Dc Nanogrid: The Brand New Energy System

Nanogrids can be termed as the subset microgrid which can be used powering a single building or house. Low voltage DC distribution within building or house structures can be called as DC Nanogrid. DC power electronic loads like BLDC fans, LED Lights, battery management system and renewable sources like solar PV Converters can be integrated to the Nanogrid, more efficiently when compared to normal AC due to less power conversion stages. DC Nanogrid is low voltage dc distribution system, which is very much suitable for residential power requirements. The average power demand in the Nanogrid is provided by the renewable energy resources like wind and solar PV. The battery management system is used to ensure uninterruptible supply to the high priority loads and also to sustain stable operation of the Nanogrid.

The architecture for the DC Nanogrid is shown in the Figure 1 with mainly consists of subsystems such as the Nanogrid system controller for system management and the network coordination, smart power switch and socket for connecting DC based load to the DC Nanogrid , Battery Management System for the battery charging and discharging control , Solar PV Converter which is the default powering element in the DC Nanogrid and AC/DC converter which power the DC Nanogrid when both PV and battery powers are unavailable. In this DC Nanogrid, 48V DC is considered due to the fact that the user can handle this voltage level without any serious risk and also 48V is sufficient enough to drive highly efficient DC powered loads such as BLDC fans, LED lights, which are very common in home [2]. Various simulations studies and experimental analysis also have shown that 48V is an ideal voltage level for light loads. Nanogrid system controller manages and controls all the subsystems and connected loads. Nanogrid system controller communicate with subsystem using its controller area network and remotely control and monitors its. It also monitors and control Nanogrid power socket, which are used to connect the dc loads like BLDC fans and LED lights.

DC Nanogrid can operates in various mode based on the energy availability. The default operation mode of the DC Nanogrid is the Islanded Mode in which the Solar PV Converter delivers the required power and also charges the battery with its remaining available power. In the case in which the Solar PV power is not able to meet the load demand, BMS supplies remaining power to the load. If excess energy available from Solar PV, remaining energy supplied to the grid and is called the Grid Connected Inverter Mode. Energy drawn from the grid when Renewables and Battery unable to deliver the load demand and it is called the grid connected rectifier Mode. Nanogrid system controller manages the mode controlling activities, based on the information shared between the subsystem.

For a Nanogrid network fast, reliable and robust communication network is required, as it directly affects the energy flow and power management. A suitable communication protocol with well-defined architecture, which would perform satisfactorily in a harsh electrical environment is a must. CAN (Controller Area Network) due to its versatile features like robust error handling, high frame rate, collision free arbitration, broadcasting, differential signal transfer etc. provides an apt option to the need.

The CAN networking provides good platform for interconnecting electrical nodes and allows

each node to communicate with the system controller. Controller Area Network (CAN) protocol can be used for the communication between nodes inside a room zone and by using ZigBee protocol we can transmit the data to Nanogrid system controller and the room controller. ZigBee is an IEEE 802.15.4 standard for data communications with devices. This multi-layer communication for power network management is a cost effective one and it can be used in various applications like home, industries, automobiles, etc.

In this paper a power management system for DC Nanogrid application is discussed, the proposed power management strategy for DC Nanogrid architecture has been deployed by Power Electronics Group of C-DAC, Thiruvananthapuram and the project is funded by National Mission on Power Electronics Technology (NaMPET), Govt. of India.