# Swarm Grids – Distributed power grid control for distributed renewable power generation

Abstract for IRENEC 2021 Conference
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A distributed power generation with renewable energies benefits from a distributed control of the power distribution. The concept of cellular grids proposes a distributed structure of the power grid for such a purpose. Here, a proposal for the control of such a cellular power grid structure is made, which is named "Swarm Grid" by the author. The name refers to the swarm-like control structure, which implies no master control for the coordination of the grid components.
In a swarm (e.g. a swarm of fish), members are able to measure (e.g. fish can see), know about the others or communicate (e.g. keeping an eye on each other), decide and react (e.g. change the direction of swimming). Likewise, components in a Swarm Grid should be able to measure, communicate to each other, process the information and react. Precisely, the presented concept includes the following:
The components are able to measure the voltage at the connection point and the power or current of the device connected to this point. In a more advanced environment, the devices are able to detect the voltage phasor or even the grid impedance.
The components communicate to each other by exchanging the measured information. This way, each component can get an overview of a much large portion of the grid than only the point of connection. Preferably, the communication is based on powerline communication, such that only components on the same branch of the grid communicate to each other.
By considering the measured values, each grid component is able to calculate a detailed view of the actual grid state. From these calculations, the components can make decisions on their performance, e.g. power management to avoid overload.
Inherently, this applies only to controllable loads, which power may be modulated without deterioration of its function. It may apply to components like charging boxes for electric vehicles, electrical heat pumps, climate controls, batteries or combined heat and power (CHP) systems. Such components will dominate future distribution grids in a 100% renewable energy society.
The final presentation will show details of the Swarm Grid concept. As exemplary grid components, charging stations of electric vehicles and the background of this use case are presented. First results from a related research project will also be presented which include methods to estimate the grid's topology from the measurements and then the calculation of voltage and current states in the determined power grid. An own tool for the visualization of the data is being developed.