

# Automatic Porting of BFD Library

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System-on-Chip for Real-Time Applications

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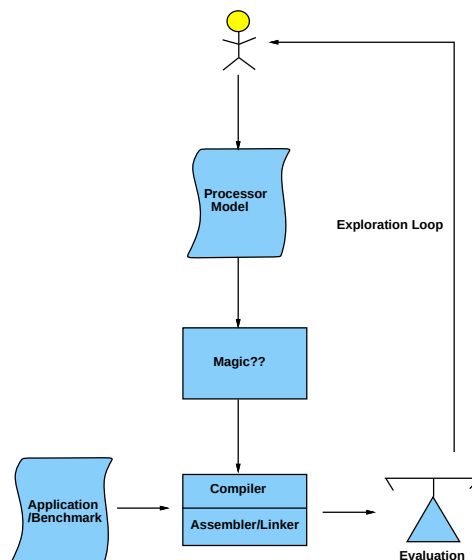
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## Motivation

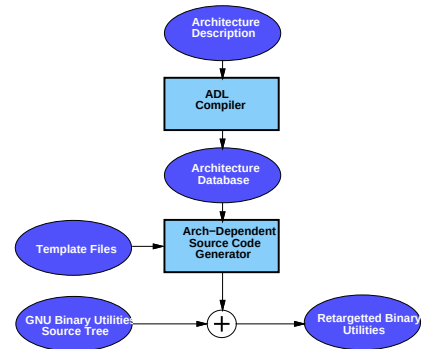
- System-On-Chip dominated by software
- Is software really cheap?
- Yes if development tools readily available
- *de facto* standard: GNU binutil package
  - A quarter million lines of code
  - Target-dependent interface not cleanly defined
  - John Levine: Backend gurus can be “packed in one single room”.



## Automatic Porting of Binary Utilities

- Bridge the gap between
  - Abstract architecture model of ISA and ABI
  - GNU's porting interface
- Template files
  - C, header, configuration, Makefile
  - Placeholder for substitution
- No change to GNU binutils distribution

### Retargeting binutils



## Implementation Statistics

### Our Tools

| Component          | #lines |
|--------------------|--------|
| Babel compiler     | 3538   |
| ISA plug-in        | 2124   |
| ABI plug-in        | 1474   |
| rbinutils          | 2785   |
| ISA/ABI data model | 207    |

### Processor specification

| Processor    | Beh (#lines) | ISA (#lines) | ABI (#lines) |
|--------------|--------------|--------------|--------------|
| SPARC        | 196          | 2300         | 56           |
| SimpleScalar | 90           | 1048         | 45           |
| Alpha        | 1144         | 4511         | 52           |
| I386         | 1234         | 20406        | 44           |



## Result: Retargeting SPARC

### ■ Generated BFD code

| File                 | #line |
|----------------------|-------|
| bfd/elf32-sparc.c    | 1899  |
| include/elf/sparc.h  | 114   |
| include/elf/common.h | 641   |
| bfd/archures.c       | 1088  |
| bfd/config.bfd       | 1093  |
| configure.in         | 838   |
| bfd/cpu-sparc.c      | 78    |
| bfd/targets.c        | 1243  |
| bfd/bfd-in2.h        | 3918  |
| config.sub           | 1449  |
| Total                | 12361 |

### ■ Generated ld code

| File                         | #line |
|------------------------------|-------|
| ld/Makefile.am               | 985   |
| ld/emulparams/elf32_sparc.sh | 12    |
| Total                        | 997   |

### ■ Generated opcodes code

| File                   | #line |
|------------------------|-------|
| include/opcode/sparc.h | 116   |
| opcodes/sparc-opc.c    | 2128  |
| opcodes/Makefile.am    | 658   |
| opcodes/configure.in   | 283   |
| Total                  | 3185  |

### ■ Generated gas code

| File                   | #line |
|------------------------|-------|
| gas/config/sparc-tmp.h | 521   |
| gas/config/tc-sparc.c  | 2436  |
| gas/config/tc-sparc.h  | 205   |
| gas/configure.in       | 984   |
| gas/Makefile.am        | 2280  |
| Total                  | 6424  |

### ■ Verification: SPEC2000



## Conclusion

- Formal architectural model: ISA and ABI
- Use typed, generic language as ADL
- Leverage open-source, production quality software
- More detail at our poster!

