

Storitve prožnosti prorabnikov za upravljanje pametnih omrežij / Prosumer flexibility services for smart grid management

Dušan Gabrijelčič
Jožef Stefan Institute
Jamova 39
SI-1000 Ljubljana
+386 1 4773 757
dusan@e5.ijs.si

Arso Savanović
Smart Com d.o.o.
Brnčičeva ulica 45
SI-1231 Ljubljana
+386 1 5308 350
arso.savanovic@smart-com.si

Damjan Bobek
Elektro Celje d.d.
Vrunčeva ulica 2
SI-3000 Celje
+386 51 601 207
damjan.bobek@elektro-celje.si

POVZETEK

Električno omrežje je izredno pomembno za delovanje in upravljanje pametnih mest. Električna omrežja postajajo vedno bolj pametna, več se uporaba informacijsko komunikacijskih tehnologij, število pametnih števecov, porazdeljenih virov električne energije ter pametnih električnih naprav. Pametna omrežja morajo biti učinkovita in zanesljiva. K tema ciljema lahko pomagajo končni uporabniki, proizvajalci električne energije ali porabniki. Skupaj jih bomo imenovali prorabniki. Osamljen prorabnik težko prispeva k učinkovitosti ali zanesljivosti omrežja, ta cilj veliko lažje doseže v skupnosti. V tem predlogu bomo predstavili upravljanje prožnosti uporabnika in storitve, ki so potrebne, da lahko prožnost prorabnika izkoristimo za učinkovitejše delovanje električnega omrežja. Predstavili bomo pilotna testiranja, v katerih se bodo te storitve evalvirale. Podali bomo nekaj idej, ki bi lahko izkoristile sinergijo predloga in iniciative Pametnih Mest in Skupnosti.

ABSTRACT

Electrical grid is of vast importance for the operation and management of Smart Cities. The grid is becoming increasingly smart and involves more and more information and communication technologies, smart meters, distributed renewable energy resources and smart appliances. It is important that the grid is resilient and efficient. These goals can be achieved with the help of end users, either consumers or producers - often referred to as prosumers. Single prosumer can do little good for the grid and himself; as a community of prosumers a lot can be achieved and gained. In this proposal we will discuss prosumer flexibility management and needed services for utilizing prosumer resources for more efficient grid operation. We will report on initial efforts for the services validation in Slovenia. Some ideas will be proposed how developed services can be reused and additionally enhanced through the concept of Smart Cities and Communities.

1. INTRODUCTION

Electrical grid is currently being transformed into a smart grid. Regulation stimulates increasing a share of renewable energy sources, penetration of smart meters and usage of common information communication technologies for smart grid operation and maintenance. All together, with more

decentralized production, advent of electric cars and electric storage, increased electrical domestic heating/cooling and consumers increasingly becoming producers are changing the grid from unidirectional towards multidirectional system. The situation is calling for introduction of new actors and services that can be provided in the grid, for the grid and grid stakeholders interest.

Smart cities on the other hand uses information communication technologies to bridge between city government, citizens and urban environment with an aim to improve the environment, urban services, quality of living, reduce costs and stimulate citizens engagement. Smart cities promise an ecosystem of seamlessly communicating entities, services, sensors and things as a platform for new innovative services implementation.

Proposal as presented is centered on the prosumer and elements at the edge of the smart grid. Internal information about the grid operation will be used whenever meaningful, possible and applicable. The aim of proposal is to define the services needed to manage prosumer flexibility and to validate such services in real world pilots. Prosumer flexibility is an ability of electrical grid users to adapt their electricity consumption or generation according to the needs or suggestions of other electrical grid stakeholders. By utilizing the flexibility the load can be shifted and electrical peaks in the grid can be reduced. The potential of such flexibility are reduced operational costs and investments in future electrical grid distribution, transmission and generation. The electrical grid can become more resilient. A number of services need to be provided before the flexibility can be fully utilized. The services will be further discussed in next section.

For most stakeholders in interaction, provisioning and consummation of flexibility services is actually new. Virtual Power Plant concepts are well know and already implemented in Slovenia, but they involve only business and commercial sector. On the other hand the relationship between the distribution and prosumers is quite rigid and weak. Other stakeholders like aggregators are only beginning to emerge. At this point the goal of this proposal is close to Smart Cities one; bridging the gap between stakeholders.

2. PROSUMER FLEXIBILITY MANAGEMENT SERVICES

A number of prosumer flexibility management services are needed to utilize the prosumers flexibility. Currently identified are being developed in the Flex4Grid project¹. They will be presented through the main elements implementing them, giving some details on possible implementation. Envisioned elements and their services are:

- *Simple and prosumers kit*: two set of kits to be used at end user home as a system gateway, one intended for simple measurement and control of individual sockets and the other more sophisticated for prosumer and more,
- *Communication and APIs*: communication is mostly based on REST APIs as well on messaging platform,
- *Data collection and storage*: cloud based services for data collection and storage, suitable for both end-users as well other stakeholders like DSOs (Distribution System Operator), data analytic or aggregators. Based on this element Prosumer Cloud Service will be built serving the end user devices like smart phones or tablets,
- *Security and privacy*: one of the core requirements of the system, end user information collected and stored in the cloud needs to be shared with the other stakeholders only with the user agreement. Both access control and cryptographic mechanisms will be used to provide confidentiality of the user information. Most of the information will be encrypted at user gateway and stored as such in the storage. Novel ways to build the services will be researched based on partial clear-text information and encrypted information,
- *Data analytic*: based on agreement with the end users part of the end user data will be available for analysis together with the data obtained through DSO interface. Early targets are profiling of the users, their flexibility estimation and peak usage prediction,
- *Prosumer flexibility management*: a collection of information on prosumers, grid topology and flexibility information. Multiple ways to stimulate the prosumer are envisioned, from common based on pricing to utilizing games,
- *DSO interfaces*: the interfaces for collection of relevant grid information from the DSO mainly for data analytic usage, reporting on prosumer flexibility utilization for incentives and for triggering the signals for load balancing.

The elements and services will be developed up to the TRL 7, see European Commission specification of technological

¹ Flex4Grid - Prosumer Flexibility Services for Smart Grid Management is EU Innovation Action project from Horizon 2020, reference number 646428, see <http://www.flex4grid.eu> for details. Partners in the project are from Finland (VTT, coordinator), Germany (Fraunhofer Institute for applied Information, Stadtwerke Bonn Energie und Wasser GmbH and Bocholter Energie und Wasserversorgung GmbH), Slovakia (SAE Automation) and Slovenia (Jožef Stefan Institute, Elektro Celje d.d. and Smart Com d.o.o).

readiness level for details. They will be evaluated in live, six months pilots in Germany and Slovenia in 2016 and 2017. Slovenian pilot will engage up to 1000 prosumers with a simple kit, the number can be even higher if the pilot will involve end users with smart meters only.

3. FURTHER POSSIBILITIES FOR COLLABORATION UNDER SMART CITIES AND COMMUNITIES INITIATIVE

Smart Cities and Communities and presented proposal both share same goal of bridging the gap between the stakeholders. Most specific and hard to involve right stakeholder are the end users. More work is needed to study and compare their ways to interact with the system, different means to incentivize their cooperation and willingness to participate actively in the flexibility management. Particularly interesting to study are communities of end users sharing their expertise on participation in the system or even technological "scripts" of recommended or optimal behavior.

Smart Cities sensors and things ecosystem can be fruitfully used for better analytic and end user modes of engagement estimation. On the other hand the city itself can act as a large resource of flexibility that can be utilized through the same system as is presented in the proposal for even better smart grid operation.

Proposal partners are always interested to discuss further possibilities and opportunities for cooperation in mentioned or new areas with any stakeholder involved in the Smart Cities and Communities initiative.