Project: Grid frequency control with 5G.

1 Motivation

One of the main assets of a Grid of the future will be constituted by renewable energy sources (RES) like hydro, solar and wind generators. For an efficient RES inclusion into the Grid it is important to have flexibility and reliability in the communication of the control parameters into the Grid [1]. The main control parameters are the voltages and frequencies at the different points in the Grid. The current communication solution consists of the use of large wired lines based on industrial Ethernet or costly optical fiber. To improve flexibility and reliability, the industry is exploring the use of 5G technology, which also offers range of coverage, and massive device capacity. Compared to 3G and 4G, it offers also the use of slices for optimization and low latency. Among the different application scenarios for 5G and Grids, this proposal focuses on the situation described in Fig 1.

The application consists of a distribution generation control [2]. The main Grid is connected to three other power sources to help in the balance of the frequency. When the Grid frequency exhibits dropping or increasing voltages (due to the dynamic connection of loads and other RES components in the Grid), it sends a reference signal to the power sources to increase or decrease the power, respectively, and restore the frequency. The hardware illustrated in Fig. 1 is part of the PHIL laboratory in our department [3] and shows the PHIL demo scenario. The demo setup consists of four distributed generation units (DGs), which, together with the real-time computers (RTCs) are emulating: a Grid, a super capacitor, a battery, and a fuel cell generator. The configuration and control of the DGs-RTCs is managed by Matlab/Simulink environment. The 5G modules shown at the bottom are interconnected to a dedicated local ethernet network to the PHIL laboratory. The 5G connectivity is produced thanks to the BTU private stand-alone 5G network.

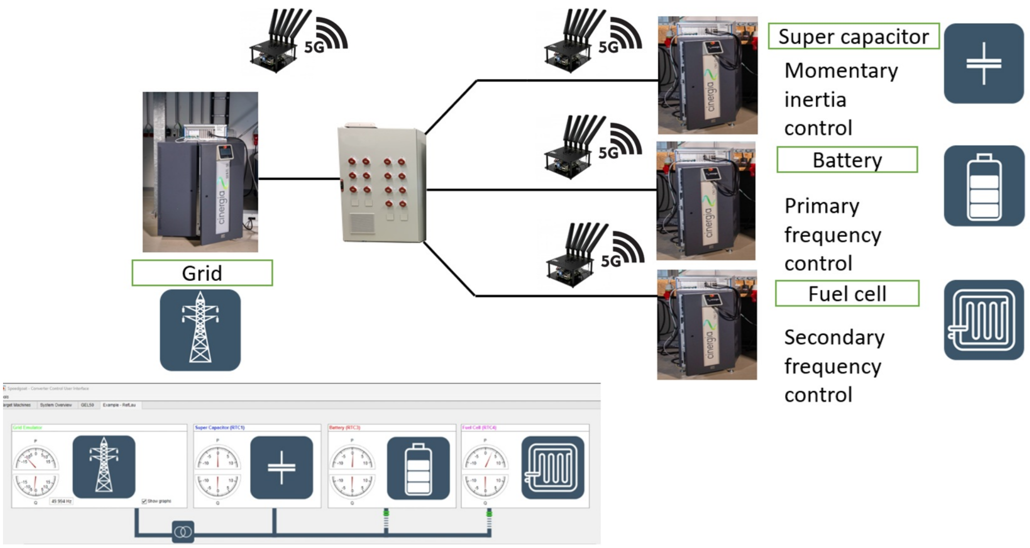

Figure 1: Setup for the Grid voltage control in the PHIL laboratory.

2 Project objectives

The project's overall objective is to control the Grid frequency using the demo setup using 5G communication. The particular steps of the project are

- Familiarize with the equipment in the laboratory.
- Customize and test the 5G communication.
- Integrate the whole system.
- Compare the results with 5G and original communication system.

3 Recommended literature

Some recommended literature is listed below. You can and should look for further information in papers, reports or theses and exchange your findings and ideas with your team members. A useful search engine for academic publications is `https://scholar.google.com/`.

- For the use of the PHIL lab [3].
- For 5G and its use in Grid applications [1], [2].
- For modeling of renewable energies [4], [5].

References

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