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A CRITICAL STUDY OF POWER SYSTEM AUTOMATION, INFORMATION AND COMMUNICATION TECHNOLOGIES FOR MART GRID

Momin Mohd. Nadeem Research Scholar, Department of Information Technology, Kalinga University, Raipur, Chhattisgarh 492101.

Gyanendra Gupta Research Guide, Department of Information Technology, Kalinga University, Raipur, Chhattisgarh 492101.

***Corresponding Author- Dr.Gyanendra Gupta, Associate Professor, Department of Information Technology, Kalinga University,Raipur, Chhattisgarh 492101.**

ABSTRACT

Smart grid (SG) is a proven power system that combines a modernised power distribution system with enhanced data, communication, and modern communications (ICT). Improved electrical team quality from energy production to a sophisticated user with optimal efficiency and power flows are among the SGs. Multiple connections, sophisticated surveillance, and control to optimise power quality are all standard characteristics of SGs, in adding to above modern mechanization. This protectsto effectively and dependability of all its linked power system elements from business threats and extends their life span. SGs boosted utility firms' working capacity by ict Implementation into the power system. As a result of combining ICT with SG, end users benefit from better asset management and energy management. The main areas of information and communications technology engaged in SG automating are presented in this journal article.

Keywords-Energy management, Power system automation, Smart gird, Information technology, Data communication.

1.Introduction

The current focus of alternative energy is on treatments for future energy demand rise at various usage levels, as well as holistic solutions for supplying ongoing and economical electricity systems. Artificial processes are being introduced into the electrical system as part of future electricity system advances to increase power quality and dependability. This study defined that renewal energy is help to increase the power sources which can be seen as a beneficial alternative to meet electricity demand while reducing greenhouse gas emissions. However, because of its inconstancy, RES has drawbacks [1]. The accompanying power swings can indeed be alleviated by utilising effective energy storage devices in conjunction with renewable energy sources. Integration of various RES entities, traditional grid operating, and control activities is a difficult and time-consuming undertaking. Since the power grid involves generators, communication systems, distribution channels, selling different, and utility system integrators, this is the case. Data transmission between power system organisations must be efficient in order to coordinate the energy infrastructure (SG).

2. Power system automation scenario for smart grid

Energy to generate electricity, converters (step it up type), and transmission feeders are all linked components of the power network system. They are dispersed across a vast area, which makes monitoring utility firms more difficult. The existing energy system was intended as a centralised system with only bidirectional power supply, that is, from power plants to end-user locations [2]. Because it delivers improved services for generating electricity, transmission, and distribution, SG has become a valuable resource for utilities. It transforms the aforementioned operations from a centralised to a market-based operating system [3]. Although the use of renewable energy sources helps to reduce carbon emissions, it does not guarantee a constant supply. This problem could be solved by adopting generating from renewable energy sources, and yet this generation is unreliable due to high penetration in the environment. As a result, it is critical to pay close attention to security systems in order to ensure that supply and demand remain constant. The schematic diagram of a smart energy structure is shown in Fig 1. In electrical network, the SG technique introduces sophisticated multiple interaction (information flows).

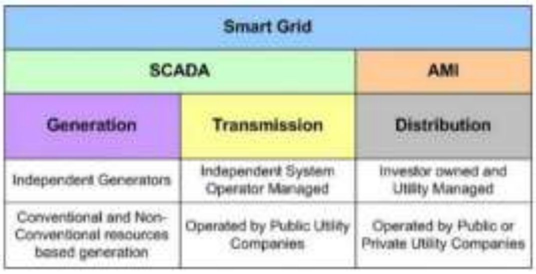

Fig 1: Smart grid block diagram

(Source**:** Bagdadee and Zhang 2021)

2.1 Scope of Smart grid power system in generation side

The electrical business may operate more intelligently thanks to the advances research in energy systems. The interconnectedness of the various generation stations, as well as their mutual dependency, has ensured that power generation systems are more reliable. The network linked with electrical systems has increased in complexity, resulting in the creation of "intelligence" in systems that have gotten increasingly sophisticated over time. In compared to the earlier approach, the current power dispatch ensures that the current infrastructure has more flexibility [4]. To meet electricity needs, effective performance management strategies are required. Customized to load balancing between utilization of renewable energy sources in a structured manner. However, continued use of conventional energy resources (coal and petrochemical goods) depletes them, despite ensuring a continual supply of electricity. As a result, renewable energy sources (RES) and renewable power supplies (SER) are an alternate and vital aspect in power generation, however there's any need to ensure electricity quality. The absence of wind and solar energy options causes electricity production to fluctuate rapidly [5]. As a result, establishing dynamic infrastructure and procedures for better energy fluctuation management is needed. It necessitates the addition of a new type of intellect.

2.2 Key requirement for smart grid follows:

- **Generation monitoring**: Data from metering resources is collected in real time. The generation is scheduled and also the timetable is allotted to everyone energy sources depending on the info acquired. In addition, critical success factors (Key performance indicators (kpi) mostly on generation source are routinely checked in order to improve power reliability. It will also include gross generation, each of which have different trends.
- **Dispatch of merit orders**: The key priority for utility would be to reduce generation costs. The demand is effectively divided among numerous units of generation to reduce costs. SG has scheduled this successfully.
- **Reporting function**: With implementation of SG, utilities and consumers can receive complete reports on facility and unit activities,

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plant or unit scheduling, unit capacity factor, and unplanned interchanges.

3. SG (smart grid) for power system to words distributed system

Because distribution systems are more localised and accessible, they haven't experienced significant automation. However, unlike lengthy electricity network or the generation end, after the system has been installed just on feeders and linked to the transmission line, the utilities will have a completely local system. It would only necessitate adjustments on a sporadic basis [6]. Any reactive current arrangements that must be formed based on load situations via capacitors might be done automatically using local inputs and predefined settings. Furthermore, a fault state would be automatically addressed with only a certain number of times. In the event of a current overload, the set transverse fuses will blow. As the consumption of power grows, so does the need for distribution transformers to be automated. A greater demand for distribution automation is indicated in the smart energy regulations (DA) [7]. DA will begin with power distribution user interfaces and progress through the transmission system and interactions with it, eventually leading to higher and more integrated distributed generation units (DER) or any other component requiring design and scheduling work.

4. Data communication scenario for smart grid system

In both normal and dangerous situations, you must make educated decisions. Improved monitoring will result in fewer failures, less maintenance, lower outage costs, and longer asset life for power systems. Optimized control innovations combined with advanced data communications technology will reduce power outages, isolate faults, and restore service quickly. In order to coordinate generation facilities, transmission systems, utility firms, distribution systems, and the energy market, the telecommunication setup is critical. The use of data transmission for transmission networks can improve real-time monitoring and safeguard the systems from future interruptions by minimising losses and voltage changes, enhancing dependability and assuring optimal transmission system utilisation. For smart distribution networks, the DA or station automation are critical enablers. Increased use of DERs is being examined as a future distribution system solution. By recognising and establishing distinct DERs first from existing distributed generators, SG shifts the peak loads [8]. The communication infrastructure in use is critical for exchanging data between the Global Automat and Monitoring Solutions and indeed the sub - stations.

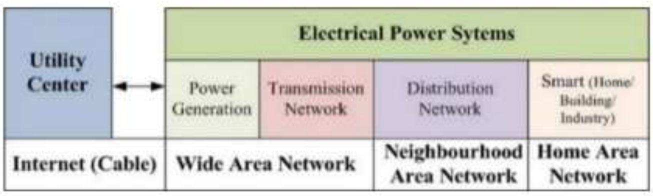

Fig 2: Network model network for 5G

(Source: KocakTaplamacioglu and Gozde 2020)

5. Role of IoT (internet of things) for smart grid application

The IoT concept was used to develop the first technology upgrades for the conventional grid. The first iteration of the SG was named as sophisticated utility system, or innovative delivery automation, and it was built on IoT ideas. That's not remarkable, given that utilities have a little more "things" scattered across a larger region than nearly every other industry, forming a big, complicated, interconnected machine. Based on the unitality sector creating a new energy related source and service will be intelligent gadgets enable new use cases. Using a perfect energy sourcesdevelop related service and other devices to get insights for improved business choices and automated is becoming increasingly important. Many of the more developed initiatives used today's IoT concepts, and SG embodies a fraction of IoT principles. One of Internet business applications is using IoT towards the shifting environment of decentralized and renewables generating [9]. Utilities frequently begin their IoT approach with their well-known smart grid projects. They may apply these concepts in continuing of SG, whether in various counties or for advanced tasks such as distributed intelligence, as they continue to embrace more parts of IoT, like analytics applications, IoT cloud, sensor technology, or information management. Figure 3 depicts the IoT's role in enhanced energy planning.

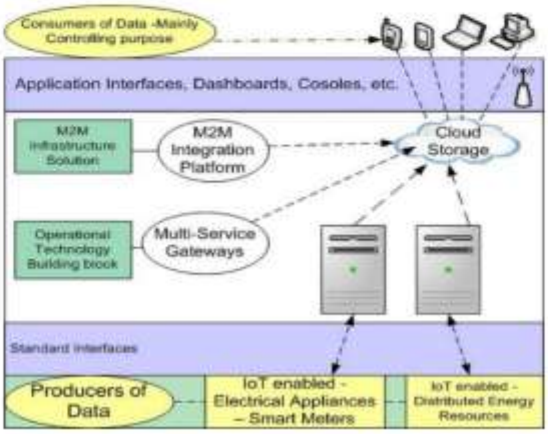

Fig 3: Aspect of IoT relatives for advance energy management

(Source: Abrahamsen Ai and Cheffena, 2021)

6. 5G cyber security challenges

The SG environment's processing capabilities to create or process such information is extremely reliable. This dependability is due based on the interconnection with a large number ofa electrical device, which raises issues of security and requires it to be tackled as a top priority. The definition of cyber has been narrowed down to the area of SG. Many standards deal with this from the perspective of an operator, while others deal with it from the perspective of implementation. In the December 2015 series of events demonstrates the damaging powers of an SG ecosystem that is not stable in terms of cybersecurity. The cybercriminals were successful in gaining external of the systems' computer interaction, resulting in a 10-hour blackout that impacted with a live of around 225,000 individuals [10]. Ex-post investigations by authorities ranging from the US FBI to Ukrainian authorities found that the attacks targeted vulnerable software on the system, with 'Black Energy' malware found throughout the systems' internal networks, culminating to an assault here on process control. Control of the system had to be reclaimed through manual rebooting and resumption of activities.

7. Conclusion

Modern technologies such as information and communication technology (ICT) are being used to change old grids into smart grids with improved automation, which become the potential for future energy requirements. The SG's effective energy administration with both the adoption of DER is by far the most crucial factor to consider. Peak demands could be transferred or delayed until other periods, and aggregate supply is managed logically. This method of electricity management will benefit not just TELKOMNIKA but also the rest of the world. Compute El Control Telecommand For (Vikram Kulkarni) 1025, power system mechanization, telecommunication, and communication technology not only improve system stability, but they also reduce carbon emissions and safeguard the environment.

Building AMI technologies for creating bidirectional connectivity to learn about electric usage between end-users and utilities is the most crucial infrastructure for SG. Dynamic tariffs were established, requiring active participation on the part of the end-user. AMI comprises communication technologies such as WAN, NAN, and HAN. Depending on the type of application and data throughput, variety of communication service mode different objectives. Issues of interoperability among technologies such as telecommunication, information, and data processing must to be solved urgently. The need to bridge the gap among different SG technology, and future research on this topic has a lot of potential. One of the important challenges addressed by SG is the maintenance of power quality. The input voltages and active power will be managed by the smart metre at end-user premises and the IED at distribution systems. The smart metres must capture the reference voltage delivered to end-user premises and report this information to the utility centre at regular intervals. Data utility centres will be able to optimise voltage levels as a result, improving the system's power quality. The equipment at the finished premise perform more efficiently with a greater voltage. With the help of event and situation-based operation in power systems are insufficient for managing and therefore can ensure stable operation.

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