

INCREASE OF ENERGY EFFICIENCY AND FAULT TOLERANCE WITHIN A DISTRIBUTED COMPUTING SYSTEMS BY VIRTUALIZATION MECHANISMS

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Purposes

Improving energy efficiency, fault tolerance and the economic benefit of a large data processing system through the use of virtual machine technology.

Tasks

- 1) Development of a distributed computing system mathematical model;
- 2) Development of an algorithm for distributing virtual machines to distributed system physical servers(multi-criteria optimization).

Methods

- 1) Optimization methods;
- 2) Software modeling.

Mathematical model

Goal function

$$G_x = \frac{1}{\sum_{k=1}^{NR} AV_k} \left(\sum_{k=1}^{NR} \frac{AV_k \cdot C_k}{RM_{k,x} - OS_k} \cdot \left(\sum_{n=1}^{NV} VM_{k,n} \cdot z_{x,n} \right) \right) \rightarrow \max$$

$$\forall x \in \{m^*\}$$

Restrictions



- 1) Basic operating system consumption $\sum_{n=1}^{NV} VM_{k,n} \cdot z_{m,n} \leq RM_{k,m} - OS_k, k = 1..NR$
- 2) Virtual servers bandwidth \leq physical channel capacity $\sum_{n=1}^{NV} LV_{n,m} \cdot z_{m,n} \leq S_m, m = 1..NP$
- 3) Special restrictions for placement $\sum_{j=1}^N L_{q,j} \cdot z_j \leq 1, q = 1..NL$

Optimization algorithm

Modified local search method with a multiple start mechanism and a variable search radius. The appointed servers are excluded from further consideration. Virtual machines placement algorithm diagram presented at right.

Employment

Tested on a real computer system: 50 virtual servers; 5 physical servers; 1 Gbit/s channels.
Increase of efficiency ~ 20%.

Conclusions

- 1) Increase the efficiency of using the real system resources => increase energy efficiency.
- 2) Restrictions allow to host redundant virtual servers => increase fault tolerance.

Virtual machines placement algorithm

