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Description of publishable data sets from experiments and field trials, V2

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Abstract
This deliverable describes the current plans of the edgeFLEX project on what data sets are planned to be collected in trial sites as well as laboratory experiments, simulations and calculations, what part of it then will be published and thus be made available for the general public. This report has been written based on the expected data drawn from project work that is planned to be completed in the second year of the project (M15-27) or even later. The description will be evaluated every 12 months based on new findings made during the project year and will be updated again in M27 of the project.

edgeFLEX will conduct field trials of fast and slow dynamics distribution management control services and energy flexibility trading with prosumers in Germany and Italy. Furthermore, the project plans to conduct laboratory trials and simulations based on electricity grid simulated data in Dublin, Bologna and in Aachen.

Keyword list
Research participants, consent, incidental findings, privacy, ethics, publishable, data, renewable energy, electricity grid, VPP, Energy Community

Executive Summary

Reproducibility of results is the goal of research and development. The transparency of the input data used is essential to generate results under the same conditions and with that make them comparable. This transparency is ensured by publishing not only results but also all input data and methodologies included in the investigations. On the other hand, this data is often the core of existing or future business models. With these points in mind, the edgeFLEX project carefully weighs what data sets and in what form they can be published in the course of the project.

The development and simulation of new technical solutions is set in Work Packages 1 to 4 (WP1-4) of the project. These solutions will then be implemented in the project's lab experiments and field trials. The edgeFLEX field trials and investigations are managed by Work Package 5 (WP5) of the project. WP 5 will organise live field trials in Germany and Italy and laboratory-based experiments at project partners in Dublin, Bologna and Aachen using simulations and hardware in the loop.

At the date of preparation of this revised second version of this report, work packages 1 to 4 are in the process of preparing the deployment the edgeFLEX platform and all relevant and needed services to the trial sites. This is done in close work with WP5. WP6 is accompanying this work by estimating business impacts of specific solutions.

Therefore, data sets which are planned to be published in the second project year or later might have an emphasis on implementation at the trial sites and preparing to gather feedback. This report will be updated a second time and published as the third version of this report at the beginning of the third project year.

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1. Introduction

1.1 Objective of this report

The edgeFLEX projects participates in the Open Research Data Pilot (ORD Pilot or ORDP) and therefore fully supports the publishing of research data and findings in an open access manner.

This means, the consortium aims to fulfil the following two requirements regarding their data gathered in trials and lab experiments:

- Publish the data in a research data repository.

- Attach appropriate licenses for further use of the published data.

In partial fulfilment of ORDP, this report gives a description of the data expected to be gathered in lab and field trials and published during months 15 to 27 of project work.

1.2 How to read this document

This report is an updated version of Deliverable "D8.8 - Description of publishable data sets from experiments and field trials, V1", which was due and submitted in Month 15 of the project. In the version 1, the report gave a description on data to be published in the project period from month 1 to 14 and, where possible, an estimate of when later work or data would be published.

As part of the preparation of this revised version of the deliverable, all project plans regarding the publication of data by the project were reviewed and this revised version 2 of the document provides revised and updated estimates of when new data will be generated in the coming project year. Much of the text of this document is similar to that of version 1 or with only minor updates.

2. edgeFLEX field trial plans

edgeFLEX is organising a range of field trials and lab experiments during the project. The field trials will be located in Germany and Italy.

It is anticipated that only for the field trial organised by SWW in Germany the participation of field trial participants is required. Hence, it is possible that personal data needs to be collected, which will be done strictly in accordance with the following deliverables:

- D8.2 – D8.2 Data management plan [M4],

- D9.1 – POPD – Requirement No.1 [M3],

- D9.1 – H – Requirement No.2 [M3].

Consequently, personal data and any data including meta data which makes it possible to trace back to e.g., a single person or household from the trial sites, are considered as not publishable data.

In the following, the expected sets of publishable data per trial site will be described.

2.1 Field trials organized by Alpiq

The field trial under the responsibility of Alpiq, consists in testing the algorithms developed in WP3 – "Optimisation of 5G dynamically controlled VPP solutions" on an ad hoc VPP.

While the information relative to the assets used in the field trial cannot be disclosed for data property reasons, the aggregated outcome of the comparison between the optimized management of the VPP and the current classic management of the assets will be made available in the frame of edgeFLEX.

In particular, the following data elements will be delivered: a financial output comparison between the independent management of the assets taking part in the VPP vs the aggregated optimized management of the VPP. This will be provided as a percentage of increase in performance.

2.2 Field trials in Italy organized by University of Bologna (UniBo)

At the trial sites in Italy organized by UniBo, especially fast dynamics, are planned to be tested.

The following description for the work over the whole project time was already introduced in version 1.0 of this deliverable and is still valid for the second project year:

- The DSOs will not provide access to any sensitive data of customers/prosumers. Access might be granted to aggregated and anonymized data.

- Possibilities to publish electricity network data of DSOs – potentially in a masked way – is aspired and will be evaluated individually in all cases with the respective DSO.

- They are typically inclined to share their feedback after the service implementation.

2.3 Field trials in Germany organized by SWW

At the trial site in Wunsiedel, Germany organized by SWW, both slow and fast dynamics will be tested.

Some of the new technologies will be implemented at prosumer premises or even need consumer support e.g., in the sense that already implemented technology will be used within edgeFLEX trial activities. Therefore, the consortium will continue running its user involvement process. It has started in GOFLEX with various design thinking activities and the development of new, user centric products and services. In these co-creation activities, many citizens have expressed their wish for the utility to get more control over the local energy generation and supply system. They

have shown interest in operating storage in a grid supportive way or have their photovoltaic inverters provide ancillary services.

Data planned to be published will only relate to types of stakeholder or participants on average level. Data on individual level of participants will not be made available. This data can contain information on what type of technology is being used, possibly what tariff is defined, and what other framework conditions are in place. Connected to those configurations, it is possible to give data on what type of flexibility can be provided in different quantities and resolutions. Since the data is real data from end-users, it is sensitive and must be clustered or aggregated accordingly so that it can no longer be traced back to individuals.

Data on power grid or network topology from this trial site is not planned to be made publicly available in a more detailed manner than already available due to transparency regulations in Germany.

3. edgeFLEX simulation and calculation plans

edgeFLEX is planning to perform simulations and experiments in laboratory environment. In the following the publishable data per WP will be described.

3.1 WP1 – Dynamic-phasor driven voltage control concepts for dynamically controlled VPP solutions (UniBo)

WP1 will continue the development and test of voltage control concepts/algorithms that have to be integrated as services into the edgeFLEX platform and applied on the field trials.

In the second phase of the project, the voltage control algorithm described in D1.2 will be applied to the simulated electrical grid from the field trials, where realistic profiles based on the nominal power of the appliances present in the grid will be produced. The profiles and control algorithm as well as other information on the grid under test can be made available taking system security into account.

The control algorithm, implemented as part of the edgeFLEX services deployed in the platform, will be tested with data provided by the edgePMUs, to verify the proper integration of the control service in the platform.

The objective of the tests is to measure, collect and analyse the voltage and power profiles of the controllable resources (reactive power injection of the PVs, active power of the energy storage systems). These profiles can be published.

3.2 WP2 – Frequency and inertial response control concepts for dynamically controlled VPP solutions

In the first phase of the project, WP2 developed frequency control for VPPs and inertia estimation algorithms to be integrated as services into the edgeFLEX platform.

For such developments, WP2 validated and ran the algorithms through simulation tests on reference grids, such as the IEEE 9-bus system, which is commonly used as a benchmark system for stability studies, and its data is publicly available for the scientific community. The simulation tests resulted in the following publishable datasets: 1. power system simulation measurements which are used as input to the algorithms 2. the resulting output of the algorithms i.e., control signals and estimation trajectories for the frequency control and inertia estimation algorithms respectively.

In the second phase of the project, the researchers of WP2 will further develop the frequency control algorithms for local energy communities and propose an inertia allocation algorithm for optimal placement of virtual inertia in VPPs.

Following the same approach as in the first phase of the project. The new algorithms will be tested and validated in the IEEE 9-bus system and 39-bus system through simulations. The simulation measurements (frequency, voltage and power measurements) used as algorithms inputs and the algorithms resulting output datasets can be made available for reproducibility of the results.

Two novel concepts are proposed *complex frequency* and *geometric frequency*. The former allows defining analytically and with minimal modelling approximations the link between active and reactive powers and frequency variations at network buses. To this aim, an extension to the complex domain of the classical definition of frequency is proposed. The second concept, namely, the *geometric frequency*, utilises geometric algebra to define frequency as a multivector. This definition exploits the formal analogy between space curves and three-phase voltages and currents. Both concepts have never been proposed before and pave the way to a variety of applications, ranging from measurement and estimation of frequency and other electrical quantities to control and stability analysis of power electronic-based devices. These applications will be studied in the second half of edgeFLEX project.

The data required for the validation of the new frequency concepts are conventional voltage and power measurements at network buses. The measurements obtained with the field trials will be the main input for this validation. All simulation result will be also made available to the edgeFLEX partners and published on international journals and/or conferences.

3.3 WP3 – Optimisation of 5G dynamically controlled VPP solutions

A publication regarding the optimization algorithm and the mathematical approach to ensure efficient convergence of the problem solving given the characteristics of the problem is proposed. It is submitted as of March 2021 and is under academic review.

The following description for the work over the whole project time was already introduced in version 1.0 of this deliverable and is still valid.

In Deliverable 3.1 [M30], EDD will describe the results of its on-going and planned investigations of the edgeFLEX energy use cases as large-scale deployments in commercial electricity networks enabled with 5G technology and define the resulting potential 5G ICT requirements and solutions.

Furthermore, 5G proof of concept implementations utilised in carefully selected edgeFLEX energy use cases will be carried out. General proof of concept implementations solution architectures and interfaces will be described and published in Deliverable 3.1.

3.4 WP4 – Platform and services for dynamically controlled VPP solutions

WP4 will over the whole course of the project define, implement and assess a set of platforms, tools and services that will enable the deployment of the control algorithms developed in WP1 and WP2. The following description was already introduced in version 1.0 of this deliverable and is still valid for the second project year:

The activities for WP4 in the first project year consisted of compiling a full set of requirements for both the services and the trial sites so that we can efficiently and accurately develop the software supports and platforms required to implement the services. These requirements describe each service in terms of, among others:

- the optimal latency and data volume required for the service to operate;

- the measurements needed to execute the service;

- the preferred communications and security mechanisms and protocols;

- the base operating systems and software modules needed to instantiate the services.

The requirements in the initial stages of the project would provide pointers of the basic software and ICT requirements needed to run each service as a minimum viable product (MVP) and may be broad with a view to updating them with more precise requirements as the services are further researched, tested and assessed in both the laboratory and field trials.

The end goal was to derive and publish a summarised set of requirements for the edgeFLEX platform in deliverable D4.1 due in Month 18. It is also planned to correlate the set of requirements gathered for the services and tools and publish them as a dataset on a public GitLab wiki page that will contain a representation of the requirements in tabular form.

3.5 WP5 – Field trials of dynamically controlled VPP solutions

The following description of the work over the duration of the project was already introduced in version 1.0 of this deliverable and is still valid for the second project year:

It is not expected to gather or publish additional data from trial sites which was not already mentioned in Chapter 2 and the above description of WP1-4.
The data relevant to or generated in connection with the laboratory test are described below:

The 5G performance in enabling the proof-of-concept implementations of services developed in WP3 for the edgeFLEX energy use cases will be evaluated in the 5G lab trial in WP 5. As part of the published results of this set of tests to be reported and published in Deliverable 5.5, the general test lab infrastructure configuration, the general test methodologies, the general descriptions of the test cases and the general latency performance results will be described.

3.6 WP6 – Evaluation and Exploitation

Among other work, in WP6 it is planned to assess the business impact of services developed in edgeFLEX.

For the impact assessment of the Voltage Control service, the goal is to build on the simulations of the voltage control algorithm conducted in WP1. For this, it is aimed to connect the results of the simulations to financial dates relevant in grid management and maintenance. The results will then be analysed with regards to business impact for relevant groups. The result of this analysis will be published at the latest in deliverable D6.2 due in Month 36.

3.7 WP7-9

The following description for the work over the whole project time was already introduced in version 1.0 of this deliverable and is still valid for the second project year:

Address lists, mailing lists and other data and meta data collected for administrative reasons within the project are not considered publishable data (sets) in the sense of the Open Research Data Pilot. In WP7 – "Dissemination and communication" information and data fulfilling these tasks will naturally be published on appropriate channels. These are also not considered data sets for the purpose of the Open Research Data Pilot.

4. Conclusion

Requirements for the edgeFLEX platform as well as data generated by simulations and experiments in work packages 1-4 were published as far as possible in deliverables due in the first 14 months of the project or in other types of publications (e.g., journal papers). This is planned to be continued on the next years of the project work.

The publication of specific data from the trial sites will need to be carefully considered as this concerns both privacy and system security issues in the end. As the project evolves further, the data set description will be revised carefully at the beginning of the third project year.