CS5052 – Paper Review

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"Mesos: A Platform for Fine-Grained Resource Sharing in the Data Center"

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INTRODUCTION :

The growing demand for big data and computing has led to the development of large-scale data centres that host a wide range of applications. Large Internet services and an increasing number of data-intensive application domains are both powered by clusters of commodity servers, which have emerged as major computing platforms.

Due to these uses, academics and industry practitioners are creating a wide range of cluster computing frameworks to make cluster programming simpler. It has become clear that no one framework will be best for all cluster computing applications as new cluster computing frameworks keep coming into existence.

As it's clear that businesses want to run several frameworks in a cluster, selecting the optimal one for each application. The problem seems to be the mismatch between the allocation granularities of these solutions and existing frameworks.

Mesos is a distributed systems framework that acts as a resource-sharing layer, providing various cluster computing frameworks with a standardized interface for accessing cluster resources.

The authors propose Mesos, which aims to address the challenges of resource allocation and utilization in large-scale data centres.

OBJECTIVE:

The authors emphasise that the issue they are attempting to address is resource fragmentation in data centres, where various applications require various resource kinds and the resources are frequently underutilised.
They contend that because existing solutions, such as cluster managers, are designed for particular workloads and do not offer fine-grained sharing, they are insufficient.

The authors observe that Mesos surpasses these systems in terms of resource consumption, fault tolerance, and scalability when they evaluated the Mesos architecture by comparing it to already-existing systems like Hadoop and Condor.

NOVELTY:

The study introduces a novel issue of fine-grained resource sharing that is not sufficiently handled by current solutions like virtualization and cluster management.

The Mesos framework, according to the authors, is original and distinctive since it enables various frameworks to share a single cluster, resulting in effective resource management.

The problem is resource fragmentation and underutilization in data centre environments, and the solution is novel and makes an opportunity to address it.

EVALUATION:

Comparing the Mesos system to other ones, such as Hadoop and Condor, was part of the evaluation process. The authors contend that by permitting fine-grained resource sharing, revocable resources, and isolation between activities, the Mesos architecture offers effective resource use. The result reveals that Mesos, in comparison to other options, can increase resource utilisation and decrease work completion time.

Specifically, the evaluation highlights the following strengths of Mesos :

- Mesos offers fine-grained resource sharing, which enables resource allocation on a per-task basis, improving resource consumption.
- Multiple frameworks are supported by Mesos, allowing many applications to coexist and share resources on the same cluster.
- Mesos offers fault tolerance by separating tasks from one another and delicately addressing failures.

The evaluation also identifies some of the limitations of Mesos :

- Existing applications must need major modifications to work on Mesos.
- Mesos lacks inbuilt security mechanisms; these must be added independently.

The paper makes the argument that Mesos is superior to existing solutions in terms of fine-grained resource sharing over virtualization and cluster managers, which do not offer the required level of sharing and may lead to inefficient resource utilization.

However, the study notes that Mesos might not be suitable for all workload types and that other solutions might be better suitable under some circumstances.

The review appears to be comprehensive and well-planned, testing Mesos' functionality using a range of benchmarks and workloads. However, there is always a chance that the evaluation may have shortcomings or restrictions that are not instantly evident.

To completely evaluate the advantages and disadvantages of Mesos in various contexts, additional study and analysis may be required.

CONTRIBUTIONS :

The contributions of the paper are summarised below :

- In this study, a hierarchical scheduling architecture is proposed, which enables Mesos to support a wide range of scheduling strategies, such as fair sharing, priority-based scheduling, and gang scheduling.

- The cluster can be divided into many frameworks, each with its scheduling policy, owing to the design.

- Mesos was implemented by the authors, who then tested it using a variety of workloads such as Hadoop, MPI, and web services. In comparison to current resource managers, the evaluation revealed that Mesos offers greater resource utilisation and quicker response times.

Numerous practical use cases and real-world applications demonstrate the influence of Mesos, including:

- *Large-scale web services:* Large-scale online services like Twitter, Airbnb, and Apple Siri have all been deployed and maintained with the support of Mesos. Mesos offers the essential foundation for effective resource sharing and usage. These services require dynamic resource allocation to manage shifting workloads.
- *Big data processing:* Frameworks for large-scale data processing, like Hadoop and Spark, have been deployed and managed using Mesos. To manage large-scale data processing, these frameworks need to use resources effectively, and Mesos offers the essential abstraction layer for precise resource allocation.
- *High-performance computing:* High-performance computing workloads like MPI and OpenMP have been managed by Mesos. To manage large-scale scientific computing, these workloads need effective resource sharing, and Mesos offers the essential scheduling principles for gang scheduling and resource sharing.

Mesos has developed into a popular platform for managing highly scalable applications and frameworks in the data centre as a result of the contributions made by the research, which have had a substantial overall impact on the field of distributed systems and resource management.

CONCLUSION :

In conclusion, the paper proposes a novel solution to the problem of resource fragmentation in data centres. The paper describes several features of the Mesos system and provided real-world applications providing superior performance compared to existing systems in terms of resource utilization, fault tolerance and scalability. Overall, the paper presents significant contributions to its respective field.

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