Load management using virtual machine migration

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Abstract: Load balance mechanism does the vital role in high performance computing (HPC) and energy efficient computing (EEC). An effective load balance mechanism achieves high performance resource management. Several load management platform (e.g. Openstack, Nebula and Eucaluptus) available to simulate/perform status of algorithm. Load balance manager should be able to customize the resource management and also able to find objectives (e.g. high speed performance, flexibility during migration and energy aware resource allocation. Load balance mainly belongs to three categories (a) Cluster (b) Grid (c) Cloud computing. Proper load distributions among the all VMs are necessary to achieve objectives of load balance. Proposed paper focused on thrashing mechanism to manage the resources during live migration in different VMs. Paper also focused on different aspect of thrashing resource management policy to manage resources in effective way and time. Our algorithm will be effective to classify between high loaded machine and under loaded machine by using trash value of VM.

Keywords: VM (Virtual Machine), Load Balance, Resource management, Migration

Introduction:
Virtualization or hypervisor optimize resources (e.i. Compute, Memory and Network) and utilize the resources of physical system. Virtualization has ability to transform single physical system to multiple encapsulated VMs (Virtual Machines). These VMs have own operating system, storage and applications. VMs isolated from each other and load can be migrated from among VMs. If VM failure occurred, then exits load transfer to another VM in minimal downtime. Hypervisor provides isolation, consolidation, and work load management policy. A good Load balance mechanism can improve performance and make energy efficient mechanism. Xen and VMware provide live VM migration during failover without downtime [1]. On demand dynamic resource allocation and migration is though rather than static (pre-reserved). Load balance manager migrate the load among VMs, these are locally isolated in physical machine. High demand of resources may not be managed by single physical VMs, than VM will migrate to another physical machine. Over loaded condition in physical server is known as Hot Spot. Hot Spot detected due to highly resource demand and on time request arrival rates. At the Hot Spot occurrence resource manager has to pre-reserve on demand resource allocation to fulfill the resource requirement. High demand resource availability managed by dynamic server consolidation with migration [7].

VM migration usually used static, dynamic and dynamic consolidation with migration control approaches [6]. In static consolidation VMs are belong to same physical machine during hole life time, dynamic consolation system VM capacity can be change according to end user requirement and migration of VM with steady capacity will be change in dynamic consolidation by migration control management. Researchers are continuously doing work on dynamic consolidation with migration control and proposed many approaches [4], [5], [6], [7], [8]. Resource requirements may be different during frequently changing environments, but fixed load doesn’t constraint all time. The best suited VMs migration strategies are dynamic/heuristic approach in frequently changing environments [2], [3]. Next section II present previous proposed work, section III resource management method and goals, section IV shows algorithm description and section V conclude the research work.

Related work:
Researchers proposed various VM migration approaches Zehang et al [4] proposed CP (Constraint Programming) and heuristic algorithm. Two dimensional first fit and two dimensional best fit approach used in CP- Heuristic algorithm for manage multiples data centers. Li,K., et al .[5] proposed online/offline VM migration management. Simulation result of algorithm shows better performance from previous proposed approaches. Ferato et al. [6] proposed LP (Linear Programming) and heuristic approach manage VM migration management. Result shows LP-Huristic approach is also one the most effective approach to manage VMs migration. Beloglazov et al. [7] simulate his/her result on Cloudsim. Proposed algorithm able to manage VM consolidation with energy efficient mechanism and be a milestone for future generation of green computing. Lav et al. [8] proposed adaptive load distribution algorithm research shows previous result of sender/receiver initiative algorithm. Proposed algorithm does the work in heterogeneous load.

Resource Migrations Goals and Management Strategies
Resource management is a semantic relationship between resource availability and resource
distribution. Network, compute and storage are main resource component. Resource manager manages the resources according the availability of resources and provide to end user as per of SLA agreement.

The main goals of resources distribution are (a) Performance Isolation, (b) Resource Utilization and (c) Flexible Administration.

Performance Isolation: VMs are isolated from each other and do not affect to another VM capacity. Failure of VM does not affect the performance and load. Load will migrate to another VM. Hyper-V provide the facility of quick migration and VMware provide the facility of live migration. VMs reserved network, storage and compute capacity depend on SLA based end user requirements. Load should be migrate VM to VM or VM migrate to another physical server due to occurrences of high load (beyond max capacity) or failure of VM. Available, performance measurement techniques are not enough good. VMs resource consumptions must map to physical machine resource capacity VM to VM performance analysis can help to get the tangible performance [11], [12].

Resource Utilization: Dynamic resource allocation management does the effect on resource utilization and provides resources from physical machine. Resource utilization is based on maximum consumption of available resources from resources in minimum down time. Good resource management managers maximize the resource availability and minimize the energy consumption during high load requirements. Resource manager must give attention to SLA based on demand dedicated resource requirements. Resource manager map the highest requirements on day, weekly and monthly basis and observed the type of resource need. This analysis can manage rush hour end user resource requirements.

VM have predefined load capacity in static load management. Load manager can map/measured load of individual VM. VMs resource utilization can be measured from capacity of physical machine and unused resource can be used as reserve resource. Not used resource capacity is called headroom and it can be utilized at high resource demands [13].

Flexible Administration: Resource availability administrator must able to handle high load resource demand and migrate in synchronized manner. VMware uses DRS (Distributed resource scheduler) to manage VMs capacity (resource reservations, priorities and limit) and VM migration. VMware, DPM (Distributed Power Management) system manage power on/off management of used/not used VM and does the vital role in energy aware resource management [14]. Microsoft Hyper-V uses SCVMM (System Center Virtual Machine Manager) support system and manages support system to Virtual Machine Manager 2008 R2. SCVMM increases the flexibility in storage management and migration management of VM among different host.

iSCSI (Internet Small Computer System Interface) internet protocol flexibly manages the target storage server and uses SAN (Storage Network protocol) consolidate storage into storage array. SAN can manage storage consolidation and disaster recovery.

Requirements of Resource Migrations Management Strategies

Improvement of load balance mechanism should follow these objectives.

Scalability: Make an effective mechanism to large number of VMs and also capable to scale load of all VMs with respect of Average thresh hold value (Atv) and map with the respect of High thresh hold value (Htv). Htv > Atv and Low thresh value Ltv < Atv.

Location transparency: In Live migration VMs locations should be hide from cloud users and also hide the queue length and memory status and check the high load Htv and Ltv and transfer load with respect of [ok=Utv<Atv<Utv] condition.

Determination: Load of all VMs should be specifying after load transfer from Htv to Ltv and also have record of current thresh value (Tv) with respect of Atv. It should determine VMs, Tv value after every load balance and specify a specific ID of VMs.

Preemption: VMs must be equally load balanced and if any VM crashed then it should remove form list and failure VM load will migrate to another VM without interruption of services. Load management policy must able to manage risk management and recovery management. Resources are should be available in any disaster circumstances.

Heterogeneity: VM migration system manages the heterogeneous environment, heterogeneous architecture machine, heterogeneous operating systems (OS) and heterogeneous applications in single physical machine with the help of VMs.

Description of algorithm

HPC (High performance computing) can be achieved by DRS (Distributed Resource Scheduler) in minimal mean time. Trash based load migration with LP (Linear Programming) is superior approach to load migration. This approach is static during distribution of VMs ID allocation and dynamic in load migration among the VMs. Load balance system divided in two parts, first algorithm allocate ID to all high load, low load and average load VMs. Second algorithm control the process of load migration among VMs

First algorithm count and locate the ID to all VMs. Algorithm, classified the VMs according to high, average and low load. Algorithm first array store the ID of high load VMs and second array store low load VMs information. Load low and high load measured by average trash value (Atv). Average thresh value is maximum queue length of individual VM. VMs can be distributed according high load, low and remaining (average load) VMs store in average array.

Algorithm-1: VMs ID and Load Identification
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1. VMs counter and VMs Identification (ID)
Start counter VM = 1 to VM = n
If (VM !== null)
{
    VM [ID] = VM counter // counter number == VM [ID]
    Show all VMs ID
}
2. Thresh Valve (Atv == VM max capacity)
Check VM = 1 to VM = n
If (VM > Atv )
{
    High [array] = VM [ID]
    Htv [ID] = VM [ID]
}
else if ( VM < Atv )
{
    low[array] = VM[ID]
    Ltv [ID] = VM[ID]
}
else
{
    avg[array] = VM[ID]
    Atv[ID]= VM[ID]
}
Algorithm- 2: Load Distribution Process

1. if ( Htv > Atv) // High load identification
    go to step 2
else
go to step 7
2. { Ok = Ltv < Atv < Htv } // Load transfer condition
3. if ( Htv > Atv and Ltv < Atv )
    { go to step 2 }
else if ( Ltv == Atv)
    go to step 6
else
{
    If (Htv == Atv)
    go to step 4
    if(Htv < Atv) go to step 5
}
4. avg [array] = Htv [ID]
   // Assign in avg array
5. low [array] = Htv [ID] // Assign in low array
go to step 1
7 exit

Second algorithm specifies the load distribution form high load to low load VM. Algorithm can find the high load VM form high [array] and low load VM form low [array]. Check the transfer condition, if transfer condition is true then transfer the load form high load VM (Htv) to low load VM (Ltv). Low load VM queue length is full then high load VM load will be transfer to another low load VM. High load VM load will come equal to Atv then assign Htv to Atv [array] and exit, if Htv current load is low then Htv go to Ltv [array] then exit.

Algorithm manages low load and high load VMs. Meantime of response will be shorter and effective. Load balance must be flexible, performance based resources utilization. Thresh valve of VM define the high capacity of VM and does the help to find low load and high load VMs.

Conclusion:
Traditional computing system mostly uses centralized server system but cloud system uses distributed and grid computing systems to manage resources with effective time and energy. Management of resources in effective time and energy saving mechanism both are not parallel easy to manage. Algorithm balances the load among VMs and achieve on time migration. Load migration should be proper scheduled, synchronized and also able to simultaneously load distribution. Algorithm proposed a way to find over loaded VMs and under loaded VMs with load transfer mechanism in live migration. This algorithm would be help l for finding over loaded/ under loaded VMs and also able to transfer loads form high loaded VMs to under loaded VMs by using thrashing mechanism. Researchers all ready done lots of works in live VM migration but still need improvements. Load balanced policy should be monitored and scalable during VMs migration. Proposed concept can flexible manage the load distribution among VMs and produce optimized result.

References: