Smart Grids with Intelligent Periphery:
An Architecture for the Energy Internet

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Abstract

With the growth of distributed PV and other renewable generation, residential electricity storage, and electric vehicles, the structure of the future grid will be fundamentally different than that of the conventional electric grid. The smart grid of the future must serve as an Energy Internet, through which the self-generated energy will be shared with others, just as we now create and share information online. To prepare for the future, a smart grid with intelligent periphery, or smart GRIP, is proposed. A layered architecture that allows a seamless transition from the present to the future and plug-and-play interoperability is presented. The building blocks of GRIP architecture are called clusters and include an EMS-controlled transmission grid in the core and distribution grids, micro-grids, smart buildings and homes on the periphery; all of which are hierarchically structured. Basic functions of all clusters are defined. A Risk-limiting Dispatch methodology and a new power-electronic device called Electric Spring are developed, and will be discussed.