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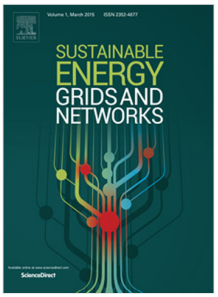

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G. Neglia, L. Giarré, I. Tinnirello, G. Di Bella

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Teletraffic Engineering for Direct Load Control in Smart Grids

G. Neglia[a], L. Giarré[b], I. Tinnirello[c], G. Di Bella[c]

[a] *Université de la Côte d'Azur, Inria, Sophia-Antipolis Méditerranée, France - giovanni.neglia@inria.fr*
[b] *Dipartimento di Ingegneria "Enzo Ferrari", Università di Modena e Reggio Emilia, Via Vivarelli 10, - 41125, Modena, Italy - Laura.Giarre@unimore.it*
[c] *Dipartimento di Energia, Ingegneria dell'Informazione, Modelli Matematici, Università di Palermo, Viale delle Scienze - 90128, Palermo, Italy - gsp.dibella@gmail.com, ilenia.tinnirello@unipa.it*

Abstract

The traditional paradigm for power grid operation is to continuously adapt energy production to demand. This paradigm is challenged by the increasing penetration of renewable sources, that are more variable and less predictable. An alternative approach is the *direct load control* of some inherently flexible electric loads to shape the demand. Direct control of deferrable loads presents analogies with flow admission control in telecommunication networks: a request for network resources (bandwidth or energy) can be delayed on the basis of the current network status in order to guarantee some performance metrics. In this paper we go beyond such an analogy, showing that usual teletraffic tools can be effectively used to control energy loads. In particular, we propose a family of control schemes which can be easily tuned to achieve the desired trade-off among resource usage, control overhead and privacy leakage.

Keywords: Smart grid, Direct Load Control, Admission Control, Privacy

1. Introduction

Direct load control (DLC) refers to the possibility of the energy utility (or third-party entities) switching some specific users appliances on and off during peak demand periods and controlling customers electric loads. While at the beginning, DLC was primarily used in critical situations to prevent blackouts by shutting down these loads, more recently, an extensive use of DLC has been proposed as a way to shape energy demand peaks or provide other ancillary services. In [1, 2] for example it has been used to control thermostatic loads, such as air conditioners and heating systems, for a fine-tuning regulation of power demand. Alternative approaches [3, 4] battery-empowered appliances, like electric vehicles, which can act as adaptive loads, but can also re-inject energy in the grid. To respond to different frequency components of the regulation signal [5], multiple load typologies, including deferrable loads such as