CS 152 Computer Architecture and Engineering

Lecture 17: Vector Computers

Krste Asanovic
Electrical Engineering and Computer Sciences
University of California, Berkeley

http://www.eecs.berkeley.edu/~krste
http://inst.cs.berkeley.edu/~cs152

Recap: VLIW

- In a classic VLIW, compiler is responsible for avoiding all hazards -> simple hardware, complex compiler. Later VLIWs added more dynamic hardware interlocks
- Use loop unrolling and software pipelining for loops, trace scheduling for more irregular code
- Static scheduling difficult in presence of unpredictable branches and variable latency memory
- VLIWs somewhat successful in embedded computing, no clear success in general-purpose computing despite several attempts
- Static scheduling compiler techniques also useful for superscalar processors

Supercomputers

Definition of a supercomputer:

- Fastest machine in world at given task
- A device to turn a compute-bound problem into an I/O bound problem
- Any machine costing $30M+
- Any machine designed by Seymour Cray

CDC6600 (Cray, 1964) regarded as first supercomputer

Supercomputer Applications

Typical application areas

- Military research (nuclear weapons, cryptography)
- Scientific research
- Weather forecasting
- Oil exploration
- Industrial design (car crash simulation)
- Bioinformatics
- Cryptography

All involve huge computations on large data sets

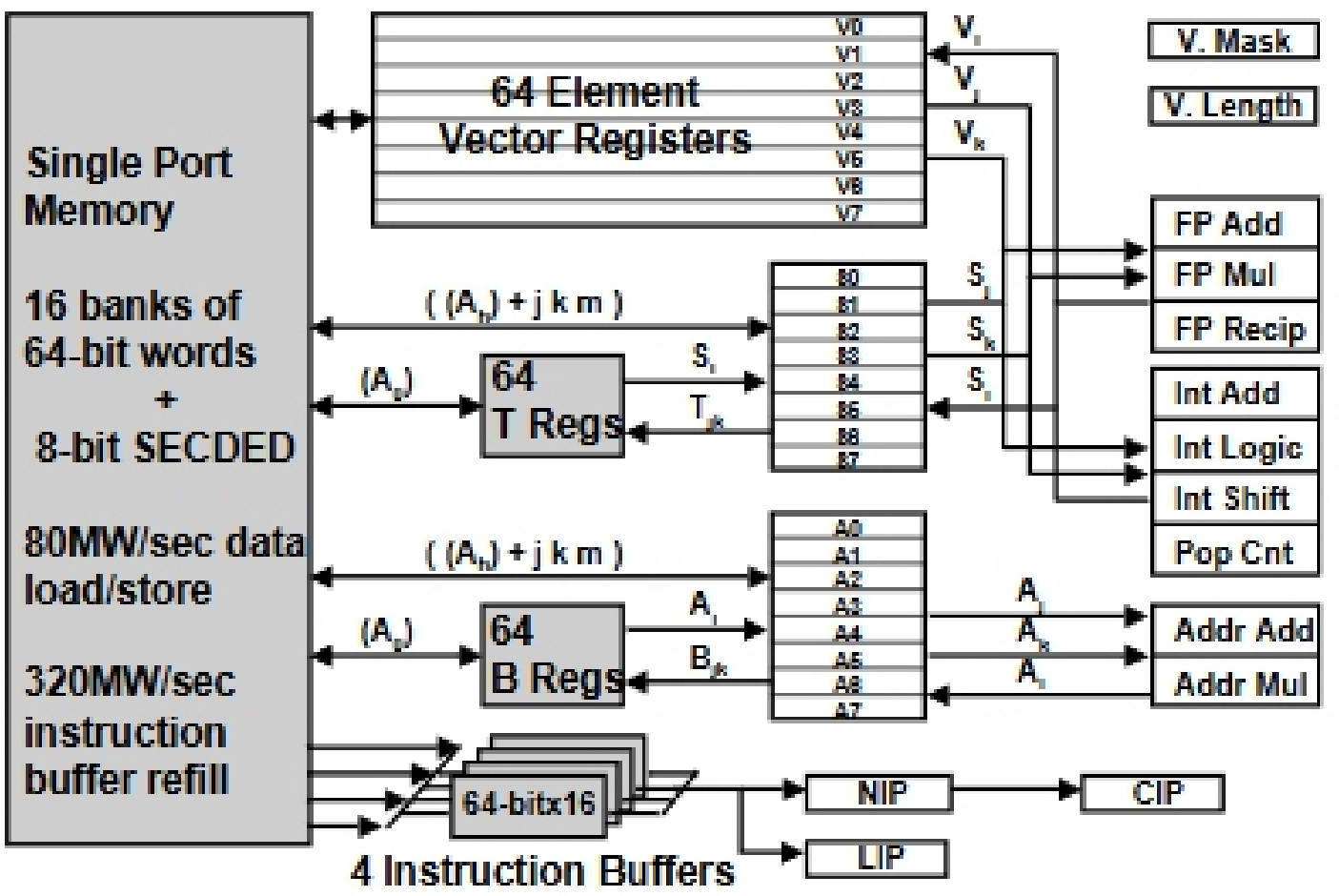
In 70s-80s, Supercomputer ≡ Vector Machine

Vector Supercomputers

Epitomized by Cray-1, 1976:

- Scalar Unit
  - Load/Store Architecture
- Vector Extension
  - Vector Registers
  - Vector Instructions
- Implementation
  - Hardwired Control
  - Highly Pipelined Functional Units
  - Interleaved Memory System
  - No Data Caches
  - No Virtual Memory

Cray-1 (1976)



memory bank cycle 50 ns *processor cycle* 12.5 ns (80MHz)