Coprocessing Datapath Generation in Configurable DSP Platforms

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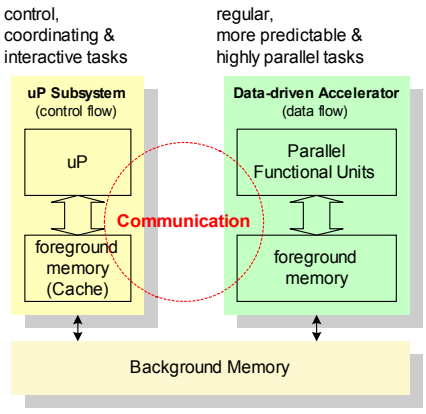
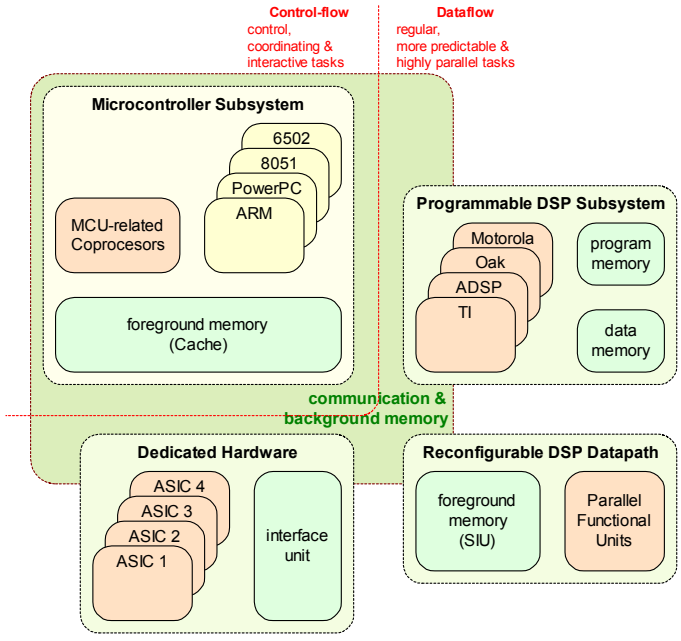
Heterogeneous Platform

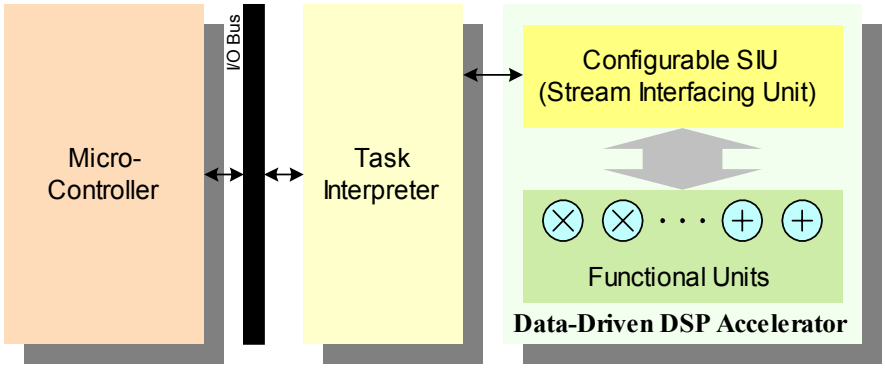




- ✓ **Task classification & distribution**
- ✓ **Communication**
  - synchronization mechanism
  - granularity
- ✓ **Coprocessor design**
  - programmability
  - high speed, low power, etc

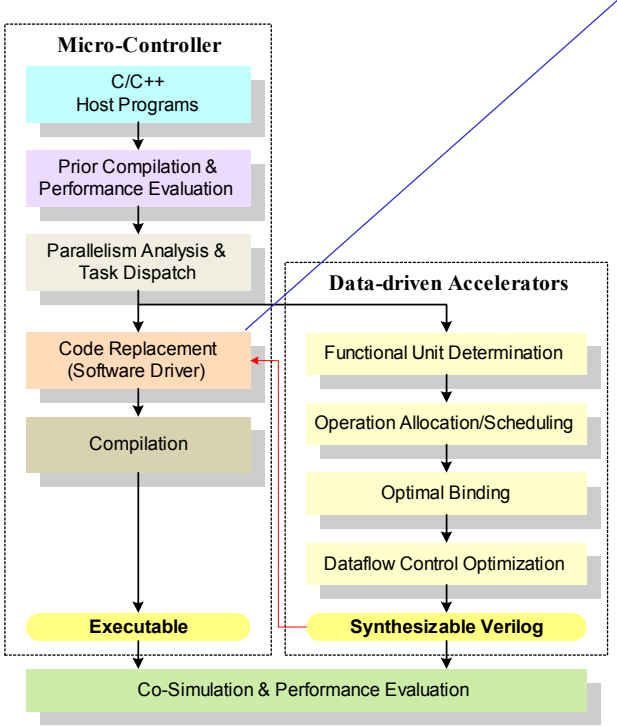
Data-dominated coprocessors with different programmability.

Proposed DSP Platform



- ✓ # of datapaths & # of their internal parallel FUs are ***scalable*** to meet the performance requirements.
- ✓ The coprocessing datapaths are ***configurable*** for various applications based on the executing algorithms in C/C++.
- ✓ Performance boost is achieved by
  - control overheads elimination (program flow)
  - reduced load / store operations with specific SIU data generator (data generation)
  - parallel processing via SIMD-like functional units

CASCADE – Configurable And SCAlable Dsp Environment




```
void dispatch_fun(fix *Din, int size, fix *Dout)
{ int   index1=0, index2=0;
  fix   din, dout;
  bool  valid_in, valid_out;

  Codes for Exception Handling

  while(index2 <= size)
  { valid_in = (index1 < size);
    din = Din[index1++];
        IO_Operation (din, valid_in, &dout, &valid_out);
    Dout[index2] = dout;
    index2 = index2 + valid_out;
} }
```

- ✓ The data-driven accelerators are synchronized with host's instructions.
- ✓ The interfacing software could be compiled and scheduled (by compiler & RTOS) as usual.

Performance Improvement of MJ-like Encoder

	DCT Kernel		320*240 Frame
Software alone	5,595 Cycles	111.9 us	152.928 ms
With Accelerators	246 Cycles	4.92 us	24.552 ms

- The host micro-controller is 50-MHz ARM7TDMI.
- The data-driven accelerator is composed of 4 MACs.
- 8-by-8 DCT, quantization specified in JPEG standard, run-length coding, and Huffman coding are performed on the 320*240 frame.
- An ideal memory subsystem (no memory stall) is assumed for simplicity.

Conclusion

- ✓ The proposed coprocessing datapath generation is
  - easily ***configurable***
  - performance ***scalable***
  - simple low-power management (e.g. our example)
- ✓ The accelerating datapaths are ***driven by host instructions*** in the software interface, which is also auto-generated, to simplify the synchronization problem.
- ✓ The coprocessing datapaths boost the performance of low-cost micro-controllers to ***lengthen their product life span***.
- ✓ Automatic generation of the accelerators with simple software-controlled interfacing dramatically ***reduces the development time***.