# EARLY GRID ACTIVITIES

Over the past several years, there has been a lot of interest in computational Grid Computing worldwide. We also note a number of derivatives of Grid Computing, including compute grids, data grids, science grids, access grids, knowledge grids, cluster grids, terra grids, and commodity grids. As we explore careful examination of these grids, we can see that they all share some form of resources; however, these grids may have differing architectures.

One key value of a grid, whether it is a commodity utility grid or a computational grid, is often evaluated based on its business merits and the respective user satisfaction. User satisfaction is measured based on the QoS provided by the grid, such as the availability, performance, simplicity of access, management aspects, business values, and flexibility in pricing. The business merits most often relate to and indicate the problem being solved by the grid. For instance, it can be job executions, management aspects, simulation workflows, and other key technology-based foundations.

Earlier Grid Computing efforts were aligned with the overlapping functional areas of data, computation, and their respective access mechanisms. Let us further explore the details of these areas to better understand their utilization and functional requirements.

**Data**

The data aspects of any Grid Computing environment must be able to effectively manage all aspects of data, including data location, data transfer, data access, and critical aspects of security. The core functional data requirements for Grid Computing applications are:

- The ability to integrate multiple distributed, heterogeneous, and independently managed data sources.
- The ability to provide efficient data transfer mechanisms and to provide data where the computation will take place for better scalability and efficiency.
- The ability to provide data caching and/or replication mechanisms to minimize network traffic.
- The ability to provide necessary data discovery mechanisms, which allow the user to find data based on characteristics of the data.

- The capability to implement data encryption and integrity checks to ensure that data is transported across the network in a secure fashion.
- The ability to provide the backup/restore mechanisms and policies necessary to prevent data loss and minimize unplanned downtime across the grid.

**Computation**

The core functional computational requirements for grid applications are:

- The ability to allow for independent management of computing resources
- The ability to provide mechanisms that can intelligently and transparently select computing resources capable of running a user's job
- The understanding of the current and predicted loads on grid resources, resource availability, dynamic resource configuration, and provisioning
- Failure detection and failover mechanisms
- Ensure appropriate security mechanisms for secure resource management, access, and integrity

Let us further explore some details on the computational and data grids as they exist today.

**Computational and Data Grids**

In today's complex world of high speed computing, computers have become extremely powerful as to that of (let's say) five years ago. Even the home-based PCs available on the commercial markets are powerful enough for accomplishing complex computations that we could not have imagined a decade prior to today.

The quality and quantity requirements for some business-related advanced computing applications are also becoming more and more complex. The industry is now realizing that we have a need, and are conducting numerous complex scientific experiments, advanced modeling scenarios, genome matching, astronomical research, a wide variety of simulations, complex scientific/business modeling scenarios, and real-time personal portfolio management. These requirements can actually exceed the demands and availability of installed computational power within an organization. Sometimes, we find that no single organization alone satisfies some of these aforementioned computational requirements.

Later in this book, in the "Grid Anatomy" section, we will see that this definition has evolved to give more emphasis on the seamless resource sharing aspects in a collaborative virtual organizational world. But the concept still holds for a computational grid where the sharable resource remains a computing power. As of now, the majority of the computational grids are centered on major scientific experiments and collaborative environments.

The requirement for key data forms a core underpinning of any Grid Computing environment. For example, in data-intensive grids, the focus is on the management of data, which is being held in a variety of data storage facilities in geographically dispersed locations. These data sources can be databases, file systems, and storage devices. The grid systems must also be capable of providing data virtualization services to provide transparency for data access, integration, and processing. In addition to the above requirements, security and privacy requirements of all respective data in a grid system is quite complex.

We can summarize the data requirements in the early grid solutions as follows:

- The ability to discover data
- The access to databases, utilizing meta-data and other attributes of the data
- The provisioning of computing facilities for high-speed data movement
- The capability to support flexible data access and data filtering capabilities