Chapter I
Overview of Grid Computing

Emmanuel Udoh
Indiana University–Purdue University, USA

Frank Zhigang Wang
Cranfield University, UK

Vineet R. Khare
Cranfield University, UK

ABSTRACT

This chapter presents a historical record of the advent of Grid with a recourse to some basic definitions commonly accepted by most researchers. It discusses the current and potential users of Grid computing and the expected changes in the user base as it gains popularity. The role of the Internet infrastructure in shaping the grid evolution received detailed treatment. Furthermore, the chapter contrasts grid computing with distributed and peer-to-peer computing and highlighted the salient features. Finally, the chapter discusses the recent advances in Web and Grid service technologies, including international projects, emerging standards and organizations, and the current challenges faced by Grid researchers.

INTRODUCTION

The computational grid emerged in 1990s from the works of Ian Foster and Carl Kesselman (Foster and Kesselman, 1999, 2003). The word “grid” is analogous to the electric power grid, which provides pervasive access to electrical power. Residential homes source power from the power plant through the distribution grid, which sometimes covers a region, a nation and even a continent. Similarly, computational grid is predicted to provide pervasive access to advanced computational resources to people across national boundaries. According to Foster and Kesselman (1999), the grid is a new class of infrastructure built on the Internet and the World Wide Web.
Using the Internet as a bedrock, the grid offers networked computer systems access not just to information but also to computing power. Sometimes, the grid is dubbed as Internet II (next-generation Internet). However, the grid differs from the Internet, as it is much more than a means of communication between computers.

Today’s Internet and web technologies address basic communication requirements, but not the computational tasks. The grid’s mission is to provide the infrastructure and tools that make large-scale and secure resource sharing possible and straightforward. In this regard, the grid subsumes the traditional Internet. Nevertheless, the grid is not an alternative to “the Internet”: it is rather a set of additional protocols and services that are built on Internet protocols and services to support the creation and use of computation- and data-enriched environments.

Scientists in many different fields today require world-wide collaborations, i.e. multi-domain access to distributed resources. But even as computer power, data storage, and communication continue to improve exponentially, computational resources are failing to keep up with what scientists demand. The advent of grid technologies could change the way that many institutions practice science. Grids provide access to large data processing power and huge data storage capabilities. Furthermore, as the grid grows its usefulness increases with availability of more resources. Scientists hope that with the help of the grid, vast computing resources around the world can be harnessed and shared to tackle some of the biggest challenges in medicine, physics, astronomy and engineering.

In this chapter, we present some definitions of grid computing accepted by most researchers. An examination of the historical record of the advent of grid and the current and potential users of grid computing was undertaken. We discuss how the basic Internet infrastructure has shaped the evolution of grid. The grid was also contrasted with the Internet and distributed computing. Finally, we discuss recent advances in web and grid service technologies, including international projects, emerging standards and organizations, and the current challenges faced by grid researchers.

**BACKGROUND**

**Electrical Power Grid**

Most of us have a pervasive access to electrical power. It is a little bit like the air we breathe: we don’t really think about it until it is missing. Power is just “there,” meeting our every need, constantly. It is only during a power failure like the 2003 North American Blackout, when we walk into a dark room and instinctively hit the useless light switch that we realize how important power is in our daily life. We use it for heating, cooling, cooking, refrigeration, light, sound, computation, and entertainment. Without it, life can get somewhat cumbersome. Electrical power is brought from the power plant to our houses through an amazing system called the power distribution grid, which sometimes covers a region, a nation and even a continent. For power to be useful in a home or business, transformers step transmission voltages (in the tens or hundreds of thousands of volts range) down to voltages of typically 100-250 volts. Through this regional, national or even continental distribution grid, finally we are down to the wire that brings power to our house. No matter if we live in a suburban or rural area, availability of electricity is the same. It is so public, in fact, that we don’t even notice its existence anymore. Our brain ignores all of the power lines because we have seen them so often.