International Conference on Information Engineering, Management and Security
2015 [ICIEMS 2015]

ISBN	978-81-929742-7-9	**VOL**	01
Website	www.iciems.in	**eMail**	iciems@asdf.res.in
Received	10 - July - 2015	**Accepted**	31- July - 2015
Article ID	ICIEMS055	**eAID**	ICIEMS.2015.055

A Review Paper On Latest Trends In Distributed Smart Grid Technology

Upendra Vishnu Kulkarni[1], Aruna P Phatale[2], S A Naveed[3] (Member, IEEE)
[1, 2, 3] Department of Electronics & Telecommunication, MGM'S Jawaharlal Nehru Engineering College
Aurangabad, Maharashtra, India

Abstract: *In current era of Internet of Things, overall internet is made intelligent by making each individual 'smart' at its own place. Use of distributed energy sources including both renewable and non renewable in smart grid technology has gain lot of importance in today's era facing energy crisis. These distributed resources provide greatest flexibility whenever continuous and uniform deployment of power flow is required, across all networks. Interest in the potential of smart grid to transform the way societies generate, distribute and use electricity has increased dramatically over the past decade. This Paper identifies and illustrates the radical, competing and influencing priorities in Distributed Smart Grid Technology. Following latest researches primarily, the goal of paper to cover maximum aspects of to make system design-integration-implementation approach more powerful and perfect is reviewed.*

Keywords: Adaptive, GUI, self healing, management, DSG, Big Data

I. INTRODUCTION

The electricity or power is considered to be backbone of each and every enterprise and has witnessed many recent developments in research and infrastructure, significant socio-economic and other non-tangible benefits to the community at large.Overall interconnection of advanced system components well known as Smart grid. "Ref.[5]" The arrival of power system deregulation and corresponding parallel growing vertically integrated utility business model is a second important development which shaped the direction of electric power technology in drastic but fruitful manner. It is a dynamic interactive, real-time infrastructure that responds to the challenges of designing and building the power system of the future.
"Ref.[14]"To illustrate the diversity of terminology as in figure 1, the paper summarizes subfields with examples and definitions of Smart Grid. Miscellaneous Operating Level model of Smart Grid Technology can be seen in terms of diagrams and definitions mentioned .Smart distribution and utilization systems are suitably referred with their detailed abbreviations in subsections from corresponding figures respectively. "Ref.[15]" This paper includes the concept of Distributed smart grid and its various manifestations to allow for an appreciation of the complexity, potential benefits, and challenges involved in this exciting field to particular extent.

Cite this article as: Upendra Vishnu Kulkarni, Aruna P Phatale, S A Naveed. "A Review Paper On Latest Trends In Distributed Smart Grid Technology." *International Conference on Information Engineering, Management and Security (2015)*: 328-333. Print.

Fig.1 Customer-Vendor insight of DSG

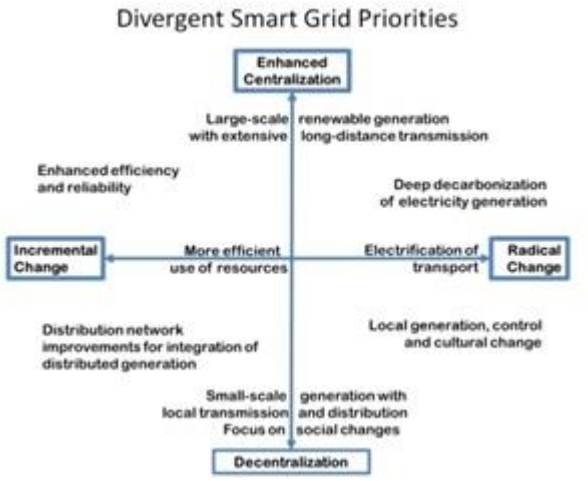

Fig. 2 Divergent Smart Grid Priorities

Topics such as real-time energy control approach for any smart building energy management systems, optimal opinion of energy-efficient buildings with distributed energy resources, various management strategies at device, big data, system and environment levels with suitable diagrams in short. These concepts needed to be followed thoroughly along with Divergent Smart Grid Priorities as shown in fig 2.

Different kind of facts is stated related with this Distributed Smart Grid (DSG) with addressing challenges and related innovative technologies, products and services. Further short note on DSG technology activities in China, India, and around the globe on this roadmap is done.

II. CONTRIBUTARY INFORMATION

"Ref.[13]"Currently available literature on the term "smart grid" shows a vast array of publications and latest valuable trends in distributed system to become backbone of "Internet of Things". Today the power industry is taking advantage of advanced computer, communication, and control technologies throughout the 21th century to enhance its 360 degrees of capabilities.

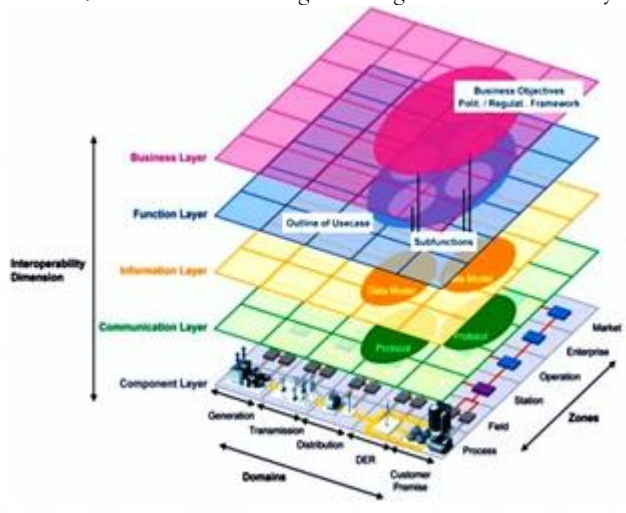

Fig.3 Miscellaneous Operating Level model Fig4. Distributed Parallel Network of Energy & Information Technology

III. THE MOTIVATION FOR DISTRIBUTED SMART GRID

"Ref.[15]"Presently the stakeholders (utilities, vendors, manufacturers, regulators, consumers and their advocates, and governments) recognize the need to address challenging issues that motivate developing and implementing the Distributed smart grid and its

Cite this article as: Upendra Vishnu Kulkarni, Aruna P Phatale, S A Naveed. "A Review Paper On Latest Trends In Distributed Smart Grid Technology." *International Conference on Information Engineering, Management and Security (2015)*: 328-333. Print.

peripheral elements due to limitations of simple smart grid system. In every situation the priority of local drivers and challenges might differ from one point of view to another when a partial list of issues given below is concerned.

a. Aging and underinvested infrastructure

b. Fulfilling the demand of Electricity throughout the world

c. Adoption of alternative energy sources to reduce pollution.

d. Optimization in flexibility of the distance between generation sites and load centers in either or parallel with large numbers of small, decentralized generation.

e. Intermittent and fluctuating energy availability of renewable energy sources

f. Need for securing electric supply and dataflow associated with it.

IV. DISTRIBUTED SMART GRID FEATURES

"Ref.[6]"Many Distributed smart grid possess following attributes as representative of its functions:

1) *Efficient*—satisfy consumer's electricity demand without adding infrastructure.

2) *Accommodating*—works with any kind of energy source, platform, virtual online mode

3) *Motivating*—enabling real-time communication using graphical user interface (GUI)

4) *Opportunistic*— ability to capitalize on plug-and-play innovation wherever and whenever required

5) *Quality focused*—capable of delivering the power quality necessary, free of sags, spikes, disturbances, and interruptions to power our increasingly digital economy and the data centers, computers, and electronics necessary to make it run.

6) *Resilient*—increasing decentralized process helps to improve flexibility, maintenances and reinforce the smart grid security protocols.

V. SOME IMPERFECTIONS IN DISTRIBUTED SMART GRID

"Ref.[3]"As with many new innovative technological developments, care must be taken to address particular concerns and issues that present itself to forward progress, adoption, and acceptance of this enterprises .With current Big Data Concept huge information related with this technology is also growing exponentially and securing it is a big issue .

a. *Stakeholder Engagement:* Well-knowing the fact that the benefits of each component of the smart grid to the customers that are the potential key to service success they worked seriously on it.

b. *Security:* As with integrated approach information in turning into big data, creating cyber-security vulnerabilities, tackling security risks gained utmost importance.

c. *Privacy:* The concern like consumer acceptance, privacy violations needs to be addressed appropriately.

Costliness: New cutting edge inventions will be costly if we put them into practice

VI. SMART DISTRIBUTION AND UTILIZATION SYSTEMS

"Ref. [10] [11]"Given that the origins of many power system issues are typically based in the electrical distribution system, the point of departure for grid enhancement and modernization is to be found at the bottom of the supply chain.

"Ref.[9]"While the distribution system shown in figure 5 are major part of the electric power system, it comes as a surprise that there is not a corresponding appreciable level of embedded intelligence with the only information available—that from the feeder at the substation. This makes it difficult to optimize the operation of the distribution system and to recreate and recover from abnormal

Cite this article as: Upendra Vishnu Kulkarni, Aruna P Phatale, S A Naveed. "A Review Paper On Latest Trends In Distributed Smart Grid Technology." *International Conference on Information Engineering, Management and Security (2015)*: 328-333. Print.

events. Distributed Energy Resources(DER) are able to create self contained cells (micro-grids), which can in turn help to assure energy supply in distribution grids even when the transmission grid has a blackout . Moreover, it also facilitates more effective utilization and life extension of existing distribution system infrastructure integrating DERs and some of their functional requirements are as below.

i) *Distributed intelligence:* possess high-speed data processing capability; make decisions locally through distributed intelligence offered by low-cost embedded computing facility.

ii) *Visualization:* As per high-priority requirement we can recognize available and controllable resources to maximize economic and reliability benefits. It can also visualize in terms of devices and entities as shown in figure 4 and figure 6 respectively.

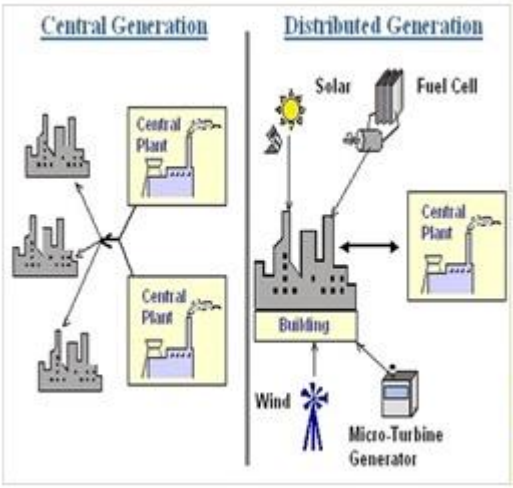

Fig.5 Centralized Vs Distributed

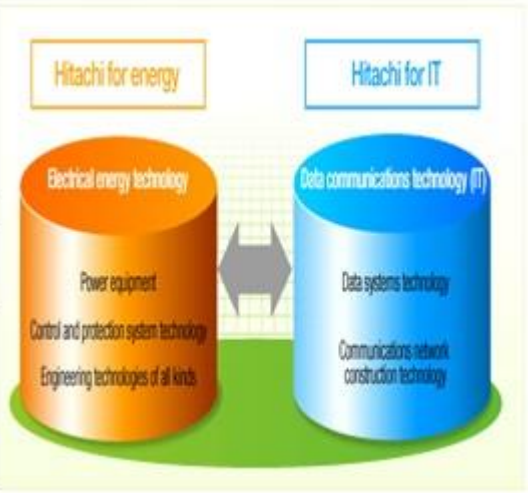

Fig.6 Hitachi for Energy and IT Power Generation

iii) *Forecasting and prediction:* Due to immaturity and low penetration of DERs which increases the uncertainty associated with their performance it is challenging.

iv) *Interoperability:* "Ref.[3]" Among networks, systems, devices, applications or components to externally exchange and readily use information securely and effectively standards need to be followed with drastic variation.

"Ref.[5][8]"As in figure 7, a Distributed management system for energy, outage, number ON/OFF devices in certain time, fault location are important component of the DSG to increase efficiency of overall system . It allows remote meter configuration, communicating dynamic tariffs, power quality monitoring, and potential load control. The fig. 7 considers distribution network active management and future development trends in technologies and methods, where centralized and decentralized management frameworks and applying agent-based coordination are shown. Smart grid initiatives, developments, plans, and example technologies are taken shortly.

Fig.7 Overview of Distributed Smart Grid

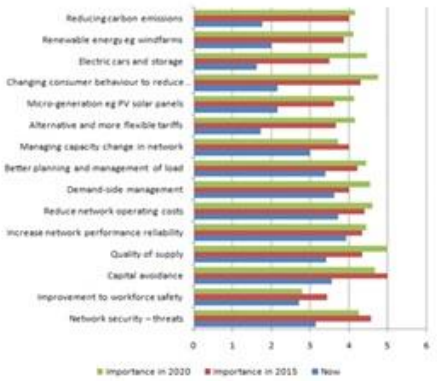

Fig.8 Evaluative Graph of various aspects and parameters for Distributed Smart Grid as future perspective

Cite this article as: Upendra Vishnu Kulkarni, Aruna P Phatale, S A Naveed. "A Review Paper On Latest Trends In Distributed Smart Grid Technology." *International Conference on Information Engineering, Management and Security (2015)*: 328-333. Print.

VII. DISTRIBUTED SMART GRID INITIATIVES, DEVELOPMENTS, PLANS, AND EXAMPLE TECHNOLOGIES

1. Recent Advancements on Smart Grids in China :

"Ref.[3]"Xu, Xue, and Wong from Hong Kong Polytechnic University, China; State Grid Electric Power System Research Institute, China; and University of Western Australia, Australia, respectively, discuss China's 12th Five-Year Plan (2011 2015)by renewable energy accounting for15% of national primary energy consumption by 2020.The State Grid Corporation of China (SGCC) established the plan to implement smart power grids in China by 2020 with further phases, policy and strategy.

2. Smart Grid Status in India :

"Ref.[12]"Government of India has launched the scheme namely Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME India) under National Electric Mobility Mission Plan (NEMMP) 2020 in the Union Budget for 2015-16 with an initial outlayofRs.75Cr. The scheme will provide a major push for early adoption and market creation of both hybrid and electric technologies vehicles in the country.

3. Activities Worldwide:

"Ref. [12]" International Renewable Energy Agency (IRENA), an intergovernmental organization that supports the spread of renewable energy worldwide is expected to finalize details this week of a road map to install 160 Giga watts (GW) of battery storage worldwide in 2030. The volume of battery storage is expected to soar on the back of increasing electric vehicle penetration specially; lithium-ion battery-based storage is due to rise from 100MW in 2012 to around 25GW in 2020, and 150GW in 2030 applications, allowing the operational layer to be secured.

VIII. FEW FUTURE RESEARCH TRENDS

"Ref.[12]"To implement DSG successfully, the smart grid requires careful attention to the multitude of new needs for applied research as given as.

a) Optimal sizing and placement of distribution system resources
b) Optimal predictor-corrector resource dispatching
c) Integrated forecasting suites
d) Optimal adaptive reconfiguration of DNs
e) DN state estimation and observation

"Ref.[4][6]" The figure 8 gives the detailed importance of various aspects and parameters for Distributed Smart Grid as future perspective in comparison with the past, present and future .The era under observation is shown with respect to earlier study. The graph comprises of environmental health issues in joint with infrastructure needed for energy sources, building the network and its numerous components, human resources for research and associated management techniques, Quality security threats and much more. All these issues are interlinked, interdependent and as they reside in vast variety of different fields they should be of main concern.

"Ref. [10]" Distributed and embedded intelligence are important for emphasizing self-healing, optimizing operation. Functional and integration requirements of Distributed Energy Resources, Infrastructure .Management Systems, Metering ,Smart buildings and Smart devices should be of main concern with respect to recent initiatives, developments, technologies, and research.

IX. CONCLUSIONS

This paper has given short over view on the latest aspects of Distributed smart grid and closely related articles. Integrated communication using intermediate interfaces allows real time control of equipments, exchange of data measurements and optimization through atomization with certain parameters at all levels. Interest in the potential of smart grid to transform the way societies generate, distribute, and use electricity has increased dramatically over the past decade and transformed it into Distributed Smart Grid. With the above precisely selected issues this review paper has identified and illustrated the radical, competing and influencing priorities in Distributed Smart Grid Technology and until now whatever technology is developed ;still bigger challenges will be there that need to be resolved very efficiently based upon the new cutting edge technology , always as we move along the journey.

X. REFERENCES

[1] Peng Li ,Song Guo And Zixue Cheng "Joint Optimization of Electricity and Communication Cost for Meter Data Collection in Smart Grid" Received 3 May 2013; revised 7 July 2013; accepted 8 July 2013. Date of publication 18 July 2013; date of current version 21 January 2014.

[2] Yu Wang, Shiwen Mao and R. M. Nelms" Online Algorithm for Optimal Real-Time Energy Distribution in the Smart Grid" Department of Electrical and Computer Engineering, Auburn University, Auburn, AL 36849-5201, USA

Cite this article as: Upendra Vishnu Kulkarni, Aruna P Phatale, S A Naveed. "A Review Paper On Latest Trends In Distributed Smart Grid Technology." *International Conference on Information Engineering, Management and Security (2015)*: 328-333. Print.

[3] Mohamed E. El-hawary (2014) The Smart Grid—State-of-the-art and Future Trends, Electric Power Components and Systems, 42:3-4, 239-250, DOI: 10.1080/15325008.2013.868558 http://dx.doi.org/10.1080/15325008.2013.868558
[4] Jennie C. Stephens [1], Elizabeth J. Wilson [2], Tarla R. Peterson [3]and James Meadow croft [4]"Getting Smart? Climate Change and the Electric Grid" Received: 7 July 2013 / Revised: 23 August 2013 / Accepted: 23 August 2013 / Published: 5 September 2013Challenges 2013, 4(2), 201-216; doi: 10.3390/challe4020201.
[5] IEEE power & energy magazine march/april 2015
[6] http://smartgrid.ieee.org/conferences/event/196-ieee-international-symposium-on-power-line- communications and-its-applications-isplc
[7] http://www.smartgridupdate.blogspot.in/
[8] http://energy.gov/oe/services/technology-development/smart-grid
[9] http://indiasmartgrid.org/en/technology/Pages/Distributed-Generation.aspx
[10] https://www.navigantresearch.com/research/smart-grid-10-trends-to-watch-in-2015-and-beyond
[11] https://blogs.siemens.com/smartgridwatch/stories/23619
[12] SMART GRID Bulletin Volume 2, Issue 3 March 2015 (www.indiasmartgrid.org)
[13] Jayakrishnan R. Pillai 'Smart Grid– Projects & Future Challenges presentation', Department of Energy Technology Aalborg University
[14] Vikram Gandotra 'Smart Grids IIT Delhi Introduction to Smart Grids presentation 27/04/2013
[15] Nur Asyik Hidayatullah, Blagojce Stojcevski, Akhtar Kalam'Smart Grid and Renewable Energy', 2011, 2, 216-229 doi:10.4236/sgre.2011.23025

Cite this article as: Upendra Vishnu Kulkarni, Aruna P Phatale, S A Naveed. "A Review Paper On Latest Trends In Distributed Smart Grid Technology." *International Conference on Information Engineering, Management and Security (2015)*: 328-333. Print.