Preface

Advanced economical and ecological information technology methods are presented with practical examples. A special effort is made to show how the energy consumption per job can be reduced: Adjusting processor frequency to application needs, optimizing applications on cores, nodes, clusters and Grids, choosing the best suited resource to execute a job, stopping inefficient resources, and adapting new machines to the application community. For this purpose, the applications and the computational and communication resources are parameterized, running jobs and the status of the resources are monitored, and the collected data is stored in a database. At run time the input queues of all the eligible resources are accessed by the metascheduler and used to predict job waiting time. Models are applied to predict CPU time and network needs. A cost function is then defined to estimate the real cost of the application on the resources, including costs related to CPU time, licensing, energy consumption, data transfer, and waiting costs. The lowest cost resource is chosen. If already reserved, the application is submitted to the next best one. The environment can be used by computing centers to optimally schedule a Grid of computers.

The historical data is used to detect inefficient resources that should be decommissioned, and to predict new resources that would be best suited to the application community. The complexity analysis needed to estimate the CPU time can help to predict an improper behavior of an application, and can give hints to improve it.

All this information is used to reduce energy consumption directly or indirectly. Thus, it is possible to automatically adjust the frequency of each node to the needs of the application task, reducing processor energy consumption. Another energy consumption reduction can be achieved by increasing the efficiencies of the nodes and of the internode communication networks, done by an optimal scheduling of applications to well suited resources in a computational Grid. It is also possible to detect energy inefficient resources that should be stopped, and replaced by those adjusted to the needs of the Grid user community. And last but not least, optimizing the applications on cores, nodes, clusters, and on a Grid reduces their run time, and lowers energy consumption per run. Often, this latter energy reduction step is the most profitable.
All those actions are agnostic to the applications, thus, there is no need to modify a program.

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