CHAPTER 7

CONCLUSION

In this thesis, the DILOST problem for scheduling divisible loads on distributed heterogeneous environments is formulated and analyzed. The problem has been studied and examined from three points of view: single source with single resource, single source with multiple resources and multi-source with single resource. This chapter summarizes the various points covered in the thesis and presents several ideas for future enhancements.

7.1 SUMMARY OF THE THESIS

This work considers the most general form of DILOST problem for distributed environments. To simplify the mathematical model it is assumed that one or two root nodes (originators) and only five child nodes are used to examine the model, but it can be extended with any number of root nodes and child nodes. The child nodes considered in this work as heterogeneous in nature which differ in both computation and communication time. All the three problems formulated are computationally hard and are solved mathematically by reduction to non-linear programming using Branch-and-Bound algorithm.

In the single source with single resource, three models have been designed viz. sequential (single port) communication model, concurrent model and economical model. In the single port model, it is assumed that the communication between the root node and the child node is sequential; the workload fraction is distributed to the child nodes one by one. So the child
node has to wait for a long time to receive the load fraction. The way to minimize the waiting time is by using multi-installment technique, where the workload portion assigned to a child processor can be split into a smaller (chunk) portion again instead of sending the entire workload fraction.

In the single source with multiple resources model, the finish time minimizing problem involves a heterogeneous multi-level tree of processors and the link is discussed. The finish time of processing a divisible load, which is linearly dependent on the amount of divisible load is examined and is basically composed of computing time and communication time. A monetary network analysis is performed by aggregating the network speed parameters, computing and communicating parameters. This allows obtaining a solution for the processed load with a minimum computing and communication cost. While solving this model, the optimal size of the load partition for each root node, and the size of the task assigned to each child nodes are obtained.

In the last model of multi-source with single resource, it is analyzed that the allocation of workload to the child node is analyzed when the load is received from more than one originating point in the network. In this model it is assumed that there are two load originating points in the network and the solution to the two source divisible load scheduling problem through non-linear programming model with some assumptions is demonstrated. The proposed model is compared with the exiting model based on divisible load theory, which gives a better solution. The major issue in the divisible load scheduling model is the communication delay. The model has been tested with different communication time and also with different result return ratios. The results show that up to a certain point increasing the number of child nodes can significantly improve the performance.

Table 7.1 shows the salient features of the proposed model with respect to the existing model. In the existing model all the constraints are
strict, but in the proposed model they are relaxed, so that there is a very small change in the processing time and the processing cost is also considerably reduced.

Table 7.1 Salient Features of this Research as Compared with the Traditional DLS Model based on DLT

<table>
<thead>
<tr>
<th>Features</th>
<th>DLS based on DLT (Existing model)</th>
<th>DLS based on DILOST (Proposed model)</th>
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<tbody>
<tr>
<td>Allocation sequence</td>
<td>Decreasing communication time</td>
<td>Depends on both communication and computation time</td>
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<tr>
<td>Number of nodes used</td>
<td>All the available nodes</td>
<td>Necessary number of nodes</td>
</tr>
<tr>
<td>Result return strategy</td>
<td>Follows in the order of allocation</td>
<td>No specific order, return the result within the available time</td>
</tr>
<tr>
<td>Availability of the node</td>
<td>Entire scheduling period</td>
<td>Only in the specific interval of time</td>
</tr>
<tr>
<td>Processing Cost</td>
<td>Only for economical models</td>
<td>One of the parameter for allocation sequence</td>
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</tbody>
</table>

The main drawback in the proposed approach is, a child node join in the scheduling process has to be complete the process of workload fraction assigned to the node. It is assumed that there is no system failure in the processing. But in reality this is unrealistic assumption, so this has to be relaxed.

7.2 FUTURE ENHANCEMENTS

The future work can be processed in many directions of the work carried out in this thesis. The complexity of the DILOST problem is still an open issue and it makes an interesting topic in research. One can check
whether the problem can be solved in polynomial time? If possible what are the additional constraints to enforce the existing model?

The proposed model can be modified with dynamic and uncertainty in the system parameter, consideration of node failure, sharing of information or load between child nodes, submitting more than one job for a single source system, and also it can be extended with multi-source with multiple resources model to analyze the system performance. Moreover the future work would include determining performance degradation bounds, both across possible parameter values for a particular topology and across different topologies.

In the single source model one can follow multi-installment strategy to workload distribution so that the waiting time of each child node can be reduced. The single source with multiple resources model has been analyzed with two resources, and which can be extended to multiple resources, to study the complexity of the system performance. Also in the case of a multi-source model, it can be extended with more than two sources to study the system performance. All the testing strategies followed in this thesis have been carried out using LINGO modeling tool. The special feature of the tool is discussed in Appendix 1. New and different applications in different domain apart from the scientific applications mentioned in the introduction need to be developed that use the results in this thesis.