



Emerging Technological Trends of 2012-2013 Data Flow Supercomputer Design Issues for Challenging Applications

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Abstract: Computer architects have been constantly searching for new approaches to designing high performance machines. Conventional von Neumann machines are called control flow computers because instructions of program are executed sequentially as controlled by a program counter, which is inherently slow. To exploit maximum parallelism in a program, Data flow computers were suggested in recent years. The progress in VLSI microelectronic area has provided technological basis for developing data flow computers. This paper focus on various data flow computers design issues for challenging applications.

Keywords- VLSI, MIT, Data flow.

1. Introduction

The basic concept is to enable execution of an instruction whenever its required operands become available [8]. Thus no program counters are needed in data flow computations. Instructions in program are in any order whose execution must follow the control either micro programmed or hardwired [9]. But in data flow computers the execution follows data dependency constraints [7]. Instructions initiation depends on data availability independent of physical locations of an instruction in program. Program for data driven computations can be represented by data flow graphs. Providing good quality software includes attributes like usability, functionality, consistency, efficiency [17]. There are various approaches to programming including functional & object oriented, as well as design approaches top down & bottom up [18]. The multimedia includes audio, video, graphics, animation, text & image [20]. Computer graphics is used to create graphical object using computer. The infinite number of calculations are reduced into finite by computer graphics as screen is not infinite its finite [19]. Data flow & VLSI offers two mutually supportive approaches towards the design of future supercomputers [6]. Jack Dennis (1979) MIT has identified three basic issues towards the development of an ideal architecture for future computers. The first is to achieve a high performance /cost ratio. Second is to match the ratio with technological progress. Third is to offer better programming in application areas. Data flow model offers approaches to meet these demands.

2. Methodology

Each instruction in data flow computers are implemented as a template which consists of operator, operand, receivers & result destinations. Operands are marked on incoming arcs results on outgoing arcs. The basic structure can be extended to multi processors. The basic structure of data flow mechanism is as in diagram 1.

Data flow design involves understanding of how data moved from one module to another in a project. We find the various modules, and for each of the modules, we find out the inputs provided and the outputs which it provides. We then associated there inputs and outputs of each module, with other modules. For example, module 1 may accept some form of input from the user and result in some output. The output from module 1 is provided as input to module 2, which does some process and results in its own output. This output may be passed as input to the next module. This process continues, until we get the final results [7].

3. Advantages

Highly concurrent operations: Parallelism easily exposed to larger scale [5].

Programming productivity: Functional programming language will increase software productivity as compared to imperative languages fortran & pascal [7]. Solving New Problems [5][21]. The sheer processing power of supercomputers means that they can be used to do things that ordinary computers simply couldn't handle. For example, weather forecasting is highly complex and requires extremely sophisticated algorithms. Only supercomputers have the ability to perform these calculations in a timely fashion. Supercomputers have also permitted great strides in filmmaking and special effects. Pixar uses a

supercomputer with more than 1,000 individual CPUs; even using this computer, each frame of their movies can take up to 90 hours to render.

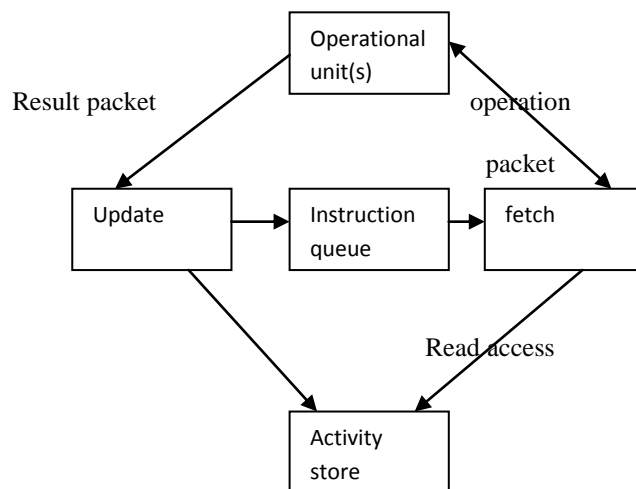


Fig 1: Basic data flow mechanism [7].

4. Disadvantages

Even if your organization has researched the benefits and advantages of using a supercomputer to tackle tough and complicated problems, it is true that supercomputers also present some disadvantages. The larger and more powerful the supercomputer is, the more infrastructure and maintenance it requires performing the calculations.

>Storage and Bandwidth:

A disadvantage is that supercomputers require massive external storage drives whose bandwidth is fast enough to accommodate the data being analyzed and produced. If storage and bandwidth can't keep up with the data flow, the supercomputer will not be able to work at its full capacity

>Maintenance and support [7]

>Cost

>Processing Time:

Supercomputer could spend months performing calculations to support research on climate change or to help cure a disease, presenting a disadvantage to people who are in a hurry for quick results.

5. Design Issues

Major design issues towards the practical realization of data flow computers include following mentioned problems that remains to be solved [7].

>Development of efficient dataflow languages which are easy to use & to be interpreted by machine hardware.

> The decomposition of programs/modules to data flow processors

> Controlling & supporting large amounts of inter processor communication with cost effective packed switched networks

> Developing intelligent data driven mechanism [3]

For either static or dynamic data flow machines

>Efficient handling of complex data structures such

As arrays in data flow environments.

>Developing memory hierarchy & memory allocation schemes for supporting data flow computations

>Operating system mechanism for CPU scheduling includes

First come first serve, shortest job first, round robin, priority scheduling [15].It is required search for new cpu scheduling algorithms.

>Large need for user acquaintance of functional data flow languages, software supports, data flow compiling & new programming methodologies[7].

6. Applications

Supercomputer is an extremely fast data-processing oriented computer. Supercomputers are also called "high-performance computers" because of their capability to crunch power measuring in billions of floating point operations. Supercomputers are used to solve complex computational problems[1], process hundreds of billions of calculations per second and simulate complex commercial research laboratories' and military sciences'[2] experiments. Supercomputers with their faster-speed Central Processing Units (CPUs) are designed to do calculations and solve other computational problems faster than

conventional powerful computers. They make use of a high-level of parallelism to enhance the processing speed. Supercomputers were earlier developed for weapons design research and development, national security purposes and university-led theoretical projects. Latest advances in power, performance and productivity have ensured that they are now also being retooled to run complex and varied mainstream industry and consumer applications.

7. Conclusions

Data flow offers a viable approach to improve today's computer performance. The development of data flow computer is in its infancy stage, with the push of VLSI computing structures we can anticipate an important role of data flow mechanism & their variations in future computers.

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