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Challenges Involved In Computing Technologies Used In E&P Organizations

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Summary

E & P organizations are typically characterized as the ones, needing computers capable of handling extremely large DATA volumes. Seismic data processing & interpretation is the most essential domain, which dictates the most crucial corporate decision of final drilling activity. Any wrong decision in this regard will severely affect the organization, on account of the cost involved in the drilling operations. This paper deals with the challenges involved in the emerging technologies, for compute intensive jobs like for E&P organizations, to meet the huge seismic data processing and visualization requirements. The old legacy systems for processing of the data were typically the mainframe systems of 1980's which were employed for the processing of the large DATA volumes in the typical time sharing mode for executing multi-processing inputs. These systems suffer badly in terms of the time taken for the execution of the special processing and prove inadequate for such highly compute intensive applications.

IT industry developed servers based on RISC based technology wherein the computing power was increased to many folds and the problems whose solutions might have taken a full year could be solved, through these multi-processor parallel servers in few hours because of the tremendous increase in the overall number crunching capacity. These servers are coupled with the client workstations (interconnected through high speed network), High end huge storage boxes, magnetic drives, other peripherals etc. to enable the Geo-scientists with the vital tool of interactive processing, in addition to the conventional Batch mode processing & interactive interpretation. These network connected servers has enabled the processing of the data in the depth domain in addition to the conventional time domain.

Subsequently the trend shifted towards the use of the PC- Cluster. These days various heterogeneous systems co-exist in all the computer set ups and it is a big challenge to the managers and technologists to manage and control the efficient and effective operation and management of these systems. Moreover due to technological advancements the older systems are sometimes declared end of life by the OEMs and are no more available for acquisition to meet the increased load and the project managers of these computer centers findit difficult to run the complete set up in the desired fashion.

The paper discusses various challenges that are being faced in different domains of the computing systems being put to use for the seismic data processing and interpretation activity and also the suggested remedies to mitigate the risks involved.

2.0 Introduction:

Computer centers, engaged in the crucial job of seismic data processing and interpretation job are equipped with the heterogeneous servers and that too from multiple vendors. Moreover the complete set up is required to be established with the following sub components:

- Huge storage boxes
- Magnetic drives
- Workstations
- Peripheral devices

These heterogeneous systems are collectively being put to use for various seismic applications and pose much bigger challenges for the efficient operations.

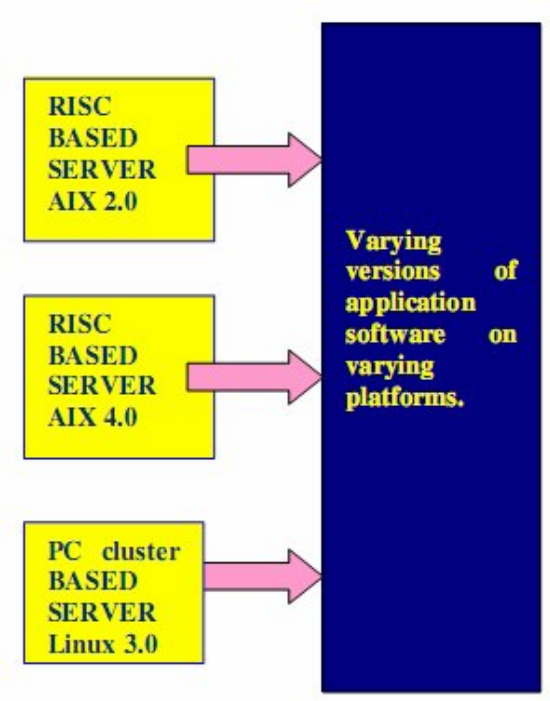
3.0 Challenges involved

3.1 Server domain:

A) Challenges involved:

RISC based older servers and the latest PC cluster servers are being put to use for various applications. The heterogeneous server platforms are co-existing and are very difficult to manage. Moreover the IT industry is enabling the application users with newer and better technology servers to address the complex problem of seismic data processing. All these factors pose a bigger challenge in managing the operations. Some of the major challenges are as appended below :

- The fast rate, system get obsolete, forces for early upgradation otherwise there is huge loss in terms of the opportunity cost.
- The recent technological advances have ushered in the technology of multiple cores in one CPU socket. The computing power of these multiple cores is lesser than equal number of single CPUs. However most of the ISVs for the application software have policy of charging on the basis of number of UNIX like AIX, IRIX, Solaris, HP-
- It is a big challenge to manage operations in an environment where different variants UNIX and Linux are co-existing. Even in a given variant like e. g. AIX the different servers are operational with different versions of AIX on account of varying requirements of the application software that is loaded on to those servers. The server architecture is even not uniform. Some older servers are of shared memory type and need different application software to be loaded.
- Whenever there are updates released for application software, the operating software too needs upgradation/ addition patches/tuning which is much challenging job particularly on account of the fact that in most of the cases the older technology servers are already declared end of life by the OEM and there is no further support available from OEMs.
- Management of even application software is a big challenge as for the same functionalities different version of application software is operational on different types of servers.



of cores on which the software is being loaded. This leads to indirect loss on account of increased licence fee.

B) Corrective measures:

To mitigate the risks involved from these factors the computer centers need to evolve a replacement policy and accordingly put the appropriate latest servers only and discarding the old systems. Additionally, the technology scouting should be done in full spirit and the centers should look out for inducting the new technology based servers to avert the loss of opportunity cost.

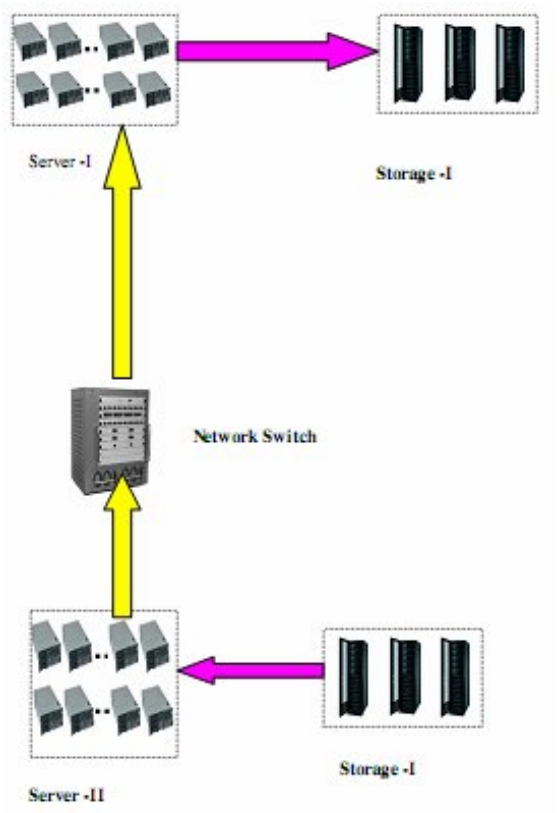
3.2 Storage Domain:

A) Challenges Involved:

The storage systems are generally directly attached to a server or these are in a SAN system which is local to that server only. Once there is upgradation of the computer centre, subsequently, to cater to the increased need for the additional computing power, new server along with the attached storage system get added to. This process goes on resulting in multiple servers and the multiple storage systems. Now as a policy the older systems are put to use for addressing the lesser compute intensive basic processing jobs and the newer servers which are more powerful are set aside for the compute intensive jobs like migration which need number crunching servers. It is sometimes required to move the data from one storage box to the other storage box. The only path generally available is through the network. This poses a big challenge as it takes huge time for movement of data and secondly it results in choking of the network.

As depicted in the diagram below the data is required to be moved from the storage box –II to the Storage box-I. The data flow will be as below:

- Server –II will get data from the storage –II which may be from Fiber interface.
- Server –II will forward the data through the network **switch through Ethernet to server –I.**
- Server –I will dump data to the storage box–I



The entire process is very slow and will result in frequent choking of the network. The other users communicating through the same network will experience deteriorated services on the network.

B) Corrective measures:

- The best way to combat this problem is try not to transfer huge data through the network. The data can be loaded on to magnetic cartridges and then transferred to other disk through the drives attached to other server. This will ensure optimal load on the common network.
- The other solution is putting all the servers and the storage on the common SAN (Storage area network) and transfer data from one storage system to other through this SAN so that common network is not disturbed.
- Still other option is extensive use of the Robotic tape library. The Library can be configured with the two different servers. The data from one storage system can first be transferred to the RTL. From RTL the data then can be transferred to the other storage box.
- In case none of the options is feasible then the network need to be reconfigured and the applications are to be optimally tuned to ensure optimal through put from the network. A case history of the project undertaken by M/S GTL to resolve the specific problem of one of the centres of ONGC is enumerated below:

Example: Case history to resolve similar problem at ONGC SPIC :

SPIC centre is equipped with the following three types of main systems:

- IBM SP #3 system with 1.5 TB storage -- mainly for basic data processing job.
- IBM Regatta server with 35.5 TB storage -- for PSTM/PSDM jobs
- 302 CPU Xeon PC cluster system – For Xeon PC cluster system.

Basic data processing job is taken up on SP#3 server through PGS-Tensor software and the PSTM/PSDM jobs are executed on Regatta and PC-Cluster servers using Paradigm software. It is required to move data amongst these distinct computing servers. The main problems being encountered were as below:

- Bottleneck on the Network
- Slow I/O on remote file systems
- Slow Remote Login
- Frequent hanging of Head Nodes of PC cluster

M/S GTL undertook the job in following three phases of the project:

a) <u>Audit and data measurement before rectification</u>:

M/S GTL conducted complete system and network audit of the Data Center at SPIC. The I/O rates at various points were measured for analyzing the scope for improvement before starting the job. These figures were finally compared with the figures recorded after fine tuning by M/S GTL.

b) <u>Rectification of network and systems</u>:

M/S GTL extensively attempted the job of rectification of the networks and systems installed at

SPIC centre. The entire network was reconfigured and the following major jobs were executed:

- SP3 server tuning.
- Regatta server tuning.
- **PC-Cluster Tuning**
- **Reconfiguration of the networking elements.**

c) Data Measurement after rectification :

The I/O rates at the various points were measured for analyzing the improvement after fine-tuning of systems and network. The varying file sizes were transferred amongst the heterogeneous servers. The times recorded for these transfer of file is employed for concluding results. These figures were finally compared with the figures recorded earlier in the audit stage and the final results obtained are as depicted below..:

- **Data transfer from Regatta server to Cluster Node.**

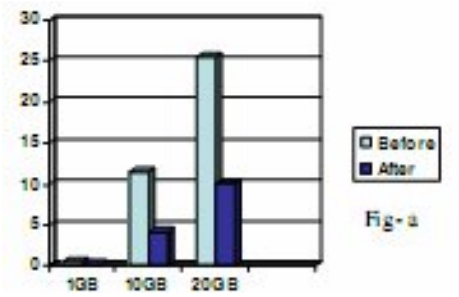


Fig- a

- **Data transfer From Cluster Node to Regatta server**

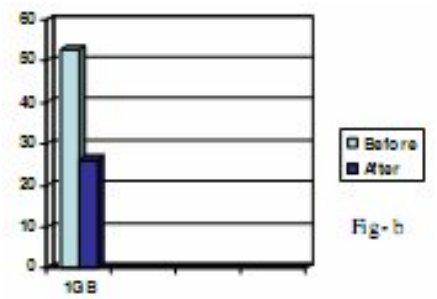


Fig- b

- **Data transfer From SP#3 to Cluster Head Node**

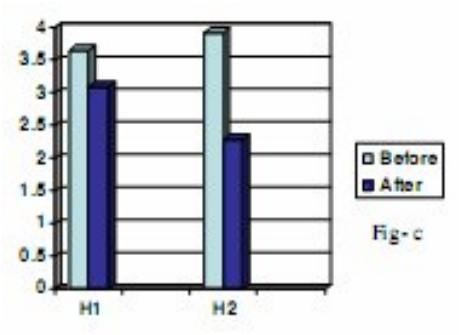


Fig- c

In the above graphs along X axis different file size that were transferred from one system to other system are plotted and on Y axis the time taken (in minutes for Fig a and Fig c and in seconds for Fig b) to transfer that file is plotted.

3.3 Archiving and intermediate storage: A) Challenges Involved:

The legacy systems for data archiving and intermediate storage used to be 9 Track Round reel systems. The technological advancements enabled the industry with the vital tool of magnetic cartridges to store data. The drives were released in market as per following sequence.

Release sequence	Drive	Capacity
1.	3480	200 MB
2.	3490	400 MB
3.	3490E	800 MB
4.	3590	10 GB
5.	3590E	20 GB
6.	3590H	30 GB

The industry practice initially was to use 3480 magnetic cartridges. Later on the 3480 drive was declared end of life. It was also suffering from the problem of less packing density of only 200 MB per cartridge. For a small duration 3490 and 3490E drives were put to use. Later on 3590 series ruled the market. Now even 3590 whole family is declared end of life. The entire industry is now in a big problem as majority of data is in the 3590 family of cartridges. Now the option available currently is 3592 cartridges which may also eventually get obsolete. It is a big challenge as to how to take care of huge data archiving requirements.

B) Corrective measures:

The options available are very limited at the moment. LTO/SDLT etc. are available but are not fit for the applications requiring frequent data read/write operations. The industry can plan for the three tier storage system.

- The front end fiber disks for processing.
- Back end low cost huge capacity SATA disks at second tier.
- The third tier can be Robotic tape Library with 3592 drives, at the moment, which can be changed as and when new drive technology is introduced.

4.0 Conclusions:

E & P organizations are typically characterized as the ones, needing computers capable of handling extremely large DATA volumes. Seismic data processing & interpretation is the most essential domain, which dictates the most crucial corporate decision of final drilling activity. Over the years, on account of the new and better technological revolutions, the computer centers are equipped with the heterogeneous servers, storage boxes and the magnetic drives. Managing the operations with the heterogeneous servers is a big challenge. To mitigate the risks involved from these factors the computer centers need to evolve a replacement policy and accordingly put the appropriate latest servers only and discarding the old systems. Similarly, managing data transfer from the different storage systems is a big issue as the common network gets choked. To resolve the problem either data be transferred through magnetic dives or through common SAN. Similarly data archiving and intermediate data storage is becoming a biggest challenge for seismic industry and accordingly a three tier storage system is suggested to be put to use.

References: Technical journals and manuals.