Scheduling home appliances for energy efficient buildings

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Abstract

The number of appliances found in users' homes is increasing together with electricity consumption of users' residences. In addition, there is a tendency to consume during the same period leading to demand peaks. During these periods, electricity providers are forced to develop costly methods to generate enough power to meet consumers' requirements. In addition, high demand peaks can lead to electricity shortages or even blackouts in certain areas. In order to avoid demand peaks, users' appliances should consume electricity in a more distributed way. A new methodology to schedule the usage of home appliances is proposed and analyzed. The main concept behind this approach is the aggregation of home appliances into priority classes and the definition of a maximum power consumption threshold, which is not allowed to be exceeded during peak hours. The scenario simulated describes a modern household, where the electrical devices are classified into low and high priority groups. The high priority devices are always granted power in order to operate normally. On the contrary, the low priority devices are granted or denied access to electrical power according to; their energy consumption and the available margin before exceeding a maximum consumption threshold. In case the appliance is denied access to consume, it will have to wait until it is possible to turn it on without exceeding the maximum threshold. In this way, it is guaranteed that the power consumption is maintained below the maximum allowed limit. This can become beneficial for both energy companies and users. The electricity suppliers companies will be capable of regulating power generation during demand peaks. Moreover, users can be granted lower electricity bill rates for accepting delaying the operation of some of their appliances. To analyze this scenario we make use of teletraffic engineering theory useful in evaluating the performance of telecommunication networks. We apply a reversible fair scheduling (RFS) algorithm, which was originally developed for telecommunication networks. The purpose is to analyze how a power consumption threshold and priorities for home appliances will affect the demand peak and the users' everyday life. We verify by means of simulation the effectiveness of the RFS algorithm with real data for power consumption and operation hours. The defined maximum power threshold of 1500 Watt was not exceeded during peak demand hours. The trade-off was a delay of approximately 25 min for the aggregated low priority class.

Index Terms: smart grid, reversible fair scheduling, electricity demand peaks, home appliances.