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SMART RUE
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Control classification in DC Microgrids.

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1. Introduction

Microgrids (MG) are a novel form of distribution systems, which belong to the wider concept of Smartgrids. The Microgrid can be considered as a small-scale electricity grid, which operates in low or medium voltage networks. It consists of distributed generation(DG) units, such as renewable energy generators and combined heat and power units, along with storage devices and controllable loads (e.g. air conditioners).The DGs are interconnected via an AC link forming an AC MG or via a DC link forming a DC MG. DC microgrids (DC MGs) are characterized by attractive features such as high system efficiency, high power quality, reduced cost, and less complex control. Currently, the most common application of DC MGs is the electric power supply of isolated systems like vehicles, space crafts, data centers, telecom systems, while they have been proposed for rural areas and islands.

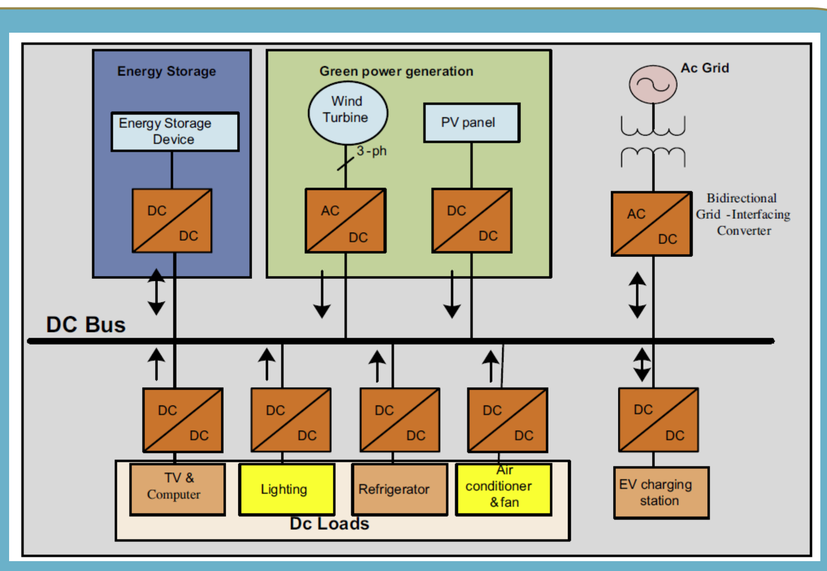

Fig. 1*. The single line diagram of a typical DC microgrid structure*

2. Hierarchical control levels in DC Microgrids

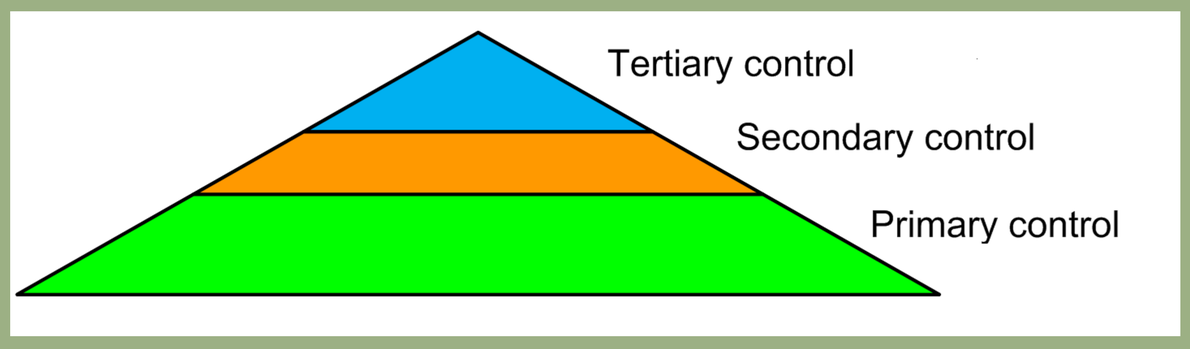

Fig. 2*. Hierarchical levels in a microgrid structure.[1]*

Primary Control:
- Active load sharing (with communication)[2]
- Passive load sharing-droop (communication free)[3]

Secondary Control:
- Centralized control[4]
- Decentralized control with communication[5]
- Decentralized control without communication[6]
- Hybrid[7]

Primary Control: This control deals with the load sharing among the microsources. The DC-DC power converters of the DGs are responsible for this mechanism. The passive load sharing mechanism (droop) suffers **from *Poor Voltage regulation*** and ***Circulating Currents*** *among microsources.* The active load sharing suffers from expand difficulties and need for communication links.

Secondary control: This control is responsible for voltage fluctuations regulation. It is also responsible for the synchronization process to re-connect seamlessly the microgrid to the upper grid. It can be centralized or distributed.

Tertiary control*:* It sets the power flow between the DC MG and the upper grid. It is also known as energy management system and it communicates with the distribution system operator (DSO). The DSO or even the transmission system operator (TSO) might decide the schedule of power exchange with the MG.

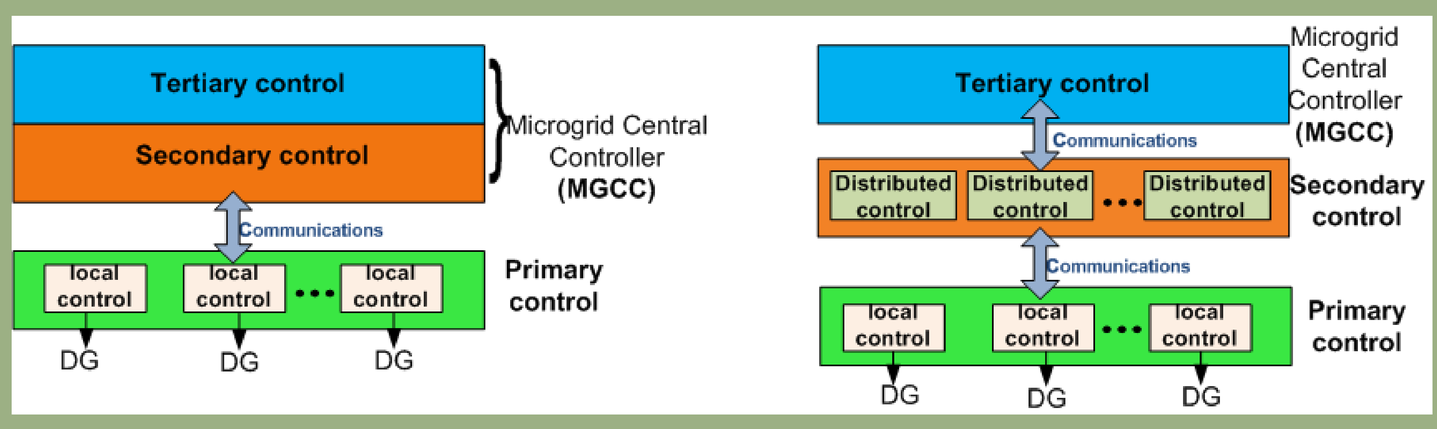

Fig. 3. *Hierarchical control - Microgrid communications, local and centralized controllers: a) centralized control architecture, b) decentralized control architecture*

3. Energy management classification

Most energy management strategies are based on Hierarchical Control. These management strategies can be divided into three major categories – depending on the way the secondary control is implemented – centralized, decentralized and hybrid. Fig. 4 shows this classification.

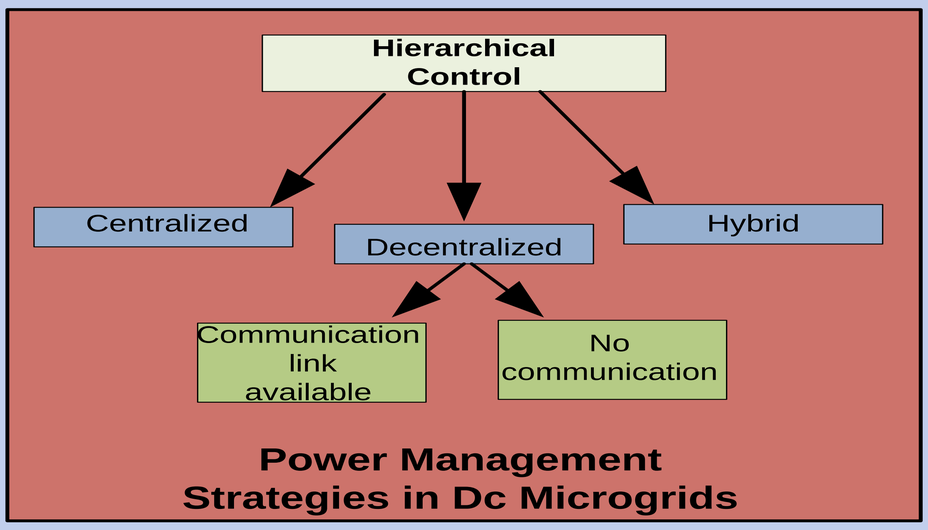

Fig. 4. *Power management strategies classification.*

Limitations to overcome		
Voltage control	**Accurate power sharing**	**Circulating Currents**

4. References

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