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Evolution of High Performance Computing Systems to Support Massively Intensive Applications

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Abstract – Computing is mainly defined as a process of rising and an up gradational activity of computer technology a computer-specific part of information technology merging and confining both software and hardware within designing and building of many virtual endless purposes like intelligent behavior, processing, gathering information and structuring etc. In this paper a systematical methodology of designing and theory of High performance computing systems has been mentioned which is being under review and progress since long time including the four architectural grand challenges of high performance computing systems; whose progress still can and will bring a revolutionary changes and will support to efficient computing. In this section we include both the era and hereafter facing the challenges form the epoch to the next generation. In this we mainly focused on the theory and design there characteristics and requirement a wide ranging discussion which establish an approach for the intensity of computing so that high performance can be acquired. The high performance computing is distributed in to two levels theory and its architectural design both of the aspects are classified in to different levels and will be discussed in detail. It mainly focused that should there be a feasible design according to the previous given constraints that supported enhancement in computing performance and the theory provides a guideline to reconfigure the constellation of methodology. In this paper the architectural design and theory will be discussed in detail.

Keywords - High Performance Computing (HPC), Cloud Computing, Grid Computing, Distributed Computing, Cluster Computing

I. HIGH PERFORMANCE COMPUTING

High performance computing HPC solve the problems of advance computational with super computer and computer cluster. Now day's computer systems had step forward to teraflop region known as HPC [1]. The require usage and feasible economics of high computing is dynamic and the demand of latest configured architecture seems to be inevitable. Until and recently some major steps has been taken to aggrandize the capability of hardware system of uni-processor and multi-processor with a large scale of integrated sophisticated electronic control system.

Now let's talk about the four grand challenges which was a USA policy for searching the new innovations in high performance computing in response to Japanese 5th generation. High computing which was basically the title of widely distributed ' blue book' that defines the united state high performance computing and communication (HPCC) program the aim of that program is to motivate and commercialized the accessibility and the usage of next generation of high performance computing. The grand challenge include four major issues which are

[a] Idealized Parallel Computer Model
[b] Use Able Peta-Ops Performance
[c] Computer In An Era Of HDTV Gigabyte Network & Visualization
[d] Infrastructure Of For Prototyping Architecture

But unfortunately the blue book does not explore the mechanism that should be acquired to the architecture to support the four grand challenges there fore a workshop was held to highlight the key issue to for what major methodology should be adopted to enlarge the performance of high computing. Computing include many types some of them are mentioned below.

A. High Performance Computing HPC

High performance computing HPC is made to solve high and complex computational problem. Now the computer system is accelerating on teraflop region which are merely known as HPC computers. It is now also be applicable on business usage for ware house and for the high transactions. All of this is done by cluster-based super computer. HPC is basically cluster based computing such as computational fluid dynamics and virtual prototype testing all it comes in high performance computing

B. Cloud Computing

In cloud computing the computational has been moved from personal computer or server to a cloud of many computers which is also remote computing software that provides the data on according to the user demand**.** Cloud computing is basically a method or software which is being used by the user on the cloud side to prevail the data.

C. Grid Computing

Several independent computing clusters are formed like a grid because of the node which is the resource is not spotted with in a single domain. The inventions of virtual computer by exploiting spare computing with in an organization. Saturating online computational as a commercial services which is some time known as cloud computing utility computing and computing on requirement.

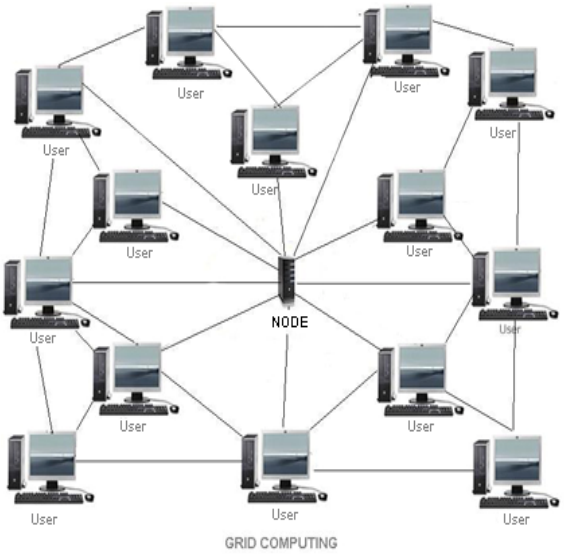


Figure: 1 A Typical Grid Architecture

D. Utility Computing

It is radically a provision of several individual servers for the ease of use to the web traffic. A virtual methodology is processed so that the storage available computing could be made larger then that of one time sharing. Multiple servers are being used at the back end to make the procedural fulfilling and might be a consecrated computer cluster which is built for this purpose this is primarily known as utility computing

E. Distributed Computing

A practical method of running a single computation on a verity of computers multiply at the same time is fundamentally known as distributed computing. The computers which are running the same program or computation at the same time are interconnected and communicating at the same time. It is considered to be type of parallel computing and require the distribution of different program into different environment so that program can be run simultaneously on different software and hardware environments and file system

F. Cluster Computing

Cluster computer is a bunch of linked computer working together in many aspects and respectively they form a single computer. Computer cluster is not always connected to each other with LAN. They are basically deployed to improve the efficiency and performance of computational system

G. Parallel Computing

Parallel computing is a type of computational in which many programs are transferred instantly following the procedure that the huge problems are further divided in to smaller one and being solved concurrently. Bit level, task level, instruction level and data parallelism is some of the types of parallel computing. They are more difficult to write and the speed up process by parallelization was first observed by Amdahl's law

H. Meta Computing

Meta computing is radically all computing based activities which include knowledge of computing, research, development and all other computing activities applications. It deals with many domains such as new emerging technologies and computing applications in any aspect such a business management and many other rich applications

II. SCOPE OF RESEARCH

The new enhancement and up gradation in the field of computing is required that is ***why*** This paper has been written to innovate the advancement in the procedural methodology of high performance computing keeping the era in focus and to participate as a trailblazer in throwing revelry ideas for the next generation. This paper presents an overview on the current systematical process and also the previous given constraints.

This research paper deals with the fundamental of design and theory of high performance computing its grand challenges and the other types of computing. With this one can understand the radical computing its background the grand challenges and envision of new design and computing theory could be viable.

The purpose of this paper is to provide an infrastructure for new architectural ideas its essentialness and easy access toward its background that could allow the new applications to be implemented. The goal can be obtained by providing a strong background and knowledge about the computing and its fundamentals to open the new ways for the enhancement of the high performance computing to create ideas of upgrading the architectural behavior and its interaction with the software, applications and technology. The design and theory not only give an overview on hardware prototyping but also the execution of remote software and applications. These characteristics are needed to be considered into the architectural design to innovate new features of software and hardware.

This goal can be achieved by providing facilities and support of fast computer and the computing experts, experimental steps should be taken to make the architectural level more advance and new designs of HPC could be introduced currently there is no such mechanism of support or sponsors. Labs of experts with efficient high performance computer should be provided to make it sufficiently applicable or to be shifted form paper research to practical implementation and to bring new innovations in the field of computing.

III. HIGH PERFORMANCE COMPUTING MAIN FRAME

The area of high performance computing gained importance from the advancement in technology started from 19th century with hyper threading hyper transport , parallelism , distributed computing are shifted to the main frame of computing. To fully exploit this many professional starts designing algorithms to deal with the complex and engineering problem. HPC is a meanwhile a difficult and need keen focus to be deployed on many of the engineering design from basic electronic component to high level components. This is also used in the designing of basic computing algorithms for the safety testing of many computing hardware. It helped us to absorb the global change of climate and also made an understanding of how to deal with it. HPC is an efficient computing plate form yet it is latest and considered to be the fastest machine of the day.

HPC also behave as the system pioneer which codes of work and design is often used to identify a verity of problems and to overcome the instabilities of any newly designed system. For every new kind of architecture there is a new type of code, library compiler and new program however this programing is a kind of low level because for a new platform high level programing is needed to minimize the human effort and to get the accuracy. Keeping in mind that high level programing for HPC is application is also a great challenge to deal so good understanding of programing is required so that meaningful results could be acquired.

There are also some interesting reciprocals. Some HPC system enable the code to have a direct access to the CPU memory that's because to reference the data directly to another *SMP* (Shared Memory Parallel System) in the system. Some act globally addressing and providing the support for this network. A method called *ccNUMA* (Cache Coherent Non-Uniform Memory Access) marketed by HP. It fetches the data transparently from the remote memory when required stored. it to the local memory and also disconfirming the same data when needed

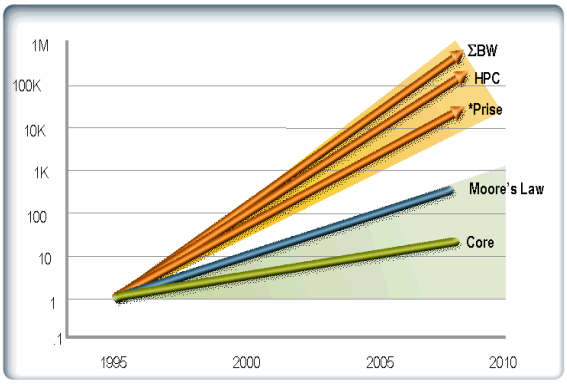


Figure: 2 The diagram shows the ranking of HPC in main frame

IV. CURRENT HPC ARCHITECTURE

Super computer of today continue providing high performance computing for some applications but its architectural design remains expensive. That is because in early days of HPC an algorithm of SMP (Shared memory parallel system) was used but was not efficient for larger scale of super computer so another system was introduced DMP (Distributed Memory Parallel) system to enlarge the usage of HPC. Most of the vendor has now combine SMP and DMP to enhance the computational on larger scale as a result two distinct architectural parallelisms are formed [4]. The total cost of the networking architecture has lessened and rapidly the performance has increased.

V. GRAND CHALLENGES

As mentioned earlier grand challenges were a USA policy to highlight the importance of HPC and its enhancement of research in response of Japanese 5th generation of HPC. Grand challenges is a problem with a huge area of applications and which solution can be avail from high performance computing For example, Fluid dynamics of computational for hypersonic air crafts, automobile body's with efficient performance, the short and long term of weather forecasting effects Recovery of oil efficiently, structure of electronic design etc.

The four grand challenges which were introduced in the start are briefly discussed bellow

A. Grand Challenge 1: Idealized Parallel Computing Model

The parallel computational model is to provide high performance computing that's why the model establishes an interface between parallel hard ware and parallel software [3]. It then is considered as the idealized form of computation with an efficient performance. Hence it is not enough that a single model can accomplish by fulfilling all the possible requirements but though it is helpful in reducing multitude of alternative it to some minimum possibilities.

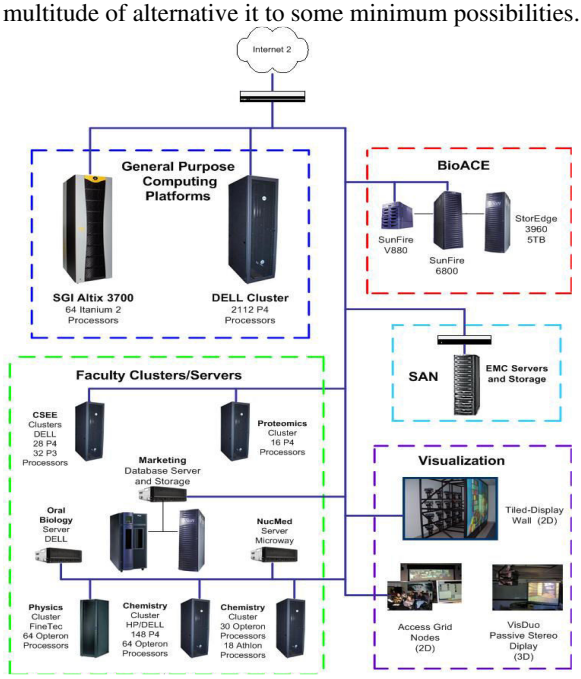


Figure: 3 The diagram shows the computing performance in general paradigm

B. Grand Challenge 2: Useable Peta-Ops Performance

Grand challenges need computer performance that could be useable and magnitudes greater then Giga and Tera-ops which are available today [3]. This computer performance could not be acquired by simply interconnecting a monolithic quantity of CPU and I/O

resource which are not manageable to and inefficient to utilize. That is why the challenge is to improve the performance and efficiency of CPU and memory

C. Grand Challenge 3: Computer in an Era of HDTV Gigabyte Network & Visualization

Technology has been able to support the latest communications applications quick and concurrent access of thousands of people to a digital system of banking system or a

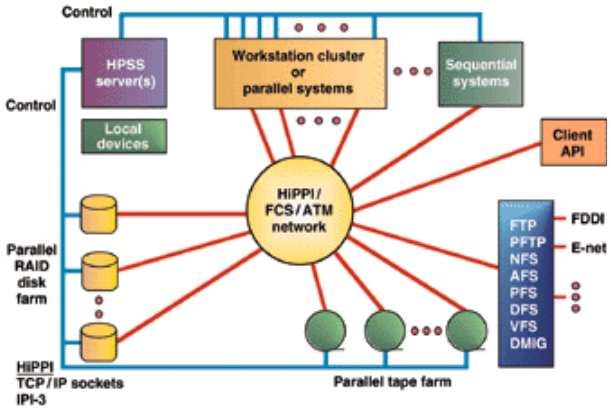
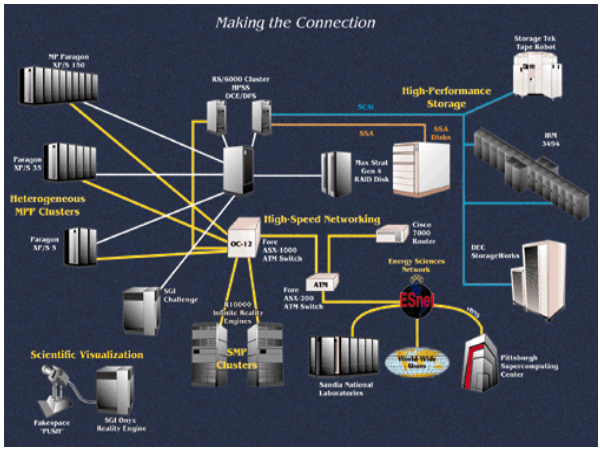


Figure Source:4
http://www.google.com.pk/images?hl=en&q=high+performance+computing&um=1&ie=UTF-8&source =og&sa =N&tab=wi&biw=1024&bih=574

D. Grand Challenge 4: Infrastructure for Prototyping Architecture

Computer generation changes or upgraded in every coming couple of year. Latest innovative ideas are evaluated and implemented quickly. Hence this prototyped architecture is evaluated first. The prototype includes the hardware and software in the form of compiler and operating system [2]. This challenge was to make an infrastructure which allow quick prototyping of hardware and software and today it has been achieved



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http://www.ccr.buffalo.edu/display/WEB/Computers+and+platforms

VI. CONCLUSION

This paper has stated some of the important issues of the computer architecture for the support of high performance computing. These characteristics need to be penetrated into the computer architecture system to create a fully featured hardware and software design that should support high performance computing. The main objective of the systems methodology is to build an effective and reliable system with low cost keeping the great grand challenges in mind and also the involvement of the all computing paradigms to make an effective infrastructure of high performance computing HPC. By following the design and theory of the computing system from epoch to current existing system a systematical methodology can be develop for the next generation of computing. There are too architecture and designed technology which are beyond the scope and cannot be discussed in this research paper.

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