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Communication Challenges and Solutions in the Smart Grid

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ISSN 2191-5768

ISBN 978-1-4939-2183-6

DOI 10.1007/978-1-4939-2184-3

Springer New York Heidelberg Dordrecht London

ISSN 2191-5776 (electronic)

ISBN 978-1-4939-2184-3 (eBook)

Library of Congress Control Number: 2014951918

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Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

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 over 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.

Contents

1	Overview of the Smart Grid	1
1.1	Smart Grid Drivers	2
1.1.1	Aging Infrastructure	3
1.1.2	Environmental Impact	3
1.1.3	Security of Energy Supply and Increase in Energy Needs	4
1.1.4	Electricity Cost	4
1.2	Smart Grid Technologies	5
1.2.1	Renewable Energy Generation	5
1.2.2	Demand Response	6
1.2.3	Advanced Metering Infrastructure	6
1.2.4	Home Energy Management	7
1.2.5	Plug-in Hybrid Electric Vehicle	7
1.3	Smart Grid Benefits	7
1.3.1	Technical Benefits	8
1.3.2	Economic Benefits	8
1.3.3	Environmental Benefits	8
1.4	ICT in the Smart Grid	9
1.4.1	Digital Communications	9
1.4.2	Wireless Sensing	9
1.4.3	Distributed Systems	10
1.5	Summary	10
	References	11
2	Communication for Control in Heterogeneous Power Supply	13
2.1	Control in Traditional Power Networks	14
2.2	Distributed Generation and Active Control	16
2.3	Communications Challenges in Active Control	19
2.3.1	Inter-Controller Coordination Traffic	20
2.3.2	Field-Device Control Traffic	21
2.4	Conclusion and Open Issues	22
	References	22

3	The Smart Grid in the Last Mile	25
3.1	Metering of Electricity	26
3.1.1	Traditional Metering	26
3.1.2	Smart Metering	27
3.1.3	Advanced Metering Infrastructure	28
3.2	Demand Response System	29
3.3	Communication Architecture for AMI	30
3.3.1	Neighborhood Area Network	31
3.3.2	AMI Wide Area Network	31
3.4	Communication Requirements and Solutions	32
3.4.1	Communication Requirements	32
3.4.2	Communication Technologies and Implementations	32
3.5	Conclusion and Open Issues	33
	References	34
4	Communication Solutions for Backhaul and Wide Area Networks	37
4.1	Wired Communications Media	38
4.1.1	Telephone Line	38
4.1.2	Digital Subscriber Lines (DSL)	38
4.1.3	Fiber Optics	39
4.1.4	Power Line Carrier	39
4.1.5	Discussion	41
4.2	Satellite Communication	42
4.2.1	Geostationary Orbit Satellite	42
4.2.2	Low Earth Orbiting Satellite Communication	43
4.2.3	Discussion	43
4.3	Radio Communication	44
4.3.1	Microwave Radio	44
4.3.2	Ultra High Frequency Radio	45
4.3.3	Discussion	45
4.4	Mobile Radio	45
4.4.1	Global System for Mobile communications (GSM)	46
4.4.2	General Packet Radio Service	47
4.4.3	Third and Fourth Generation of Mobile Phone Technology ...	47
4.4.4	Private Mobile Radio (PMR)	47
4.4.5	Discussion	49
4.5	Conclusion and Open Issues	49
	References	51
5	Home Energy Management Systems	53
5.1	Energy Usage in Homes and Buildings	54
5.1.1	Heating and Cooling	54
5.1.2	Lighting System	55
5.1.3	Daily Appliances	55
5.2	Smart Home and Home Energy Management	56
5.2.1	Existing Energy Management Solutions	56

5.2.2	Home Energy Management Operations and Components	57
5.2.3	Smart Appliances.....	58
5.2.4	Environment Sensors and Actuators.....	59
5.2.5	Home Energy Controller	61
5.3	Communication for Home Energy Management	62
5.3.1	Communication Architectures for Home Energy Management.....	62
5.3.2	Communication Requirements	63
5.3.3	Communication Technologies and Solutions	64
5.4	Conclusion and Open Issues	65
	References	66
6	Communication Technologies for Smart Energy Management Systems	69
6.1	Power Line Communication (PLC)	69
6.1.1	X10	70
6.1.2	Ineston	70
6.1.3	Lonworks	71
6.1.4	Universal Power Line Bus.....	71
6.1.5	Homeplug	71
6.1.6	KNX	72
6.2	Ethernet	72
6.3	Wireless Communication	73
6.3.1	Wi-Fi.....	73
6.3.2	IEEE 802.15.4 and Zigbee.....	74
6.3.3	Radio Frequency for Consumer Electronics.....	75
6.3.4	Bluetooth	76
6.3.5	Visible Light Communication	77
6.4	IP Protocol.....	78
6.5	Conclusion and Open Issues	79
	References	80
7	Towards a Unified Smart Grid ICT Infrastructure.....	83
7.1	Architectural Design and Data Aggregation	83
7.1.1	Smart Grid Data Aggregation.....	84
7.1.2	Interface to the Grid Control System.....	85
7.2	Provision of Computing Power.....	86
7.2.1	Use of Cloud Computing for Data Management.....	86
7.2.2	Role of Cloud Computing in the Smart Grid.....	88
7.3	Building the End to End Smart Grid.....	90
7.3.1	Power Station to Smart Meter	90
7.3.2	Smart Meter to Grid Operator	91
7.4	Conclusion and Open Issues	93
7.4.1	A Simple, Scalable and Efficient System	93
7.4.2	Secure, Robust and Reliable Communication.....	94
7.4.3	Smart Grid Deployment Pathways	94
	References	95