
A small SOPC-based aircraft autopilot system that contains an FPGA with a Nios processor core, a DSP processor, and memory is seen above. The bottom sensor board contains a GPS receiver, an A/D converter, MEMS gyros and accelerometers for all three axes, an airspeed sensor, and an altitude sensor. Photograph ©2004 courtesy of Henrik Christophersen, Georgia Institute of Technology Unmanned Aerial Research Facility.

# Table 15.1 Features of Commercial Soft Processor Cores for FPGAs

| Feature | Nios II 5.0 | MicroBlaze 4.0 |
|---|---|---|
| Datapath | 32 bits | 32 bits |
| Pipeline Stages | 1-6 | 3 |
| Frequency | Up to 200 MHz[1] | Up to 200 MHz[4] |
| Gate Count | 26,000 – 72,000 | 30,000 – 60,000 |
| Register File | 32 general purpose & 6 special purpose | 32 general purpose & 32 special purpose |
| Instruction Word | 32 bits | 32 bits |
| Instruction Cache | Optional | Optional |
| Hardware Multiply & Divide | Optional | Optional |
| Hardware Floating Point | Third Party | Optional |

[1] This speed is not achievable on all devices for either processor core. Some FPGAs may limit the maximum frequency to as low as 50 MHz.

**Figure 15.1** The CAD tool flow for SOPC design is comprised of the traditional design process for FPGA-based systems with the addition of the Processor Core Configuration Tool and software design tools. In this figure, the program and data memory is assumed to be on-chip for simplicity.

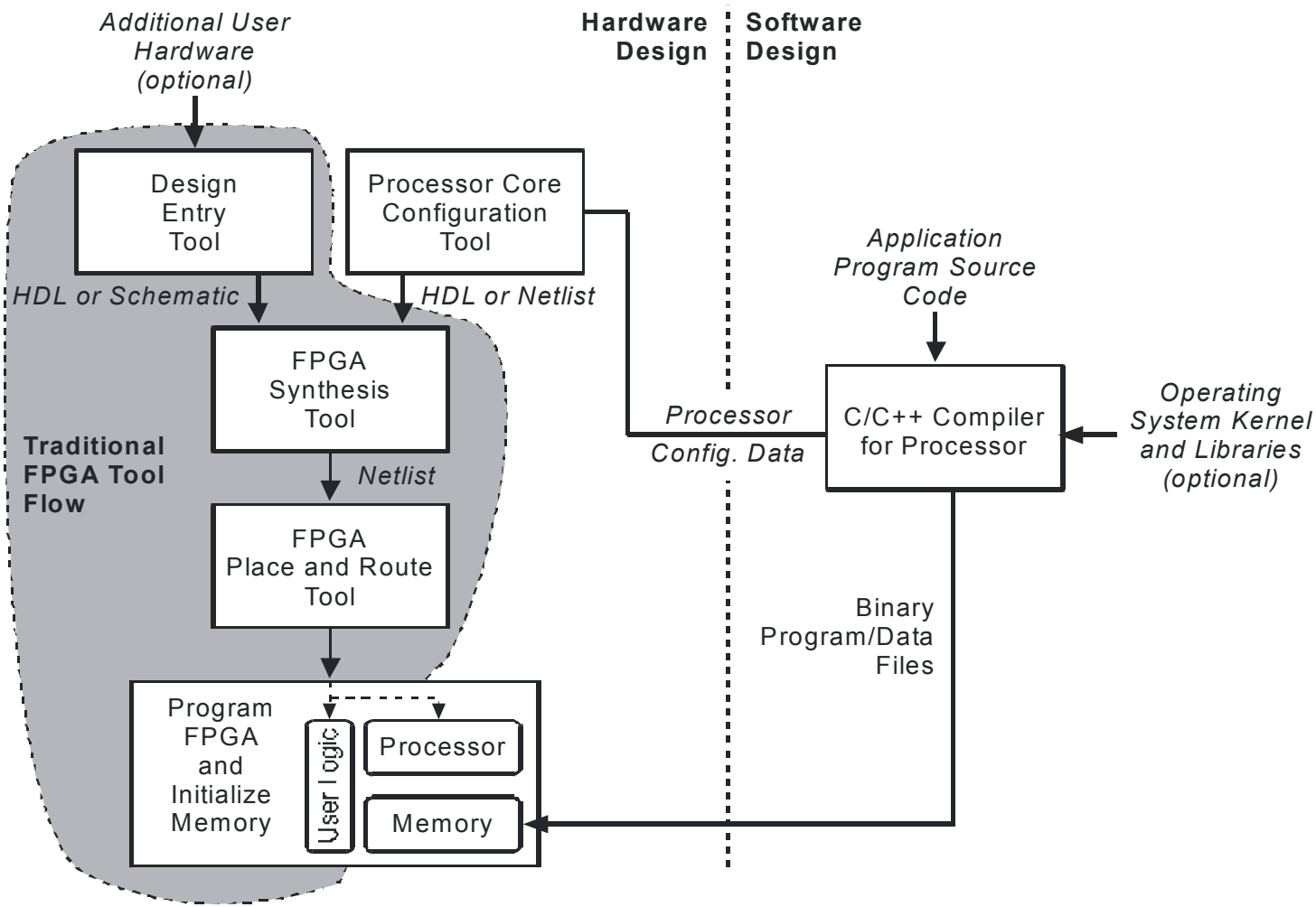
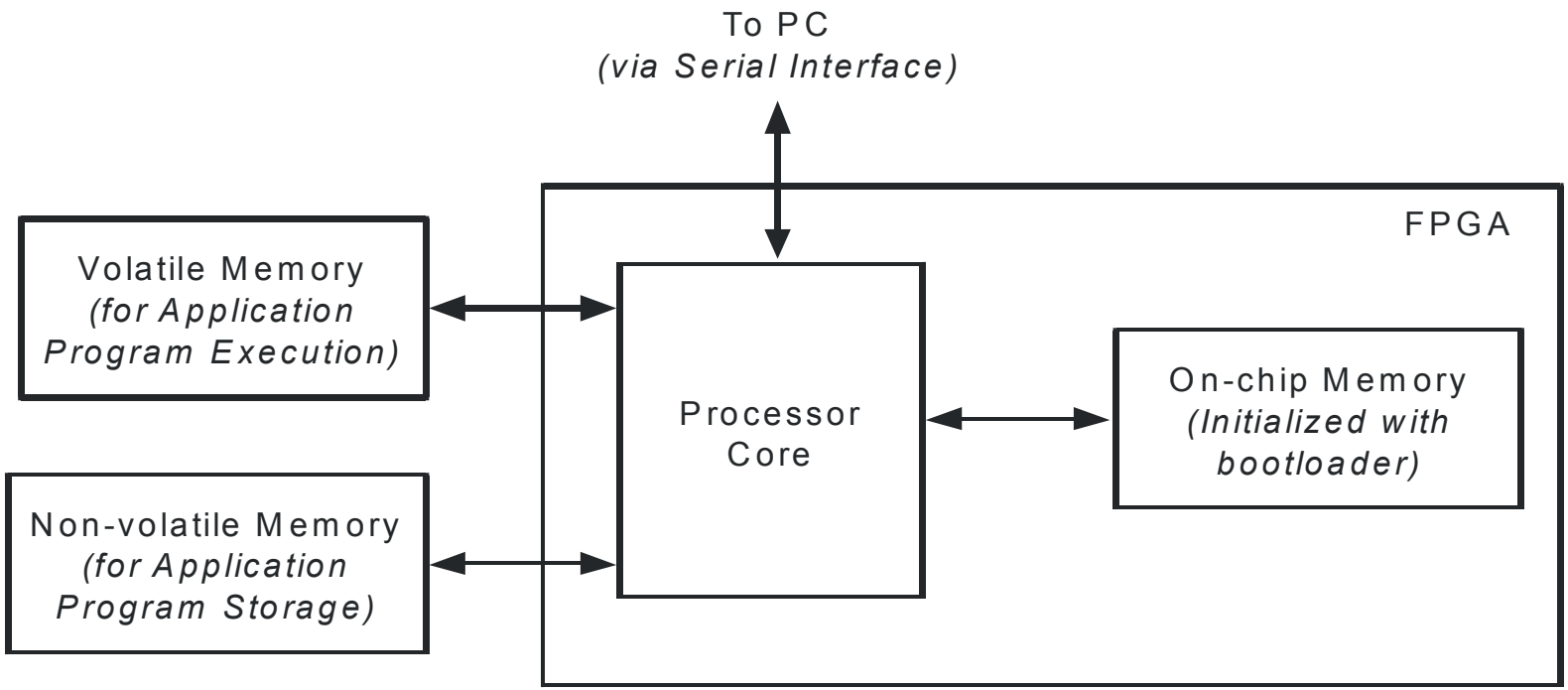


**Figure 15.2** This arrangement of on-chip and external memories provides flexibility and performance to an SOPC system.



# Table 15.2 Comparing SOPC, ASIC, and Fixed-Processor Design Modalities

| Feature | SOPC | ASIC | Fixed-Processor |
|---|---|---|---|
| S/W Flexibility | ● | ● | ● |
| H/W Flexibility | ● | ○ | ○ |
| Reconfigurability | ● | ○ | ○ |
| Development Time/Cost | ● | ○ | ● |
| Peripheral Equipment Costs | ● | ● | ○ |
| Performance | ⊙ | ● | ● |
| Production Cost | ⊙ | ●[1] | ● |
| Power Efficiency | ○ | ● | ● |

Legend: ● – Good; ⊙ – Moderate; ○ – Poor

[1] In very large quantities.