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www.elsevier.com/locate/jobe

PII: S2352-7102(18)30072-X
DOI: https://doi.org/10.1016/j.jobe.2018.06.004
Reference: JOBE511

To appear in: *Journal of Building Engineering*

Received date: 12 January 2018
Revised date: 26 May 2018
Accepted date: 8 June 2018

Cite this article as: Chuan Pham, Nguyen H. Tran, Shaolei Ren, Choong Seon Hong, Kim Khoa Nguyen and Mohamed Cheriet, A Distributed Approach to Emergency Demand Response in Geo-Distributed Mixed-Use Buildings, *Journal of Building Engineering,* https://doi.org/10.1016/j.jobe.2018.06.004

A Distributed Approach to Emergency Demand Response in Geo-Distributed Mixed-Use Buildings

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Abstract

Emergency Demand Response (EDR) has attracted research attention in recent years with its critical role in smart grids. Even though there are numerous potential participants for EDR, we especially focus on EDR, especially within datacenters and buildings, due to their huge power consumption yet flexible control knobs for power shedding. To reduce the deployment cost, many edge datacenters now are co-located inside buildings, which are responsible for power and IT infrastructure (called mixed-use buildings). In this paper, we consider a scenario that has not been addressed in the literature, in which multiple loads in geographically Distributed Mixed-use Buildings (geo-MUBs) can team up to participate EDR. We then design a mechanism that can coordinate tenants and geo-distributed buildings to minimize the system cost for EDR based on a robustly distributed framework, Alternating Direction Method of Multipliers (ADMM). In this mechanism, we also design a privacy-preserving scheme to conceal all tenants' transactions by using a lightweight algorithm. Simulation results show that our proposed method can reduce the total cost by 48.8% compared to existing approaches while satisfying all tenants constraints.

Keywords: Emergency Demand Response, Mixed-Use Building, Geographically Distributed Datacenters.

1. Introduction

Recent years, the electric power industry considers the Demand Response (DR) program as an increasingly valuable resource option, which has high potential and capacity to expand via grid modernization efforts [1]. The most important benefit of DR is to improve resource-efficiency of electricity production through various pricing schemes, such as Real Time Pricing (RTP), Time Of Use (TOU) and critical peak pricing (CPP) [2]. According to a report by the Federal Energy Regulatory Commission (FERC) [3], the DR resource contribution from all U.S. DR programs is estimated to be about 5.8% percent of the