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Description of publishable data sets from experiments and field trials, V3

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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 remaining time of the project (M27-36) or even later. The description was evaluated every 12 months based on new findings made during the project time. This is the last update of the report.

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

Disclaimer

All information provided reflects the status of the edgeFLEX project at the time of writing and may be subject to change.

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. WP5 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 third version of this report, work packages 1 to 4 are in the process of deployment and testing the edgeFLEX platform and all relevant and needed services to the trial sites. This is done in close co-operation 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 remaining project time or later might have an emphasis on assessment of services and solutions being tested at the trial sites and gathering feedback. This report is the last updated version of the "Description of publishable data sets from experiments and field trials".

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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 from month 27 of project work on.

1.2 How to read this document

This report is an updated version of Deliverable “D8.9 - Description of publishable data sets from experiments and field trials, V2”, which was due and submitted in Month 15 of the project. In the version 2, the report gave a description on data to be published in the project period from month 15 to 27 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 3 of the document provides revised and updated estimates of when new data will be generated in the coming project time. Therefore, much of the text of this document is similar to that of version 2 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)

The Italian field trial takes place in Milan, inside the A2A facilities. During this trial, the voltage control service is implemented. A2A, the Italian DSO, is now a partner of the consortium. An NDA has been signed between them and the consortium.

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:

- A2A will not provide access to any sensitive data of customers/prosumers. Access might be granted to aggregated and anonymized data.
- A2A, depending on the needs and the situation, may agree in sharing the data of the power network involved in the trial.

A2A will 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 as aggregated and anonymized data.

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

The research activities of WP2 ran until M24 of the project. 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. In the second phase of the project, the researchers of WP2 further developed the frequency control algorithms for local energy communities and proposed an inertia allocation algorithm for optimal placement of virtual inertia in VPPs.

The developed algorithms of WP2 were validated through simulation tests on reference grids, the IEEE 9-bus system and 39-bus system, which are commonly used as benchmark systems for stability studies. The benchmark systems data is publicly available for the scientific community. The simulation tests resulted in the following publishable datasets: 1. power system simulation measurements (frequency, voltage and power measurements) which are used as input to the algorithms 2. the resulting output datasets of the algorithms i.e., control signals and estimation trajectories for the frequency control and inertia estimation algorithms, respectively.

The simulation and validation results were published in international journals and conferences. Moreover, the simulation input measurements and resulting output datasets can be made available for reproducibility of the results.

From M27 until the end of the project there will be no new publishable datasets, due to the ending activities of WP2.

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 was published in 2021.

In Deliverable 3.1 [M30], EDD will describe the results of its investigations of the edgeFLEX energy use cases to define the potential 5G ICT requirements and solutions. The investigations assume the use cases are deployed on a large-scale in commercial power networks enabled by 5G technology. Two energy use cases relevant to the edgeFLEX project were contributed to the

3GPP standard group SA1 in 2021, and its description together with their 5G requirements were published in 3GPP standards, technical report 22.867 and 22.104.

Furthermore, a 5G device management API proof of concept implementation based on requirements edgeFLEX energy use cases has been implemented. The general proof of concept implementation solution architecture 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 rest of the project time:

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 which was due and submitted 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

We do not expect to collect or publish additional data from field trial sites, over and above the data sets already described in WP1 to WP4 and the data sets described in in Chapter 2.

The data sets relevant to or generated by the laboratory test are described here: The 5G performance in enabling the proof-of-concept implementations of services developed in WP1, WP2, WP3 and WP4 for the edgeFLEX energy use cases has been 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. The results of one set of 5G latency performance tests using synthetic data represented of edgeFLEX services conducted on a 5G standard network deployed in the laboratory will be published in Deliverable 5.5. Additionally, the results of another set of 5G latency performance tests of the Frequency Control service deployed together with the edgeFLEX platform on the 5G standard and the URLLC prototype network in the laboratory will be published in Deliverable 5.5.

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 – Workpackages 7-9

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 rest of the project time:

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 months 1-27 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.