Preface

The current generation of power networks are struggling to cope with the on-going rise in demand from both commercial and residential users. Initially designed to supply local geographic areas, the electricity grid has evolved over time into a highly interconnected complex system that spans overs hundreds of miles. Today's power grid is comprised of thousands of power lines, power sub-stations, transformers, and other equipment responsible for the energy supply process from fossil-fuelled power plants to the consumer.

Moreover, the centralised and complex nature of the current power grid is creating reliability and scalability issues. These reliability issues, coupled with the need to replace fossil fuel with more accessible and less polluting sources of energy, are driving the modernization initiative of the electricity grid, often called the Smart Grid. The smart grid initiative aims to provide a number of solutions and concepts that promise to change the way we produce, supply, and consume energy. The future power grid will be characterized by novel applications that will help consumers to interact directly with their energy suppliers and involve them in the economics of demand and supply. It will also help consumers to optimise their living style, rearrange their day-to-day energy usage schedule, and in turn enable them to reduce bills from a variety of energy consumption in the house.

Advances in the areas of information and communication technologies, such as wireless communications and wireless sensor networks, will also be fundamental to the smart grid. These technologies are now reaching a level of maturity such that they can be adapted for use in power grid operations. The future power grid will be built on top of on a new pervasive IT infrastructure that provides high level coordination, monitoring, and control capabilities far beyond what is used today. This IT infrastructure will need to provide fast bidirectional communications among all devices and entities involved in electricity production, supply, and consumption. As such, although the requirements of the smart grid will vary from one application to another, communications in this infrastructure will be ubiquitous and must be reliable, flexible and fault tolerant.

This book will discuss the rise of the smart grid from the perspective of computing and communications and aims to explain how current and next-generation network technology and methodologies can help realize the potential that the smart grid initiative promises. In this book, we will study the control and communication issues that need to be addressed in order to modernize the power grid and introduce smart grid applications, identify the requirements that need to be met in order to achieve this objective, and present the technologies that will help in implementing the smart grid.

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