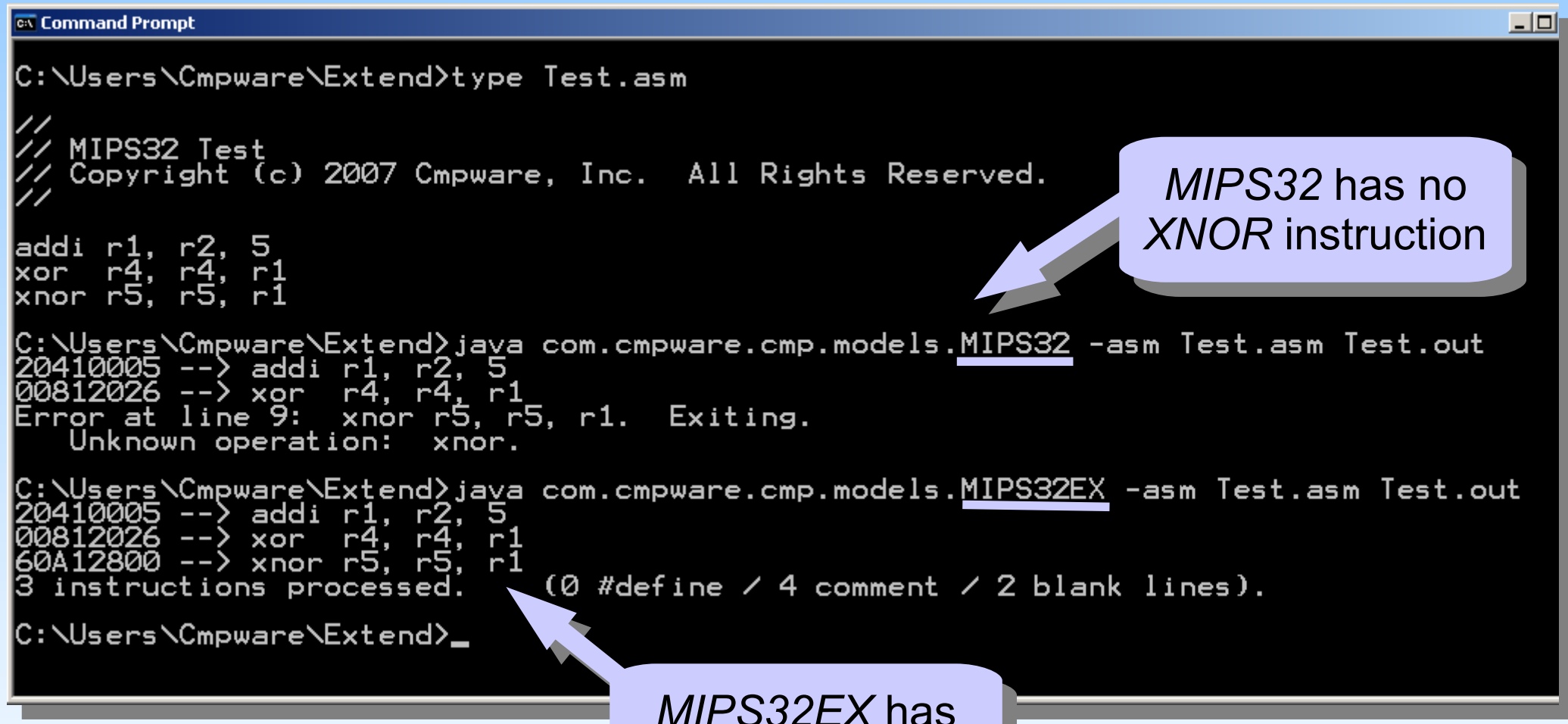
The new instruction definition(s)



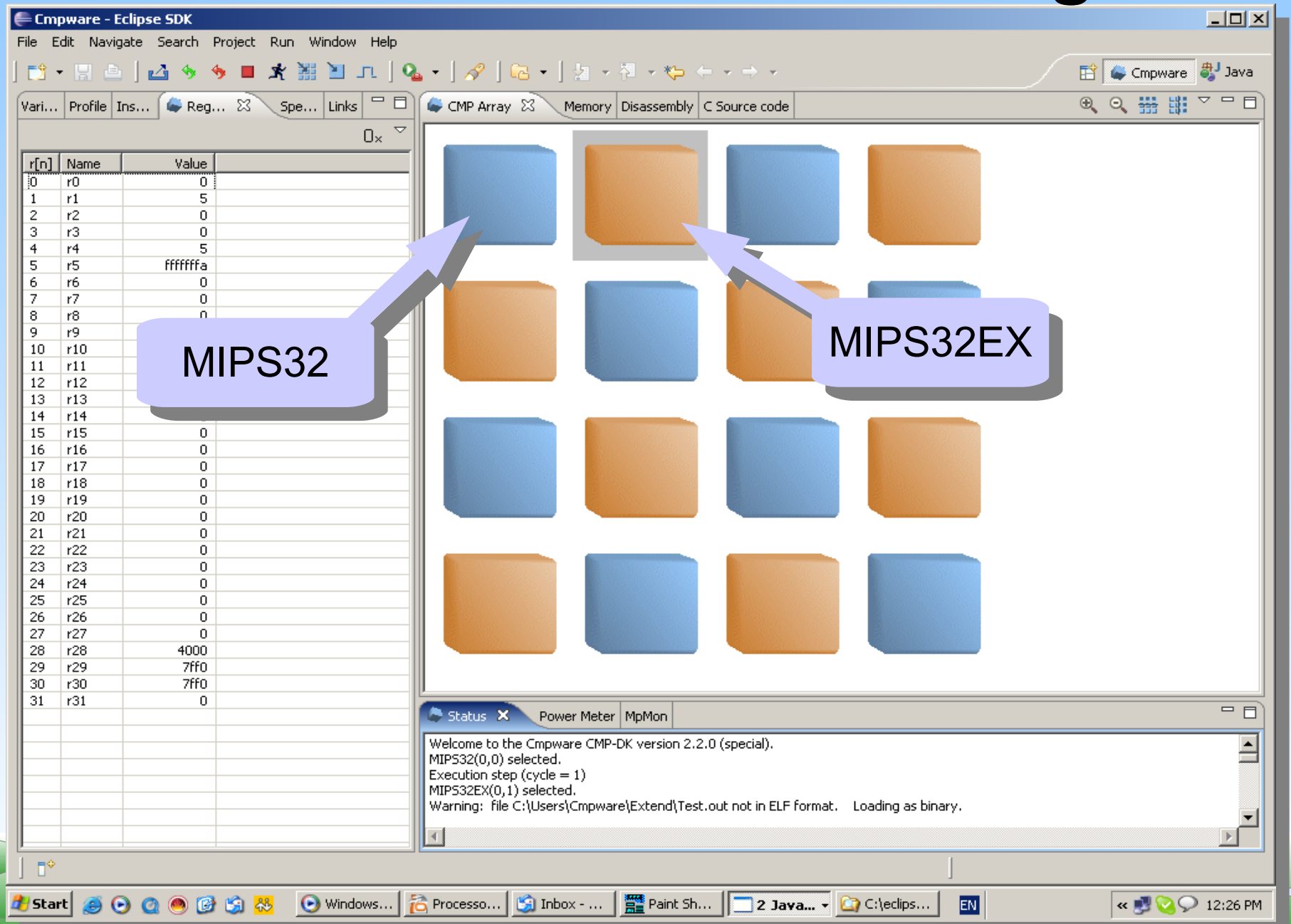
Model-Driven Tools

- Assembler and disassembler automatically extracted from model data
  - Assists in verifying new models
  - Tools always in sync with architecture
  - Can be integrated into other tools
- 'Free' tool support for extension instructions
- Example:
  - *XNOR* instruction added to *MIPS32*
  - Produces *MIPS32EX* model assembler / disassembler

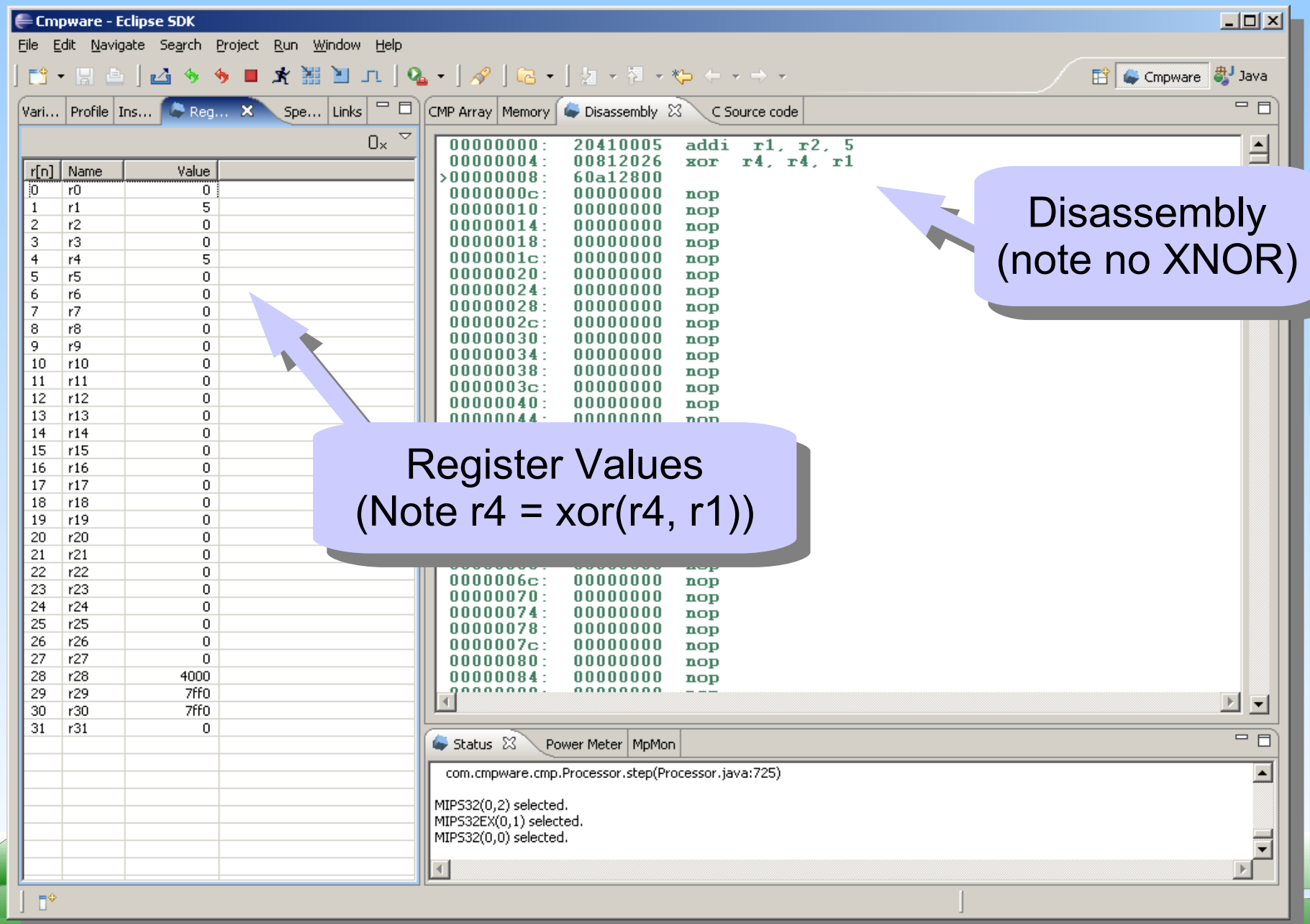
Model-Based Assembler / Disassembler



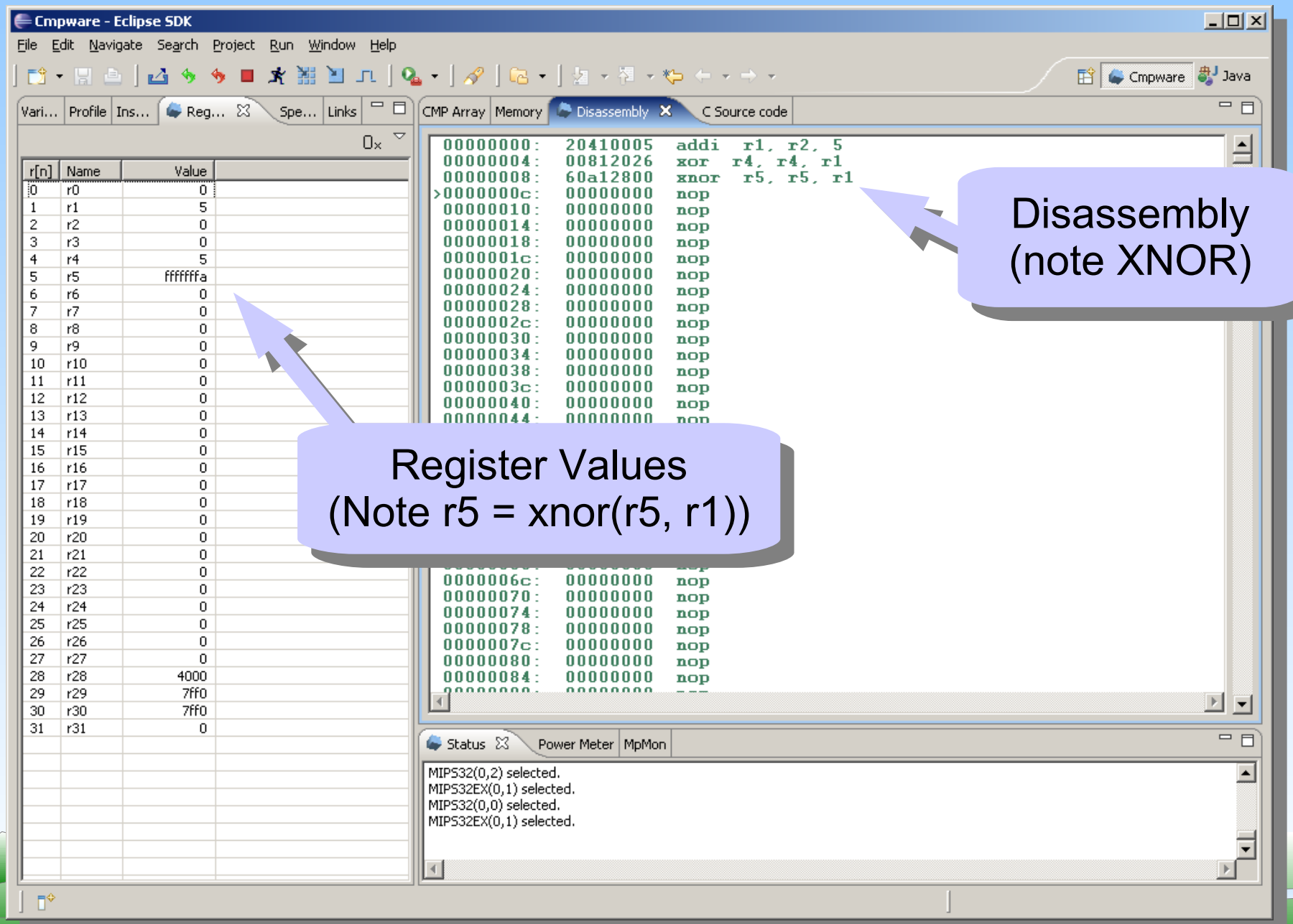
A *MIPS32EX* + *MIPS32* Design

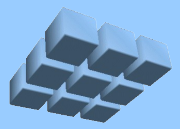


The *MIPS32* Processor



The *MIPS32EX* Processor





Conclusions

- Processor models for the *Cmpware CMP-DK* easily extended
- Extended models provide:
  - Assembler
  - Disassembler
  - IDE integration

==> Customized processors and tools easily produced and modified