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Abstract

Grid-enabled 3D Ray Tracing Algorithm for Wireless Network Simulation and Planning

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Wireless Propagation Model largely affects accuracy and efficiency of a wireless simulator because radio wave propagation model is considered as an important input of a radio network simulation, planning and optimisation process. The existing radio wave propagation prediction techniques are based on empirical models and deterministic models. Empirical models such as Okumura-Hata and Walfish-Ikegami are constructed based on a great number of statistics and a verified factor. Empirical models consider a small portion of factors, such as the height of the base stations, the frequency of transmitting waves and among others. Deterministic models consider more factors such as wave propagation phenomena, buildings and others. Compared to empirical models, they are more time-consuming but are more accurate.

3D Ray Tracing Algorithm is one of many rendering techniques that can be used to enhance the propagation prediction in a wireless network. It requires heavy float-point calculations. The algorithm simulates rays while a great data-intensive computational resource is needed to distribute a bunch of rays reflecting, diffracting, scattering and among other wave phenomena within a limited dimension due to computers' capability. Either distributing as many rays as possible from the source or enlarging the computing dimension yields better accuracy while needs more computational power.

Recent interests have shown to use network-based resources for large scale data-intensive computation problems. There are many well-defined technologies and standards for distributed computing (e.g. cluster) that can employ parallelism to speed up processing. Grid is preferable because: (1) A cluster is a group of loosely-coupled computers that are localized, which limits them in scope with dedicated functionality, local to the domain, and not suitable for resource sharing from different domains while Grid aggregates world-wide un-used computing resources that are geographically dispersed (with different control domain). For radio network simulation, planning and optimisation, it is very likely that radio network system modelling, simulation engine (e.g., use Monte Carlo, dynamic or discrete event simulation methods), and optimisation engine are in geographically dispersed areas. (2) The use of a Grid middleware would allow individual PCs, centralised & distributed clusters working on a demand basis to implement algorithms. The scalability and flexibility are guaranteed. (3) Grid Technology can be easily merged with Web Services , which can be very advantageous to make the developed simulation tool a web service for commercial use. (4) Compared to Grid, .NET, CORBA, and J2EE lack interoperability among technology protocols, resource discovery across virtual participants, a suitable platform for sharing of resources, and dynamic construction of a virtual organization.

This research aims to investigate the performance impact of a grid propagation simulator for wireless networks when parallelised 3D ray tracing algorithms are adopted. After the completion of the planned research, a grid-enable simulator will improve the process of real-time propagation simulation.