

## Model of Smart System Based On Smart Grid, Smart Meter and Wireless Based Smart Appliances

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**Abstract:** This research paper deals with networking of power system based on smart meter system. This paper will provide a complete look of smart system which involves smart meter, smart houses. The proposed method in this paper is quite efficient and reliable in contrast to all aspects to the global world. The proposed system in this paper will deal with whole power consumption and carry out all the communication throughout the entire system. The key cell in this smart system is customer house which must be a smart house as all the devices or appliances are smart due to installation of a wireless card. The card is communication icon between smart meter and appliances. A number of such smart houses are joint together to form a network under a single town server. This town server will manage both powers, one from service provider and other from regenerative sources installed in smart houses. The communication between smart house meter to town server is through local PSTN and also with power line. Many such town servers are connected in the entire system through PSTN and power line for power transmission so that they can share their information through PSTN and also power through power line. While all the town servers are connected to a main server through PSTN. All the smart houses are controlled by town server. Town server takes consumption of power for each instant from meter and save it and send it to main server after each hour. Town server also manage power in its area also from other town servers to fulfill the requirements of smart houses. Main server receive information from town server after exactly one hour and compile a bill up to that reading. The control of main server is associated with service provider. The main advantages of this system is that removal of high radiation as in ordinary system and in case of any disturbance at main server will not allow to let the system down

**Keywords** –smart meter, smart appliances, smart wireless cards

### I. Nomenclature

SMATR METER	S.M
SMART HOUSE	S.H
TOWN SEVER	T.S
MAIN SERVER	M.S
PUBLIC SWITCHED TELEPHONE NETWORK	PSTN

### II. Introduction

The most desired objective by smart power system is to control the load through efficient networking technique. The basic concern to a power system is to manage power and active frequency by balancing active power supply and its demand without this balancing of power system, due to the difference between required and available parameters, system might collapse. While few parameter limit this balancing which include stability of generators transmission line capacity limit and power losses[1,2,3]. In case of insufficient generation of power of system which is not sufficient to fulfill load requirement due to above mention factor, to avoid system from collapsing load shedding technique should be applied [4,5]. With the progressing technology a new system is introduce to market which based on smart meter and smart grid technology. It is quite efficient system, with all other key features, it is also capable of using convention power generation and transmission systems along with latest smart grid technology. Another feature of this system is that conventional meters are replaced by latest smart meters. In common practice, smart meter communication based on different method used in communication sector, like global system for mobile communication (GSM), CDMA communication, Wi-Fi communication etc. but a common problem in all these communication is high power radiation which are quite unhealthy for environment [10]. These radiations are dangerous and injurious for living things and more specially for human beings. These issue creates a mental unsatisfaction for normal person. On the other hand, by service provider point of view, all the such proposed communication technique involves some considerable drawbacks. Like in those systems which based on Wi-Fi communication needs to mount repeater poles after a certain distance. While signal problems are also observed in sensitive areas and bad weather conditions. And

those systems which uses LAN communication, using twisted pair cable need to place repeater or hub after each hundred meter to transmit that efficiently [12,13].although CDMA technology has less signal to noise ratio than GSM based system. But it requires 40 times more bandwidth. And when the burden of power system will also be added in GSM or CDMA system, it will increase both factors.

On another aspect, management problems are also observed in previous proposed systems like if the central managing unit or its subordinate managing units goes to link down, in this case, system will blank out ,etc. due to such problems of high importance, it is necessary to work on and to present a new concept which have some effective solution of high power radiations with effective price and have also some solution of management problems like one discuss above. And it also have efficient security technique against cyber crime and minimum cyber security risks [11]. Such efficient system proposed in this paper. The balancing of power and removal of high power radiation along with uncentralized management is presented in this paper by modifying smart meter and by efficient networking. System presented is named as smart system.

### **III. Description And Working**

There are four Major parts of smart system, which will work together to overcome all those problems which are drawbacks of previous systems. These are Smart House System

- (a) Smart Meter
- (b) Town Server
- (c) Main Server

#### **1.1. SMART HOUSE SYSTEM**

Smart house is a customer house which consist of smart appliances. Devices are smart due to installation of smart wireless card. The diagram of smart wireless card is shown in fig.1. it consist of

- 1 digital meter
- 2 microcontroller
- 3 Sensor
- 4 Simple wireless card

Using the smart appliances, now no need of using small socket to carry out communication between device and SM [6,7]. To sense power consumption sensor is used. It also decide current status while digital meter is the device which shows consumed power and its price. Microcontroller is device which control the flow of power. And appliances required power is also known to microcontroller and send this information to SM through simple wireless card. It is ordinary connecting device that connects SM to smart wireless card through wireless communication

#### **3.2. SMATR METER SYSTEM**

the key purposes of SMR

- (i) power management and measuring
- (ii) unit measurement and price
- (iii) communication

##### **3.2.1. POWER MANAGEMENT AND MEASURING**

SM is an intelligent device which have information about the total power required by smart appliances and distribute power taken from smart grid/power station accordingly [8].If the provided power from both sources is not sufficient it will try to fulfill requirement by extracting power from RS. And if RS are unable to satisfy power requirement, SM will send a signal to TS to provide difference of required power and available power.And if it is the case, required power is less than provided power by town server it broad cast a message to TS that TS provided power is more than require so TS can reduce power which is more than require power by SH.

##### **3.2.2. PRICE AND UNIT MEASUREMENT**

In this part of operation, SM measures power consumption unit of 3 levels

- i. power units provided by service provider
- ii. power units extracted from RS
- iii. those which are utilized by service provider

by using above mentioned readings, SM calculate price up to that time and it will be visible to customer [9].

##### **3.2.3. COMMUNICATION**

For the purpose of sending and receiving the message signal, TS is domain to communicate for SM. This is done by local PSTN. The usage of PSTN technology removes the high power radiations which are present in SM communication [10].using this communication path, SM only send those no of units and price to

TS which is to Finlay paid by the customer to service provider. While for power transmission, SM is connected to TS via power line also. All TSs are further connected to main server using PSTN.

### **3.3. TOWN SERVER (T.S)**

A town server is basic unit of smart system for management. Infact it is the central computer and a complete server which is able to take decision for all its user. The TS is connected to MS for communication only by using PSTN. As town server send calculated power units up to that time to MS after each hour so that all the data remain save at MS. while TS keeps data of current month only. It is for efficient working as long as current month passes, TS removes its data because MS have all the data of previous month and of present month up to that time. The sending of data after each hour is designed to remove the possibility of over burdening of bandwidth and also to reduce the bandwidth to considerably low level than previous smart system. The TS is operated by multitasking real time operating system and real time software which are designed for the purpose that whenever MS goes to link down state, The mode of TS automatically switch to administrative mode. In this mode TS behaves like a MS for itself and keeps to data until unless MS is not linked up. While TSs are connected to each other via PSTNs and via po lines see fig 2.all the management between TSs are possible through these both links so these links are of very importance. As discussed in introduction the draw backs of previous system and latest needs, the one strongest reason which appeals to use PSTN is theoretically unlimited bandwidth availability. Shannon theorem gives bandwidth equation as given below:

$$BPS = BW \log_2(1 + s/n)$$

BPS = bits per second

BW= channel bandwidth

S/N=signal to noise ratio

This is a real power ratio and not a db ratio. And bit per second is given by equation:

$$BPS = Rs \log_2 Ns$$

Rs= symbol rate (also bandwidth for QAM)

Ns= number of symbols in the constellation

Now beginning from very first point, SM sends a message to TS that its SH needs as much amount of power. In such away such messages will be received by TS from all of its SMs. Whenever the required power of SH decrease or increase, it will be informed to TS. Now if it is the case, ASM need to reduce its power and other SM need to increase its power, both broadcast a message signal to TS then TS reduces the suggested power of first one and assigned required mentioned power to other one. if it is sufficient for the requirement of second one then its otherwise TS will check another SH whose power can be assigned. if still deficiency remain TS will check its SHs those can provide power from their regenerative sources to compensate power deficiency. If no SH can provide or SH's power is less then it broadcast a message to its nearest TS to provide power see fig3.if nearest TS does not have power to donate from its own circle/ grid then it will borrow from next TS for the first one. If any problem occur at MS or any / few TSs, all the other TSs will remain working as working before see fig2

This is a considerable large advantage over all other systems. TS may or may not be connected directly to smart grid or conventional power station or both. Its vary area to area on the basis of cheap and reliable production of power in that area. The connection between TS and smart grid is same like main central computer of smart grid is connected in the smart grid system

### **3.4. MAIN SERVER**

MS is the central device around which all the system works. It keeps measurements, bills, records, customer records, topology of division of all the power of smart grid/ power stations for its town servers etc. every TS is connected to MS via PSTN only. as shown in fig.2. MS is directly operated by head office of service provider. And MS is can start or stop all the functionality and working of a particular SH / TS by using some type of commands or passwords. if different distribution companies are working under single umbrella of smart system, due to any reason, service provider company can stop the working of any TS under severe conditions. MS now generates a comprehensive summary at the end of the month for each SM and for each TS. MS informs the customer about their bills and power consumption by using one of their selected media(sms, post, email etc.). it also broadcast summary of the month to the relevant TS. And also keeps record of these summaries.

## **IV. ADVANTAGES**

As managing unit is TS, smart system provides electricity to each user every time. While working is described above. The usage of such networking scheme used in this paper, removes radiation remarkably and also gives a mental confidence and satisfaction to user. In any case of problem at MS or in any TS, others will remain working properly. This is considerably large advantage of purposed smart system over any other system. It is much faster and more reliable than any other system. The purposed system makes economical sense also as the initial amount of investment for the establishment of the system, is reduced by using PSTNs. A new power

company can purchase bandwidth for long duration at low cost and present communication company has its own network. With respect to security point of view, cyber security risks are more less in modern PSTN systems. As networking of smart system needs to be secure to encapsulate data and also to secure system from interruption of irrelevant person and virus.

**V. CONCLUSION AND FUTER ENHANCEMENT**

The paper presents the idea of TS as controlling and managing unit of smart system which keeps its working in case of any problem in any other part of the system. This paper discuss mutual sharing of power sources between regions and also sharing of power lines. It also discuss removal of radiation by using local PSTNs and main PSTNs. It also discusses how system Is beneficial for such countries where different distribution companies are working under a single umbrella. However customer will never suffer due to any unwanted condition and system will justify customer requirement, although MS or its own TS or other TSs are working properly or not in the system.

For future enhancement, this paper may bring a power revolution in communication market by the collaboration of power sector and communication sector so that a customer will have all the facilities from one vendor i.e. all eight services of communication sector plus power from power sector. As PLCs are unidirectional cables and cannot sent large amount of information, this paper may appeal to researchers to design a special cable in the single insulated jacket which can transmit power as well as information bidirectionally without disturbance of magnetic field.

**VI. FIGURES**

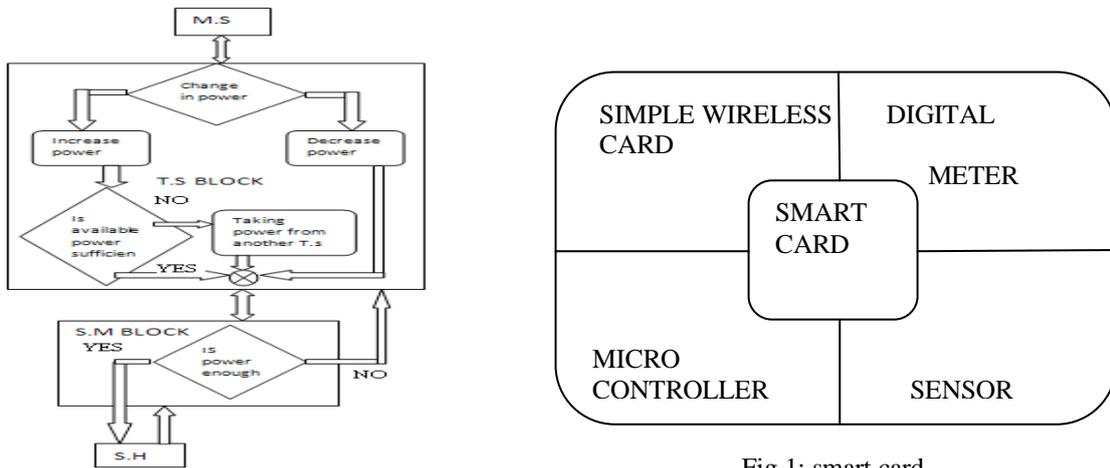


Fig.1: smart card

**figure 3:flow chart of smart system**

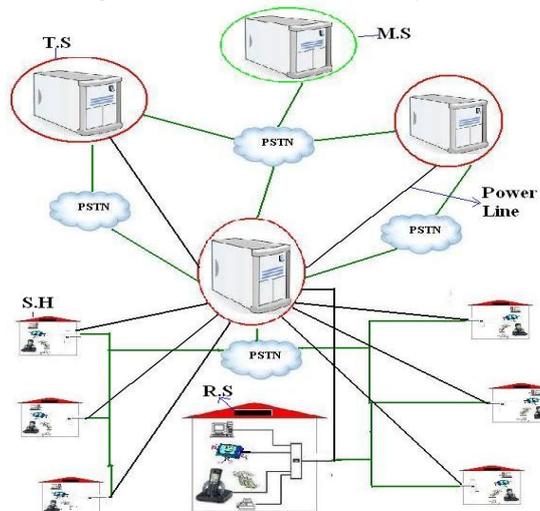


figure.2: Topology of smart system; upper part shows way of connection between T.Ss and also with M.S; While lower part shows the way of connection of S.H to T.S through local PST

### References

- [1.] Verma, V.; Singh, B.; Chandra, A.; Al-Haddad, K.; , "PowerConditioner for Variable-Frequency Drives in Offshore Oil Fields," Industry Applications, IEEE Transactions on , vol.46, no.2, pp.731-739, March-april 2010.
- [2.] Rajagopal, V.; Singh, B.; Kasal, G.K.; , "Electronic load controlle with power quality improvement of isolated induction generator for small hydro power generation," Renewable Power Generation, IET, vol.5, no.2, pp.202-213, March 2011.
- [3.] Soder, Lennart; , "Explaining Power System Operation toNonengineers," Power Engineering Review, IEEE, vol.22, no.4, pp.25-27, April 2002.s
- [4.] Seyedi, H.; Sanaye-Pasand, M.; , "New centralised adaptive loadshedding algorithms to mitigate power system blackouts," Generation, Transmission & Distribution, IET , vol.3, no.1, pp.99-114, January 2009.
- [5.] Gungor, V.C.; Bin Lu; Hancke, G.P.;, "Opportunities and Challenges of Wireless Sensor Networks in Smart Grid," Industrial Electronics, IEEETransactions on, vol.57, no. 10, pp.3557-3564, Oct. 2010.
- [6.] Moslehi, K.; Kumar, R.; , "A Reliability Perspective of the Smart Grid," Smart Grid, IEEE Transactions on, yoU, no.1, pp.57-64, June 2010
- [7.] Rozeha A Rashid; Mohd Adib Sarijari; Mohd Rozaini Abd Rahim; Tan Zun Yung;; "Flood Transmission based Protocol for Home Automation System via Power Line Communication," Proceedings of the International Conference on Computer and Communication Engineering, May 2008.
- [8.] Book : "Getting smart about smart meters answer book for residential customers" By POWER STREAM (vender company)
- [9.] M.S.Jaganmohan; K. Manikandan "Challenges in Smart Meter Design" Power system protection and automation conference, December 2010, New Dehli ,India.
- [10.] <http://stopsmartmeters.org/2011/08/22/smart-meters-more-radiation-than-a-cell-tower/>
- [11.] Book; by Orlean Koehle ; "The Latest in Bio-Hazard Technology"Information Compiled Fall and Winter of 2010, Printe Reproductions,Rohnert Park, CA 94928
- [12.] <http://stopsmartmeters.org/2011/09/04/comparing-cell-phone-and-smart-meter-radiation/>
- [13.] [http://www.youtube.com/watch?feature=player\\_embedded&v=rC-NI8gGWQk](http://www.youtube.com/watch?feature=player_embedded&v=rC-NI8gGWQk)
- [14.] Book: by Prof. Douglas C Hopkins; Prof. Mohammed Safiuddin. "Power electronics in a smart-grid distribution system" chapter #6.
- [15.] [http://www.windowsnetworking.com/articles\\_tutorials/copper-glass-guide-network-cables.html](http://www.windowsnetworking.com/articles_tutorials/copper-glass-guide-network-cables.html)
- [16.] Book: by Todd Lammale "CCNA:Cisco Certified Network Associate Study Guide" 5th Edition pp:33
- [17.] Document: "56Kbps Data Transmissiothe PSTN" By: P. Michael HendersonNovember 18, 1998