ICNP15 | Paper #74

stefan@net.t-labs.tu-berlin.de   Profile | Help | Sign out

Your submissions #77   (All)   Search

📄 **Main**   📝 Edit

#74 How Hard Can It Be? Understanding the Complexity of Replica Aware Virtual Cluster Embeddings

☑ **EMAIL NOTIFICATION**
Select to receive email on
updates to reviews and
comments.

PC CONFLICTS
Georgios Smaragdakis
Stefan Schmid

SHEPHERD
Kihong Park

Accepted   📄 2522kB   8 May 2015 10:52:30am CDT |
9226f63eb9158139e6e1b4472d5dac45945dc3a5

You are an **author** of this paper.

▸ **ABSTRACT**

Virtualized datacenters offer
great flexibilities in terms of
resource allocation. In particular,
by decoupling applications from
the constraints of the underlying
infrastructure, [more]

▸ **AUTHORS**

P. Costa, C. Fuerst, M. Pacut,
S. Schmid [details]

▸ **TOPICS**

	OveMer	RevExp	Nov
Review #74A	2	3	3
Review #74B	4	3	4
Review #74C	3	2	4
Review #74D	3	2	4
Review #74E	5	4	4

📝 **Edit paper**

📄 **Reviews in plain text**

Review #74A   Modified 2 Jun 2015 6:28:55am   📄 Plain text
CDT

OVERALL MERIT (?)
2. Weak reject

REVIEWER EXPERTISE (?)
3. Knowledgeable

NOVELTY (?)
3. Incremental improvement

PAPER SUMMARY
The paper describes VM placement and bandwidth
assignment algorithms in cloud environments. The paper
focuses on theoretical analysis of the algorithms. The
main result is that bandwidth reservation problem can be
solved in polynomial time. The main contribution is the
algorithm design.

STRENGTHS
The paper describes many algorithms that capture the
nature of many resource allocation problems in the cloud
environment. Some of the findings are new. The most
important contribution is applying the integrity theorem
to show that the algorithm for RS + MA + BW is
polynomial.

WEAKNESSES

The paper does not go beyond theoretical analysis. It abstracts out many details, such as disk I/O bandwidth. It does not show the actual run time of the algorithms, scalability of the algorithm, and treat all assignment problem as a batch process that happens all at once. In sum, it is purely theoretic and have very little systems implication.

The problem is not also very new. There are many heuristics proposed. So I'm not sur e if listing many variants add much.

COMMENTS FOR AUTHOR

The paper formulates many resource allocation problems and presents algorithms for them. One interesting thing (perhaps a new finding) is that bandwidth assignment problem (or admission control) can be solved in polynomial time. The paper presents a few variants to the resource/VM assignment problem by introducing/removing some more constraints.

 The shortcomings of this paper is that it's purely theoretic. It does not show the actual run time of the algorithms, scalability of the algorithm, and treat all assignment problem as a batch process that happens all at once. In sum, it is purely theoretic and have very little systems implication.

 What's the size of the problem that you are targeting? In large data centers there can be 10s to 100s of thousands of VMs. Also often online algorithms are used to deal with a constant stream of requests. Without measuring the runtime of the algorithm and evaluation of implementations of the algorithm, it's very difficult to see what the real problem might be. I do not believe analyzing the time complexity is important. NP or P is probably the most important implication, but other than that in real life, the size of the problem and the scalability and the run time of the algorithm is most important.

 Also many studies, including Oktopus and many other following work, use heuristics for some of the problems discussed in the paper. It would be good to see how the heuristics compare against the optimal design. In this sense, the algorithms described in the paper would be useful to other researchers who might want to come up with online heuristics to the problem.

 I think it would be better to state up front the usefulness of pure theoretic analysis, if you are solely focusing on this. Otherwise, please consider expanding the paper to include the performance evaluation of the algorithm.

Review #74B   Modified 3 Jun 2015 11:57:58am 🅰 [Plain text](#)
CDT

OVERALL MERIT (?)

4. Accept

REVIEWER EXPERTISE (?)

3. Knowledgeable

NOVELTY (?)

4. New contribution

PAPER SUMMARY

This paper considers data locality aware embedding of virtual clusters in tree based network substrates. The paper considers 5 structural features that affect optimal placement: replica selection, multiple assignment, flexible placement, node interconnect, bandwidth capacities. Based on different combinations, the paper identifies which types are poly-time solvable and which are NP-hard.

STRENGTHS

The paper takes a structural approach to address optimal graph embeddings in tree networks motivated by virtual cluster management in data networks. By focusing on tree-based networks subject to 5 constraints, the paper proceeds to classify the resultant optimization problems as poly-time solvable or intractable. The results acquire some relevance for their qualitative insights.

WEAKNESSES

It is not clear that the formulation advanced with the 5 structural features is practically relevant. For example, delay is an important concern of many applications which is influenced by network traffic. The latter need not be of the constant-bit rate, i.e., fixed bandwidth reservation type, considered in the paper. And this is but one among several features which may be more relevant than the 5 chosen.

COMMENTS FOR AUTHOR

This paper considers data locality aware embedding of virtual clusters in tree based network substrates. The paper considers 5 structural features that affect optimal placement: replica selection, multiple assignment, flexible placement, node interconnect, bandwidth capacities. Based on different combinations, the paper identifies which types are poly-time solvable and which are NP-hard.

Although the selection of the five structural optimization features is a reasonable start, future work may benefit from further interaction/discussion with practitioners of resource allocation virtual machine based data centers.

Review #74C   Modified 18 Jun 2015 8:08:48pm 🅰 [Plain text](#)

CDT

OVERALL MERIT (?)

3. Weak accept

REVIEWER EXPERTISE (?)

2. Some familiarity

NOVELTY (?)

4. New contribution

PAPER SUMMARY

This paper provides algorithmic analysis of several variations of virtual cluster embedding problem

STRENGTHS

Authors presented detailed models and analysis of several combinations of the problem under study.

WEAKNESSES

Authors should have provided more insights about how different components contribute to the hardness of the problem, and how to develop good approximation algorithms.

COMMENTS FOR AUTHOR

Authors presented a set of algorithms and complexity analysis for different combinations of the virtual cluster embedding problem along several dimensions: replica selection, multiple assignment, flexible placement, node interconnect, and bandwidth capacity. Virtual cluster embedding is an important problem in data center networking. A comprehensive study of algorithm complexity is timely. The models and algorithms presentation is clear. The Polynomial-time algorithms are well constructed. The NP-hardness study also provides good insights on the complexity nature of the problem. Since this is a algorithmic study paper. More analysis and discussion on how different components contribute to computation complexity will make the paper more insightful. Also, as listed as future work by the authors, guidelines for developing approximation algorithms will further increase the value of algorithmic study,

Review #74D   Modified 23 Jun 2015
7:38:23am CDT

Plain text

OVERALL MERIT (?)

3. Weak accept

REVIEWER EXPERTISE (?)

2. Some familiarity

NOVELTY (?)

4. New contribution

PAPER SUMMARY

The paper discusses the computations complexity of several variants of assigning chunks to virtual machines,

and placing the VMs in a tree switched network of servers. The general problem is characterized in several decision dimensions, such as whether multiple replicas of the chunks exists, whether the placement of the VMs is already determined, whether bandwidth needs to be allocated between VMs etc. The paper shows that some variants of the general problem is NP-hard, depending on the exact combinations of the decisions needed (degrees of freedom) in the problem. For the non-NP hard cases, polynomial time algorithms based on flow assignment, matching or dynamic programming are presented.

STRENGTHS

A comprehensive study of the complexity of the problem of assigning chuck to VMs and placing them on a network of servers. The number of variants considered seem to far exceed those that have been considered in the literature. The NP-hard results on some of these problems, while not surprising, are interesting and important, and some of the reductions seem non-trivial.

WEAKNESSES

Direct connection to networking protocols is weak, and the paper could be borderline in terms of scope for this conference. The paper reads entirely like a theory paper, and does not contain any simulation study or numerical evaluations. Some of the modeling assumptions are also not clearly justified (see below).

COMMENTS FOR AUTHOR

Of the polynomially solvable variants, the case discussed in Section III-C (Dynamic program) is interesting; most of the other polynomial-time cases are easy to see.

Why is the spatial distribution of the data (chunks) assumed to given (not a decision parameter)? That seems hard to justify. Also, why should the VM interconnect graph need be complete (clique)? For the MA case, why do the chunks per node need to be a constant?

While the problem motivation and basic system model is clearly presented, and the paper is generally clearly written, the consideration of so many variants leaves the reader confused on the overall message of the paper, despite the authors' discussion in that regard in the "Summary and Conclusions" section.

There a few typos; a few examples:

- Page 2: "The to be processed ..."
- Page 4: "solved with the flow ..."
- Page 5: An extra "." after "feasibility."

Review #74E   Modified 1 Jul 2015 11:44:37pm   📄 Plain text
CDT

OVERALL MERIT (?)

5. Strong accept

REVIEWER EXPERTISE (?)

4. Expert

NOVELTY (?)

4. New contribution

PAPER SUMMARY

TPC Meeting Discussion Summary: This paper was accepted ahead of the TPC meeting. The reviewers unanimously agreed that there is sufficient new contributions in this work to merit publication in the conference.

HotCRP Conference Management Software