Swarm Grids for a decentralized power grid control

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A decarbonized power supply requires not only a significant higher amount of electrical energy generation from renewable energy sources but also a higher power demand of carbon neutral loads. To limit the necessary extension of the power grid a smart control of controllable loads, storages and renewable power sources is necessary. A centralized control requires a significant amount of effort and investments for grid operators. Furthermore, a centralized control may induce legal problems, because of the many different owners and operators of the controlled devices.

Therefore, we propose a decentralized power grid control, where participating devices organize themselves to avoid an overload of the power grid. They behave like members of a swarm, such that "Swarm Grid" is proposed for it. The devices will communicate to each other and exchange information about their power needs and about measurements at their connection point. Using this information, the devices can derive further information about the grid state and limit the power consumption in case of an overload is detected.

This contribution will derive the requirements for the communication and present examples for communication implementations. Furthermore, it will give an overview of related grid state estimation methods with a special focus on worst case considerations to allow a safe grid control. As an example, an application for charging boxes for electric vehicles is presented.