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Theoretical Analyses on Implementing Internet of Things (IoT) in Power Distribution System

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Abstract – *Internet of Things (IoT) is an emerging technology in our scenario. By the process of interconnecting various elements such as energy meter, circuit breaker, control system, and monitoring system in the electrical system helps to achieve a lot of solutions such as real time fault detection, isolation, power theft management, e-billing etc… facing in the electrical power distribution system[1][2]. This paper deals with a theoretical analysis on implementing IoT in power distribution sector by proper data transfer in an economic way. This mode of implementation helps to analyse the huge data and control the whole distribution system in an effective manner.*

Key Words: IoT, internet of things, distribution system, fault, energy meter power theft, e-billing

1.INTRODUCTION

The IoT provides a proper communication between sensors, actuators controlling unit and the monitoring body by real time data sharing through various optical fiber/MW, switches, routers etc…A series of operations will simultaneously takes place in LAN, MAN and WAN.

Fig -1: Modelling

The data from the sensor is transmitted to data centre. When data arrived on data centre it analyse the data and give appropriate command to actuators. The Fig;-1 is the logical representation of the system. Physically the data centre spreads over LAN, MAN as well as WAN.

2. LITERATURE SURVEY

Our electrical distribution system is very week on monitoring in parameter variation as compared with electrical generation and transmission system. Since various accidents including electrocution and manipulation were occurred. Some of them are listed below.

1. Fault identification lag
2. Lack of information in fault location
3. Lag in power isolation
4. Power theft
5. Manipulation in energy meter
6. Billing issues
7. Lack of workman safety
8. Unauthorized switching of supply

These can be controlled and regulated by smart sensing meter[1] and smart isolator[2] by connecting them in a proper way.

3. METHODOLOGY

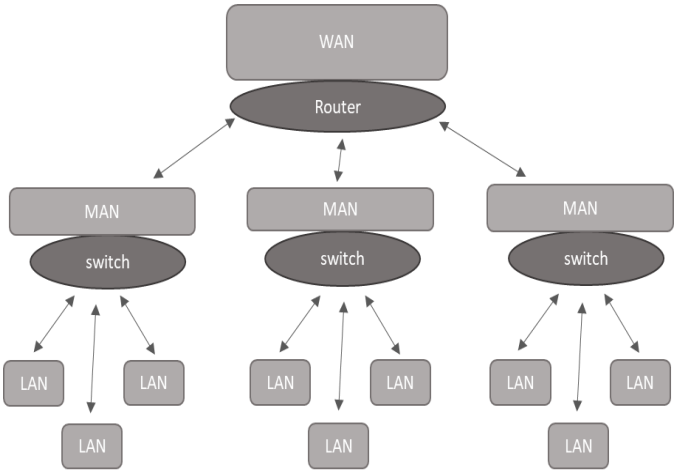

Fig -2: Data flow diagram

The system consist of 3 layer of communication for reduce congestion and traffic during data analysis.

3.1 Operations in LAN

Preliminary operations are takes place in LAN. The system contain two types of LAN. LAN-1 consist of voltage sensor, current sensor, memory unit and isolator. The voltage and current from energy meter which is calculated by the corresponding sensors send it to switches at the gateway of MAN. The energy consumption details are stored in the memory and automatically reset after the billing. Thus the operator and consumer can view the bill details at any time

according to tariff. The monitoring board can access the details at any time.

Fig -3: LAN-1

The LAN-2 consist of a relay for the isolation during fault. As the number of LAN-2 increases the precision of fault isolation increases.

Fig -4: LAN-2

3.2 Operation in MAN

The MAN receive data from LAN through a switch. The function of the switch is data filtering and management. If the incoming value exceeds the threshold value, it generate a warning and allow the warning value to enter MAN. Then it provide isolation command to the LAN that contain isolator to protect than area from further threat.

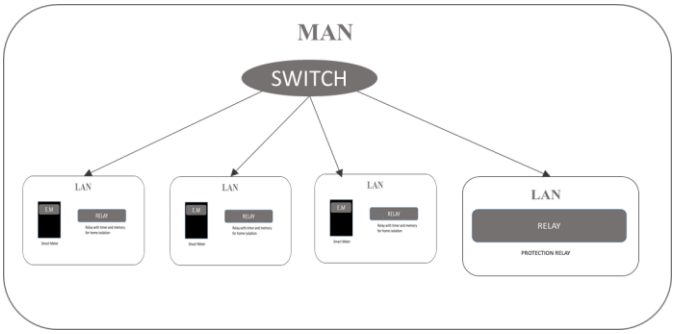

Fig -5: MAN

3.3 Operation in WAN

The router at the gateway of WAN interconnect the MAN together and analyse the data from MAN and gives appropriate instructions from WAN to MAN. WAN connect the operator to monitor and access the data from the network. Thus the operator can control the whole system with in his office.

4. ARCHITECTURE

The system consist of 3 layers

1. Perception layer
2. Network layer
3. Application layer

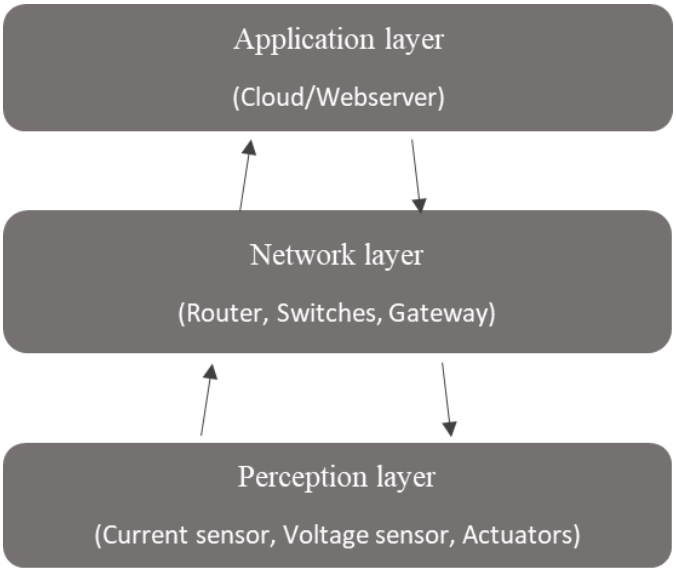

Fig -6: Architecture

4.1. PERCEPTION LAYER

Perception layer is the closest layer to end customers. It consist of sensors such as voltage sensors, current sensors, relay and other actuators. These elements sense the parameters and transmit it. It also perform the instruction from monitoring body by relay and actuators.

4.2. NETWORK LAYER

Network layer is the layer that the transportation of data takes place. The data can be transmitted via wireless or wired mode. The switches and routers determines the path of signal flow and ensure end to end data delivery. The data is transferred as packet which contain header with source and destination address, data and trailer which indicate acknowledgement of proper transfer. These data can be protected by using firewall from external access. Each operations are distributed to LAN, MAN and WAN networks for better data handling.

4.3. APPLICATION LAYER

Application layer is closest to controlling and monitoring body. It interact directly to the monitoring and controlling body which includes cloud, server, monitoring software etc…it may be private or public. Public servers are cheaper in cost but private is better for data security.

5. BENEFITS

1. Real time fault identification
2. Exact information on fault location
3. Real time power isolation
4. Effective remedy on power theft
5. Can found the manipulation in energy meter
6. Billing issues can be completely avoid
7. Can ensure workman safety
8. Unauthorized switching of supply can regulate

6. LIMITATION

Continuous stable network connection is required for the smooth operation.

7. CONCLUSION

By implementing internet of things (IoT) in electrical distribution system in a proper way, the variation in each parameter can be easily identify and can take appropriate decision at right time. It will reduce the electrical accidents as well as can prevent unauthorized intervention or manipulation in the system.

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