The study of the dynamic data management for the operating remote meter reading server in the smart grid

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***Abstract*— Smart grid is recently being presented as a means of electric facilities automation. Smart grid applies information and communications technology to electric network, enabling provision of accurate information to suppliers and consumers. In Smart grid environment, remote meter reading system is crucial that measures electricity usage in real time in order for demand control. One of the issues in Smart grid is the efficiency of real-time metering. The current operational method of remote reading server has its advantage in that the metering is compared to the past where metering was done by human hand. However, it also has disadvantage in that delay occurs when reading remote data of the same frequency at the same time. This study attempts to develop a method that enables real-time demand management by dynamic data processing in remote reading server for Smart grid. The essential part in Smart grid is the study of data transfer frequency by using properties of remote terminal and a reduction of data transfer period by determining priorities of server processing.**

Keywords-the smart grid; remote meter reading server; packet analysis; the dynamic data management

I. INTRODUCTION

By combining the information and communication technologies into existing power grids, reliability of the power grid, efficiency, the smart grid to be working to improve safety, renewable energy such as solar and wind power, electric vehicles(EV), a battery, storage devices in such demand response. Smart grid, energy source, power, communication, software, computing, consumer electronics equipment, semiconductor, etc., there is a variety of techniques are intertwined in a complex manner, only also technical elements operators and policy complex.

In this paper, we will let's examine how to manage dynamic data of remote meter reading server for the smart grid. Remote meter reading server, the existing common server operating systems there is a difference. The number of remote terminals that are connected to the server is very large. Remote terminal transmits the measured power usage fixedly facilities has been an electronic meter in place on the server. Remote meter reading server is to get the data regularly. Characteristics of the remote meter reading system is that tens of thousands of remote device repeatedly transfers the data. In chapter 2, we would design a method of managing dynamic data of remote meter reading server for smart grid to be proposed in this paper. In chapter 3, we would try to the analysis of simulation and results. Use the weight algorithm and the server priority algorithm using PID, undergo a pre-treatment process of the data. In chapter 4, we would propose conclusions and future research directions.

II. THE DESIGN OF THE DYNAMIC DATA MANAGEMENT FOR THE OPERATING REMOTE METER READING SERVER IN THE SMART GRID

A. The Framework of the dynamic data management for the operating remote meter reading server in the smart grid

Remote meter reading server using the IT technology is a method for measuring the amount of electricity from a remote. Electricity is installed a meter for measuring the power usage in a location, the remote terminal is connected to the meter, and transmits to the remote meter reading server the measured power usage across the network. The same equipment electricity locations nationwide have been facilities, it is a method of transferring data by measuring the power consumption for the server periodically.

In operating the remote meter reading server, the following problems exist. First, it is measured by the meter from the hundreds of thousands of remote terminals, it takes a long time to read and process data once in 15 minutes. And by repeating the same thing in the hundreds of thousands of remote terminal, remote terminal quantity is very large. Contract power in these remote meter reading server is large-scale customers, power usage many customers exist. Management system of remote meter reading server that is currently being operated by, there is a difficulty in the calculation of the core real-time power demand of smart grid. Thus, in this paper, by utilizing the characteristics of the power usage, and to propose a data management method for remote meter reading server for smart grid. Remote meter reading system configuration diagram that has been improved is proposed in this paper is as shown in FIG. 1.

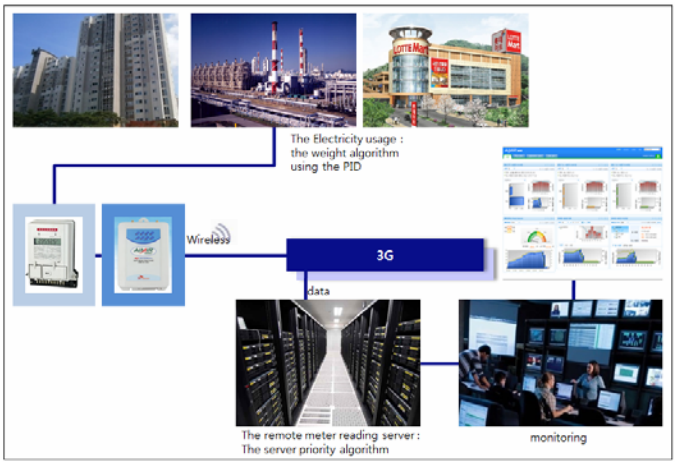

Figure 1. The Framework of the dynamic data management for the operating remote meter reading server in the smart grid

B. *The weight algorithm using the PID*

The weight of the algorithm using the PID to be proposed in this paper, it will be applied between the terminal processing unit. First, in this paper, there is provided an adaptive sampling algorithm for processing the data of the remote meter reading server. The adaptive sampling algorithm, reflecting the data values that change in real time, is suitable for calculating the optimal values. It is as follows representing the PID algorithm of the sampling method in the symbol.

$$MV_n = MV_{n-1} + \Delta MV_n$$

$$\Delta MV_n = k_1(e_n - e_{n-1}) + k_2(e_n + e_{n-1}) + k_3((e_n - e_{n-1}) - (e_{n-1} - e_{n-2}))$$

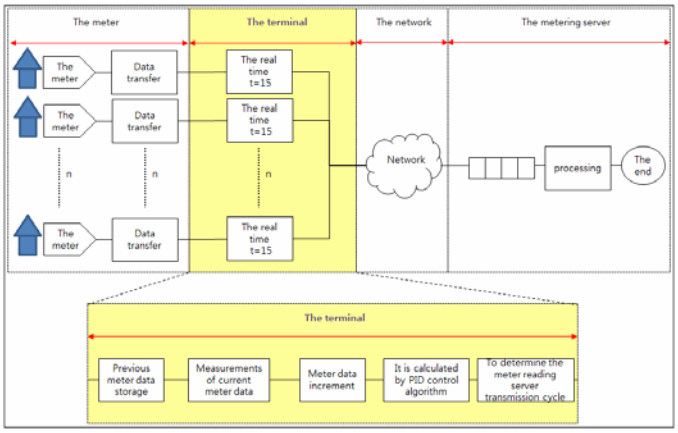

Figure 2. The weight algorithm using the PID

C. *The server priority algorithm*

The server priority algorithm is to select the priority of the remote terminal, a method of processing by the priority processing of data on the server. Priority of remote terminals, regional use of electrical, purpose of the electrical contracts, industry classification, demand systems, by utilizing the AHP based on the five elements of the power usage, and is calculated by assigning weights. After calculating the priority of the remote terminal by the server priority algorithm, in the server, the data is processed by these priority scheduling operation method.

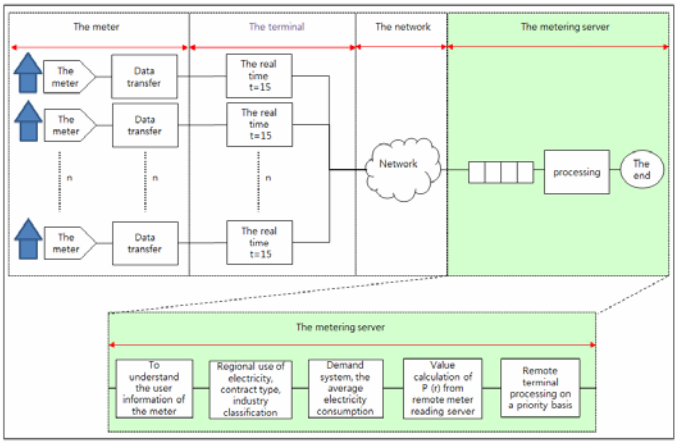

Figure 3. The server priority algorithm

In the case of remote terminal to measure the electricity consumption, during the first use, it is done through a contract with KEPCO. Use the address of the remote terminal at the time of the contract is determined. This is a G (r), which means electricity use area. And it will receive the supply of electricity by the six segments of the time electricity contract, but this C (r), that is, refers to the use contract type of electricity. I (r) means the industry classification when using electrical, D (r) means the demand plan. Z (r) is, I would say the average power usage. P to be applied to the priority of the remote terminal that has applied to the remote meter reading server (r) is as follows.

$$P(r) = gG(r) + cC(r) + iI(r) + dD(r) + zZ(r)$$

III. THE SIMULATION AND ANALYSIS RESULTS

In this paper, we would use a simulation tool as arena, that is designed based on a dynamic model developed in this ATWORTH. Arena because it has a modeling method that is consistent, engineering, factory, Supply Chain management, logistics, Call Center, etc., and supports a wide range of simulation capabilities.

In this study, depending on the period from the tens of thousands of remote terminals, it is a task of modeling remote meter reading system for transmitting data to the server. The arrival time and data processing time probability function of the data for applying the data queuing is assumed as follows. (1) After transfer from the remote terminal to the remote meter reading server, even after a certain cycle time. It conveys the information of when. (2) After the transfer of information in a single cycle, and terminates the delivered immediately. (3) for one of the remote terminal is to transmit the information, there is no influence with other remote terminal. (4) To process the remote terminal from a remote meter reading server, priority is

defined in the terminal. And processed above. (5) number of remote terminals 5 min, 10 min, 15 min, and 20 min, since it is concentrated in a particular time, the remote. Arrival probability of the terminal, in this study, following the Uniform. (6) In the actual meter reading system, after the data has been transferred to the server, and some for processing. And sent to the system, purpose of this experiment, using the transmission period of the remote terminal. Because it is in order to increase the transfer speed, the processing of the transport server, it is assumed only by.

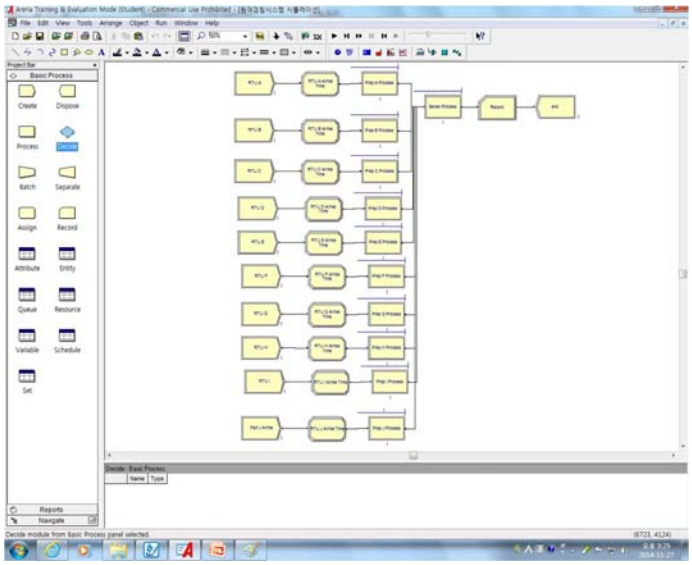

Figure 4. The work flow of the streaming server's data processing technique

In this section, the simulation experiment for the management of dynamic data in a remote meter reading server for the smart grid, and tries to analyze the test results. We try to analyze and apply the results of the method using the PID weight. K1, k2, k3 each of the weight of the weights of the algorithm is try to experiment with different of case scenarios using the PID. G of the server priority algorithm, c, I, d, z attempts to apply a value obtained weighted using the AHP.

Experiment	k_1	k_2	k_3	k_1	k_2	k_3
1	L	H	L	0.1	0.8	0.1
2	H	L	L	0.8	0.1	0.1
3	L	L	H	0.1	0.1	0.8
4	L	M	H	0.1	0.3	0.6
5	L	H	M	0.1	0.6	0.3
6	M	H	L	0.3	0.6	0.1
7	M	L	H	0.3	0.1	0.6
8	H	M	L	0.6	0.3	0.1
9	H	L	M	0.6	0.1	0.3

Figure 5. The experimental scenario method using PID weight

High under the weight of the algorithm using a PID, Middle, Low range, we want to specify in any in the following manner. L is defined in 0~0.2, M stipulated in 0.2 to 0.6. H prescribed by 0.6-1. H, M, as shown in FIG. 6 and represents the value of L in the graph.

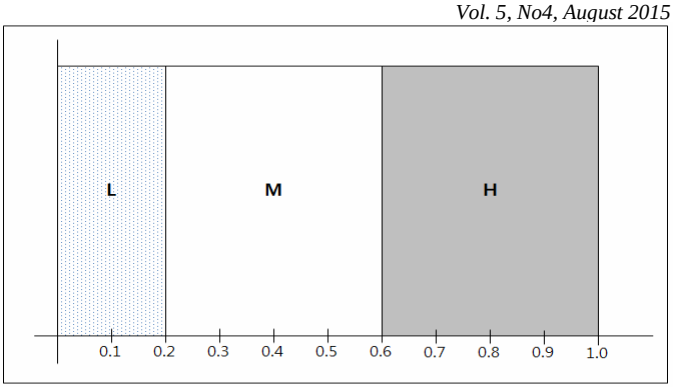

Figure 6. The value H,M,L using PID weight

Data of the experiment the weights algorithm using PID is as FIG.7. It has the metered value with changes in the RTU A RTU J to time as the data.

t	A	B	C	D	E	F	G	H	I	J
1	30	100	520	1000	100	500	1000	550	87	200
2	35	130	1120	1010	200	730	2000	1200	120	460
3	43	200	1640	1020	300	980	3000	1750	170	680
4	49	340	2100	1030	400	1050	4000	2100	230	890
5	53	450	2650	1040	500	1300	5000	2640	290	1030
6	57	520	3200	1050	600	1510	6000	3100	350	1250
7	62	763	3780	1060	700	1890	7000	3670	410	1480
8	68	890	4200	1070	800	2030	8000	4100	460	1720
9	76	920	4910	1080	900	2300	9000	4680	520	1960
10	77	1050	5200	1090	1000	2750	10000	5200	600	2300

Figure 7. The experiment data using PID weight

If you look at the experimental result, VA Time per Entity is the processing speed of each process, Wait Time per Entity, Total Time per Entity (Server), Accumulated VA Time, in the five parts of Accumulated Wait Time, from the results of Experiment 1, it is possible to know that the data processing speed becomes the fastest. Queue of processing speed Waiting Time, the data processing speed of the experimental one in Number Wait part was most excellent. When representing the experimental results in the FIG.8 is the same as the processing speed of the experimental process method utilizing PID weight and the speed of experiments queue of the PID weights utilizing the method.

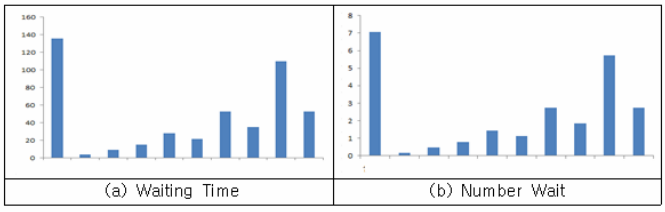

Figure 8. The Processing speed of the experimental queue using PID weight

Figure 9. The Processing speed of the experimental process using PID weight

IV. CONCLUSIONS

This study proposes a weight algorithm using PID as well as a remote reading server priority algorithm as a means of managing dynamic data control in remote reading server. First, weight algorithm using PID differentiate the transfer period to the remote reading server after analyzing electricity usage from the remote terminal. The weight is calculated according to the PID weights and the transfer period is computed according to the categorization of transfer period in remote reading server. Using the weight and transfer period, processing speed of tens of thousands remote terminals in remote reading server can be reduced through this dynamic data processing. Second, remote reading server priority algorithm sets the server processing order after determining the priorities in remote terminals based on their geographic features. The priorities are based on the five elements. After determining weight of users'properties using AHP algorithm, priorities is assigned to each remote terminal. This can address the issue of real-time reading efficiency as the remote reading server can treat remote terminals according to the remote reading server priority algorithm.

In the future research projects, we would study the data security in the smart grid. And the algorithms were applied for real-time inspection of the electrical field, which extends also to build a gas is also applicable to the characterization data model and to investigate actual applied.

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