A Grid Computing Architecture for Applications in Computational Mechanics

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Grid computing has been proposed as a framework for distributing computations over a network of computers. This paper presents a Grid Computing solution based on Microsoft's Common Language Runtime and the .NET/MONO Framework that allows quick, easy and inexpensive setup of high-performance parallel computing networks. The solution extends the common scope of "Parallel Computing" or "Distributed Computing" by incorporating remote service look-up, reference and management of computational processes over the Internet using XML based Web Services. The implementation of computations over a cluster of machines is called a "Grid Garden". Grid Garden.NET provides a novel way of distributing, managing and executing executables over the "Garden" of machines. The user needs minimal knowledge about the network structure, communication protocols or the underlying mechanisms provided by the Grid Garden. The user writes "seeds", which are programs (dll's) that inherit some common interfaces, and "plants" them in remote computers that form the Grid Garden system. The user is provided local proxies for the remote objects and the proxies can be manipulated (run, halted or killed) on the user's local machine. The implementation significantly benefits from the experience of MPI. However, Grid Garden.NET is far from being an MPI clone. Comparisons with MPI and with the Open Grid Services Architecture (Globus Toolkit 3) are provided in this paper. The potential of Grid Garden.NET in mechanics is discussed and an example of computing the multi-body dynamics of molecules in a rigid container is detailed.