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Biswaranjan Bhola

GIET: Gandhi Institute of Engineering and Technology

Raghvendra Kumar

GIET: Gandhi Institute of Engineering and Technology

Hoang Viet Long

Ton Duc Thang University

Ishaani Priyadarshini

UC Berkeley: University of California Berkeley

Nguyen Thi Kim Son (✉ nguyenthikimson@tdtu.edu.vn)

Hanoi Metropolitan University

Research Article

Keywords: Smart water management, LoRa watermeter network, LoRaWAN, Internet of Things (IoT), Cloud computing

Posted Date: October 28th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-835166/v1>

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Cloud Integrated with LoRa Watermeter Network: A Water Expense Repository

Biswaranjan Bhola¹, Raghvendra Kumar¹, Hoang Viet Long^{2,3}, Ishaani Priyadarshini⁴,
Nguyen Thi Kim Son⁵

¹Department of Computer Science and Engineering, GIET University, India, biswaranjan.bhola@giet.edu, raghvendra@giet.edu

²Division of Computational Mathematics and Engineering, Institute for Computational Science, Ton Duc Thang University, Ho Chi Minh City, Viet Nam.

³Faculty of Mathematics and Statistics, Ton Duc Thang University, Ho Chi Minh City, Viet Nam, hoangvietlong@tdtu.edu.vn

⁴School of Information, UC Berkeley, USA, ishaanidisha@gmail.com

⁵Faculty of Natural Sciences, Hanoi Metropolitan University, Vietnam, ntkson@daihocthudo.edu.vn

Abstract: Water management system towards the country is the biggest challenge to distribute the water to each corner of the country and keeps track of all the information to store it centrally which helps the government in analyzing and predicting the water situation of the country. For implementing the above things the crucial barriers are electrification and network spread all over the country which is a difficult task. The main purpose of this suggested work is to design a wide area network using low power consumption called the LoRa network. Using this network the resultant value of the water meter can transmit to the cloud to make a secure centralized repository system which helps the government as well as different business organizations a lot. The proposed work explains the whole architecture of the end-to-end communication system from water meter to cloud as well as defines all the components for managing end-user and applications. Due to low power consumption the whole communication system, and water meter, can be powered through solar energy through which electrification supply is not required. Hence using the explained technique we can efficiently monitor and collect information from every corner of a country efficiently to manage the consumption of drinking water which helps society a lot.

Index Terms: Smart water management; LoRa watermeter network; LoRaWAN; Internet of Things (IoT). Cloud computing.

1. INTRODUCTION

Water is a very essential element for the survival of life as well as society. Due to the different types of the reason the quality of the groundwater decreased day by day, and it is reported that 80 percent of diseases in the world are due to the poor quality of the drinking

water (Adimalla et al. 2018). Hence it indicates that there is a lot of scarcity of drinking water. Hence proper utilization of drinking water should be managed. The utilization of water should be tracked by the government which helps to improve the quality of the water distribution system and can find out the drinking water problems of different areas. The government is also awaked of the nearest drinking water problem which can hamper humanity. To find out the used water, a water meter will be installed in each home. Using a water meter we can find out the amount of water used by each home. For generating knowledge patterns for the prediction data should be stored into the central server which is a tedious task. For storing the data from the device in the first case each device should be IoT enabled and every device will be connected with the internet for transmitting the information from the device to cloud infrastructure. But in that concept, there is the biggest problem that makes an obstacle to fulfilling the solution. The problems are the electricity problem and the internet problem. Still some villages have no electricity supply and no internet connection.

To make a solution to the above-discussed problem in our proposed work we design a blueprint for the water meter network using LoRa technology-powered using solar energy for collecting information from the water meter and stored centrally using cloud infrastructure for prediction of future drinking water problems. LoRa used a low power wide area network (LPWAN) standard. The main difference between normal devices and IoT devices is that IoT devices are connected to the network. Think there are millions of water meters connected to solve that problem and the devices and network are also set up by different companies. Hence the network should be based on the international standard, which is accepted by all the companies to design the device as well as the network. And the good news is that the LoRa has an international standard that is LPWAN.

Figure 1: Architecture of communication between WaterMeter and Cloud infrastructure using LoRa Network

When we use solar energy and batteries for data transmission that means we have limited power for transmission. And the water meter is set up in different villages. The data should be transmitted in a long distance. Here we see the dilemma, that we want a long distance to reach but have no power to spend. In that scenario, LoRa can help us because LoRa communication devices communicate a long distance with less power. But the limitation of LoRa is that it has low bandwidth which may not create any problem for our proposed network. In our network, one meter sends information once a day. Hence low bandwidth can not make any wrong impact. The specification of the LoRa network and some other networks are bellowed in Table 1.

Table 1: Specification of LoRa Network

Parameters	LoRaWan	Narrow-Band	LTE Cat-1	LTE Cat-M	NB-LTE
Linkbudget	154 dB	151dB	130dB+	146 dB	!50 dB
Battery Lifetime	105 months (- (~9 years)	90 months (~7.5 years)		18 months (~1.5 year)	

2000mAh)					
Data rate	290 bps – 50 kbps	100 bits/sec	10 Mbps	200 kbps – 1 Mbps	20 kbps
Security	Yes	No	Yes	Yes	Yes

The main advantages for using the LoRa technology are

1. It is a very low power consumption
2. It has a very high link budget for long-distance transmission
3. It can be powered through solar energy
4. Infrastructure and antenna is very compact can be set up in a one square fit gange box.
5. The transmission of LoRa is secured by symmetric encryption.

The abstract interconnection diagram of the network is explained using Figure 1. The main objective of the proposed work is to set up a LoRa network to connect all the water meters with the cloud. The interconnection levels are, in the first stage, the water meter connected with the LoRa network to connect with the LoRa gateway. The LoRa gateways are interconnected with the LoRa Server. LoRa server interconnected with the cloud infrastructure using the IoT gateway and Edge server from making a centralized repository for the water expense by the different homes.

This article is further described in the following order. Section 2 discusses the literature survey and related works, section 3 explains the proposed architecture, section 4 evaluating the results and analysis, section 5 contains the conclusion.

2. RELATED WORK

Sučić et.al. (2013) presented a novel guidelines agreeable method for quickened Smart Grid mix and robotization based on semantic administrations. Bedogni et. al. (2013) exhibited three research commitments of the IoE venture relating to the help and

administration of portable smart administrations for EM situations. Andrade (2013) depicted and clarified IoE based on its few sort of employments and effects through the cases on the Smart Grid, Smart houses, Cooperation Objects and others executions achievable with the advancement of new advances concerning energy utilize, age, dissemination, and transmission streamlining.

Coroama et. al. (2014) exhibited existing appraisals and distinguished wandering meanings of the framework limit as the primary explanation behind the vast spread of energy force of the Internet separated by a few orders of size. Schien and Preist (2014) investigated top-down appraisals of the energy force of the Internet network and refreshed the framework limits and reference year with a specific end goal to help evaluations of computerized benefits generally adequately. Coroama and Hilty (2014) checked on ten examinations that surveyed the normal energy force of the Internet.

Jaradatet. al. (2015) given proposals and practices to be utilized as a part without bounds of smart grids and IoT. Xue (2015) learned about in what capacity the power frameworks can advance the security of the two situations and full-scale energy sources. Pan et. al. (2015) designed a one of its kind IoT trial testbed for energy productivity and building knowledge to explore utilizing a LEED-gold-certificated green office building. Shrouf and Miragliotta (2015) added to the comprehension of energy-effective generation administration homes that are improved and empowered by the IoT techniques.

Alahakoon and Yu (2016) present a thorough study of smart electricity meters and their usage concentrating on key parts of the metering procedure, diverse partner interests, and the advancements used to fulfill partner interests. Liu et. al. (2016) investigated the hypothesis of the connections between network setups and network lifetime and in addition transmission delay & proposed an inexact enhancement way to deal with limit the

conclusion-to-end defer with a diminished multifaceted nature of design under the condition that the system lifetime stays more noteworthy than the predefined target esteem.

Wang et.al. (2017) a utility-based adaptive duty cycle (UADC) directing method is proposed to expand energy proficiency, decrease transmission deferral, and keep a long lifetime in the meantime. Liu et. al. (2017) proposed a successful Knowledge-aware Proactive Nodes Selection (KPNS) framework to accomplish both energy proficiency and high checking execution. Sun et. al. (2017) a novel energy function intended for an energy router is proposed to precisely assess its transfer dependability. Mozaffari et. al. (2017) proposed a novel system for productively conveying and moving UAVs to gather information from ground IoT gadgets.

Perleset. al. (2018) create and contrast our special craft and two driving choices: LoRa and Sigfox and planned a suitable cloud architecture to manage CH observing necessities based on criteria, for example, adaptability, simplicity of arrangement, openness, and adaptability. Wanyama (2018) depicts how process and energy framework information is exchanged from gadgets utilizing Open Platform Communication (OPC) innovation over Ethernet to business applications, for example, Microsoft Excel. Jiaet. al. (2018) tested by applying the IoT techniques to structures for sparing energy and enhancing energy production. Pease et. al. (2018) present the outline, improvement, and approval of a novel, adaptive Cyber-Physical model to streamline total plant energy utilization through characterization and prediction of the dynamic and receptive energy of 3-stage mechanical machine forms. Table 2 discussed the different advantages and disadvantages of different authors.

Table 2: Summary of Related work

No.	Authors	Advantages	Limitations
1	Kumar and	Proposed a novel scalar point-	ECC method can't handle the Dos

	Sukumar (2018)	multiplication that provides low energy expended bit in light of elliptic curve cryptography (ECC).	assaults occurring on nature which should be engaged for expanded execution.
2	Yau et. al. (2018)	Provided a comprehensive review of IoT devices, from their roles and responsibilities to the challenges of operating them autonomously in heterogeneous environments and presents a comprehensive approach to analyze the energy consumption of IoT devices	Powering the forthcoming billions of connected devices effectively remains a major challenge.
3	Garína et. al. (2018)	Developed a system, based on the OSP and IoT platforms, to monitor buildings' environmental conditions.	Initial behavior of platforms would present appreciable mismatches and inaccuracies and
4	Wang et. al. (2017)	Presented an introduction and the inspiration for the development from smart grid to EI.	Technologies must be arranged well, to keep the superfluous misfortune in the security of electrical systems and correspondence systems
5	Novoa et. al. (2017)	Presented a smart socket framework that gathers the data about energy cost and makes utilization of sensors and actuators	It has not been possible to find portable equipment for fast deployment at a reasonable cost for the measurement of temperature,

		to advance home energy utilization as indicated by the client inclinations.	humidity, and CO2 concentration that could transmit the data through a WiFi network.
6	Zhou et. al. (2016)	Displayed a precise investigation of Energy Internet from the business point of view	Need to unravel vital issues, information issues, behavioral issues, security issues, and administrative issues for the long-haul advancement of Energy Internet and the full acknowledgment of its business potential.
7	Tao et. al. (2016)	The first innovative contribution is pointing out 999 the fact that IoT can be and is being applied into product life-cycle energy management (PLEM).	Need improvement for the IoT-based PLEM performance from security, scalability, accuracy, standardization, automation, and some other aspects.
8	Sun et. al. (2015)	Proposed a novel distributed coordinated controller joined with a multi-specialist-based consensus strategy which is connected to distributed generators in the Energy Internet.	The cost of equipment amid the procedure of assignment ought to be considered in the future & presented a little about the energy capacity without its control methodology.
9	Kamalinejad et. al. (2015)	Introduced an overview of empowering advancements for productive WEH, analyzed the	Only outlined advances and plans to empower WEH for IoT frameworks

		lifetime of WEH-empowered IoT gadgets, and quickly examined the future patterns in the outline of productive WEH frameworks and research challenges that lie ahead.	
10	Kaur and Sood (2015)	An energy productive design for IoT has been proposed, which comprises of three layers, to be specific, detecting and control, data handling, and presentation.	Gives same level of security and furthermore keeps low vitality utilization by accelerating the calculation time.
11	Moness et. al. (2015)	A review for cutting edge layers, segments and strategies for WECS is exhibited	The social part of nearby acknowledgment and impacts of WECS should be considered for viable sending as social IoT
12	Tao et. al. (2014)	Proposed another technique for ESER assessment in view of the BOM of an item and the new innovation of IoT.	Need to design, develop, and use of ESER exhaustive cloud benefit stage which can give different required ESER administrations, for example, displaying administration, assessment benefit, recreation benefit, investigation benefit, advancement administrations, and others.
13	Nieminen et.al. (2014)	Presented a holistic networking solution for connecting Bluetooth	Still issues exist such as evaluating additional header compression

		LE devices with the IoT.	mechanisms, IoT gadget administration, and improving portable passages by adjusting their Internet network connect to help IoT movement.
14	Shrouf et.al. (2014)	Acquainted an approach with embrace IoT worldview at the production level keeping in mind the end goal to help energy the administration also, increment energy productivity of generation frameworks at smart factories	Better compression strategies can be actualized for limiting stockpiling necessities and compelling recovery of information.
15	Cao and Yang (2013)	Advancement of electrical network is presented for tending to energy web issues.	Energy internet is an open infrastructure therefore needs to provide suitable methodologies for future energy production, consumption, and sharing to be convenient as information sharing today.
16	Krenge et.al. (2013)	Demonstrated that Energy Name Service (ENS) empowers the recognizable proof of components inside the IoE and gives the usefulness to recover additional data on the components.	ENS unequivocally prohibits security contemplations and concentrates on the recognizable proof of objects.

17	Kelly et.al. (2013)	Proposed a powerful execution for IoT utilized for checking consistent household conditions by methods for ease universal detecting framework.	Availability of IPv6 network might be a noteworthy worry in actualizing the strategies.
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3. PROPOSED ARCHITECTURE

In the past , lots of technology was developed to manage the information of different meters like energy meter, water meter, gas meter, etc. Before the nineties, one person was recruited by the government or specified by the organization to collect the meter information and submit it to the office, but that is a tedious task and the expenses are high. Also, quality service will not be provided to the customer due to some natural problems involved in human beings like diseases, disturbances, etc. To solve such a type of problem IoT is present as amnesia of solutions. Through IoT, the automation process is spread out like an automated bill generation system, as well as sending the bill information to the user through SMS or E-Mail. Payment is also accepted through the online transaction. The main problem of IoT is that its communication medium is the internet. The communication load of the internet is increasing day by day as well as still the present day in many areas having no internet. Hence the meters are not properly managed. To minimize the above problem, the proposed concept may be a solution for that and we try to implement it in the water meter network. Figure 2 explains the interconnection architecture of the water meter network and the components associated with it.

Figure 2: Interconnection diagram water meter network

The interconnection architecture of the water meter network is divided into five-layer of interconnection stages.

1. User Layer
2. LoRa WAN Network
3. Public Network
4. Cloud Provider
5. Enterprise Network

3.1 User Layer

In the user layer, all the end-user components are functioning. Directly customer or consumer-related applications have functioned in this layer. This layer contains components are IoT user, End-user application, and Water meter.

In IoT, users are referenced to all the consumers. Particularly the function of this component is to provide required information to the customer. The function of the component are outlined below

1. Sending billing information to the user

2. Sending user information to the user
3. If some maintenance work going on that information is transferred
4. Users can send complain through that layer

End-User application components contained a user and meter required application for processing the information. The application can be designed in a high-level programming language like java, PHP, or python, etc. A water meter is a hardware device which installs into the home to track information regarding the uses of water. It contains one flow sensor, processing, processing IC like microprocessor or microcontroller, and a LoRa client communication module through which it can communicate with the LoRa network.

3.2 LoRa WAN Network

The main specification of LoRa WAN is it consumes low power and can transmit the signal to a longer distance for Wide area networking. Hence the LoRa base on the low power, wide-area networking (LPWAN) standard. It is used as an unlicensed radio spectrum in the industrial, Scientific, and Medical (ISM) band. The main components for designing the LoRaWAN are LoRa Gateway, LoRa Client, and LoRa Transceiver antenna.

LoRa Gateway is a bridge between LoRa Client and the IoT network. Here the water meters are the client devices. LoRa network is a low power and low bandwidth network used by water meters to transmit the data, and LoRa gateway uses a high bandwidth device communication like WiFi, and Ethernet to transmit that data to the IoT network. Lora Client is the end-user water meter device installed in the home. A detailed explanation is explained in section 3.1. A 2.4 GHz antenna is used for communication. The frequency range is 420 ~ 450 MHz. It Provides a Half-duplex (Serial Programming Interface) SPI communication. It is also communicated through a GPIO pin.

3.3 Public Network

The public network is the third layer of the interconnection model of the water meter network. The basic function of this layer is to interconnect the LoRa network with the IoT network to interconnect with the cloud. The components of this layer are IoT gateway, Peer cloud, and edge services. IoT gateway is a bridge between the water meter LoRa network and the cloud. It is the convergence point of the whole network and manages like an intelligent central hub. The important function of this component is to filter data from the device into a piece of useful information. The common use of IoT gateway are outlined below

1. Connecting network devices with one to another
2. An interconnecting device with cloud
3. Translating the communication between different company manufacture meters with cloud accepted information.
4. Filtering the incoming and outgoing data.
5. Enforcing security into the communication

Peer Cloud is the third-party cloud system that provides services to collect data and provide a bridge to the IoT platform. It provides all the solutions to IoT infrastructure to make compatibility with IoT platforms. Edge services provide a platform to pass the data securely from the IoT network to the cloud. It also manages the domain name system to identify the device as well as the different users. In this component, the firewall is managed for security purposes from the packet filter to the application layer filter. It also implements a load balancer for managing communication load. The important operation of edge service is listed bellow

1. It maintained the domain name system to logically identified the user. It mapped the logical address with the IP address.
2. It manages a content delivery network to support end-user applications and minimizes latency.

3. It manages a firewall for a secured and trusted communication system
4. It manages a load balancer for maximizing the throughput and minimize the response time hence the reliability of the application is increased.

3.4 Cloud Provider

Cloud provider is the core part of the IoT application. It contains a centralized storage device for storing data, analytics methods for analyzing the data and predicting the knowledge, managing all the processes for the IoT system, creating the data visualization, and managing all the hosts and devices including device registry. The components of a cloud provider are

1. IoT Transformation and Connectivity
2. Application Logic
3. Visualization
4. Analytics
5. Process Management
6. Device Data Store
7. API Management
8. Device Management
9. Device Registry
10. Device Identity Service
11. Transformation and Connectivity

IoT Transformation and Connectivity will provide a secure connection and provide a scalable platform for messaging between different applications. It also processes all the IoT meter information, cleans it, and makes a comparable format as per the cloud services. The core component of the cloud is the cloud application which executes the service as per the client's request. It also triggers some action as per the user requirement and logic to handle

the user request. All the application control parts are coming under the Application Logic components. The end-user interfaces are coming under the visualization part. The user interacts with the end repository through the user interface shortly called UI. The UI is divided into three subcomponents called End User UI, Admin UI, and Dashboard. Through the end-user UI the normal user, like consumers can interact with the system, and through the admin UI administrator user interact with the system. The dashboard is the integration of both components and provides the platform for system settings. Analytics is the searching and presenting of the meaning full pattern of information getting from water metered data. It will help to describe and predict the water problem for the future and can analyze the requirements of water in the present scenario. The basic function of analytics is the analysis of data repository, converting the cloud as an intelligent system by learning the reason and purpose of the information for predicting the future situation, computing the data streaming, and providing a business environment using water.

3.5 Enterprise Network

Here enterprise networks are government departments from panchayat level to central government levels form awarded them self regarding the expenditure amount of water per day, Water problematic area, and can prepare themselves to take precautions to face the water problems in the summer season, or at the time of scarcity of water, This layer contained enterprise user directory, enterprise data, and enterprise applications.

4. EVALUATION RESULTS AND ANALYSIS

The main idea behind this work is to extend the IoT network to a large network which helps to collect information remotely and at less cost. The LoRa technology is the advanced technology for transmitting the signal in a long distance with low power consumption. But one of the biggest disadvantages is the low bandwidth link. In low power consumption, the bandwidth will not be increased as per the rule of the physics bandwidth α

power. Hence in every scenario, LoRa technology can be used. But for our scenario bandwidth is less important than long-distance communication. Because the reading of the water meter is required once a day. Due to the water meter installed into the villages, and some of the villages having no electricity and internet connection hence this work helps a lot to connect water meters and household devices. Sanchez-Iborra, (2018) evaluated the performance of the LoRa network and practically communicated Long distances. For testing the data communication they choose three different locations. One communication is performed in Urban Area, Second is Sub Urban Area and third in Rural Area present in Figure 3.

Figure 3: Graphical representation of signal communication distance

4.1 Long-distance evaluation

We also evaluate long-distance communication using Link Budget. A link budget is a calculation of all of the power gain and losses that a communication signal experiences in the telecommunication system. From a transmitter, through a communication medium such as radio waves, cable, waveguide, or optical fiber to the receiver. The link budget is filled up by the transmission power and sensitivity in the receiver and calculated in Decibel(dB). The use of the Link Budget is shown in Figure 4.

(a) Link Budget

(b) Link Budget Expenses as per the Kilometer

Figure 4: Link Budget Analysis

Figure 4(a) explains the Link Budget, and figure 4(b) explains the Link Budget required for transmitting the signal to a distance of kilometers. We have calculated the required dBm value in an idle situation using the radio link budget calculator. The main focus in the above analysis is as per the LoRa specification it provides a 154dB link budget, which means in an ideal situation it can be communicated up to 1000 km.

4.2 Analysis for data collision in communication

LoRa is an advanced technology for data communication using low power consumption. It also used symmetric-key cryptography for secure data connection. But it will not provide any collision detection technique created in communication. It believes that the channel is free for transmitting the data. To solve these types of problems Token rings can be implemented to solve that type of problem. The time transition diagram is bellowed in Figure 5.

As per Figure 5(a) First LoRa gateway sends a token to the water meter for sending the data. After receiving the token, the water meter sends the date to the IoT gateway. Then in the last step, LoRa gateway sends the acknowledgement(ACK) for ending the communication. In Figure 5(b) explain that suppose the sending token is not received by the

water meter the gateway waits T1 amount of time and realizes that the water meter is not getting the data hence it sends the token again to the water meter for getting the data. After that, the water meter sends the data to the gateway and waits for ACK. After getting the ACK the whole communication process is stopped.

Figure 5: Time diagram for data communication using token passing technology for avoiding the data collision

In Figure 5(c) it is pointed out that after getting the token from the gateway water meter sends the data. But the data has not been received by the gateway as per Figure 5(b) again the water meter sends the token by thinking that the token is not getting by the water

meter. But if the token is not reached to the water meter, the water meter sends the data again and realizes that the data is not received by the gateway.

According to Figure 5(d), the token is sent to the water meter by the gateway, and the water meter receives the token and sends the data to the gateway. Gateway received the data and has sent the ACK. But ACK is not received by the water meter the after T time again it sends the data to the gateway in thought that the gateway has not received the data.

4.3 An approximation Mathematics Model

Using the bellow model we can calculate that in an idle situation how many water meters are communicated within a day, as well as how many gateways are required to transmit the data from a particular area.

1. Data transmission rate to one gateway = N Kbps
2. In One day data transmitted = N Kbps X 24 X 3600 Kbps
3. $= \frac{N \text{ Kbps} \times 24 \times 3600}{10^9}$
4. Number of Address bit = A
5. Number of Data bit = D
6. The size of the InstructionFrame = A + D
7. Number of WaterMeter (WM) communicated in a day

$$\text{a. } = \frac{N \text{ Kbps} \times 24 \times 3600}{10^9} \times \frac{1}{\text{InstructionFrame}}$$

8. Communication Load increased

$$\text{a. } \sum_{i=1}^k 2 \times \text{InstructionFrame}$$

b. *for i is the number of WaterMeter varies from 1, 2, 3, ..., k*

9. No of Gateway required for 'T' WaterMeter

$$\left[\frac{N \text{ Kbps} \times 24 \times 3600}{10^9} \times \frac{1}{\text{InstructionFrame}} \right] T$$

10. Number of bits(Nb), transmission required for 'T' WaterMeter

$$Nb = T \times InstructionFrame$$

Example 1

One village having 100 homes, each home installed one WaterMeter that means 100. WaterMeter installed in the village.

WaterMeter is addressed by 48 bit number and the data bit send by the WaterMeter is 16 bit

InstructionFrame = 64 bit

Number of bits transmission required in a day

$$Nb = T \times InstructionFrame$$

T = 100, InstructionFrame = 64. So we have Nb = 6400bits

LORA network maximum data rate = 50 Kbps

Then to transmit one village information having 100 WaterMeter maximum 1 second is required

Example 2

LORA network maximum data rate = 50Kbps

In a one day number of bits can be transmitted is $50,000 \times 24 \times 3,600 = 4.32\text{Gb}$

Number of WaterMeter communicated in a day is $\frac{4,32,00,00,000}{64} = 6,75,00,000$

Meter can communicated

Number of village can communicated 6,75,000

4.4 Use of Solar energy to give power to the water meter and LoRa Gateway

The gateways and water meters will have provision to get energy from solar energy. Because there are some areas where electricity is not available. Hence to make success our vision solar energy should include our communicating device as well as the device. The abstract interconnection between the device to a solar cell is bellowed in Figure 6.

Figure 6: Abstract Connection diagram between solar cell and device

To calculate solar energy required for the device we can use the following simple mathematics trick

Suppose the voltage rating of a device is xV

The current rating of a device is yA

Then the power required $xV \times yA = zW$

Energy consumption for $1W = 1J/s$

Energy consumption for $zW = z J/s$

It consumer energy per year $3,15,36,000 \times z J/s$

Hence we should choose one solar cell which gives more than $3,15,36,000 \times z J/s$ energy in a year.

4.5 Comparison of simulation and analytical results

In our experiment, we take four LoRa clients and one LoRa server to communicate with each other. The output is bellowed in Figure 7. For the below experiments we take five LoRa shields and five arduino uno devices. Each arduino uno device integrated with one LoRa shield. From five devices one device contained the server program which is pointed out using black cable and another four devices are programmed as the client pointed out using blue data cable. All the client devices communicated to the server and server device response which is displayed in the serial monitor. This demonstration shows the multiple client communication to the server using the defined technology in Section 4.2.

Figure 7: LoRa clients and LoRa server

5. CONCLUSION

In the last few decades, the water department sector has faced lots of remarkable changes, in particular, the development of water meters and installed into a wide range. The efficient utilization of drinking is badly necessary to overcome the near shortage of drinking water problem and to make the government regarding the future water problem. But the biggest challenge to implement this work is the unavailability of the electrification system in rural areas and the internet connection. Using the proposed technique we can spread a wide area network throughout the rural area as well as the urban area in low power consumption. By adopting this technology, an electrification system is not required to run the water meter and the network. Both can be operated through solar energy.

Finally, due to the good performance of the LoRa network in the long-distance, it can help to connect all the water networks into one network infrastructure, hence it is possible to store all the expenses drinking water information in a central repository. This information helps a lot to find out drinking water-related information. Through that information, we also

predict the future water problem. It is necessary because water both in abundance and in scarcity pose a threat to the existence of life on earth.

Author Contributions: All authors contributed equally to this work.

Funding: This work was supported by the TDTU research fund.

Data Availability: The authors confirm that the data supporting the findings of this study are available within the article or could be requested from the corresponding author, upon reasonable request. All data are publicly accessible at the sources cited in the text.

Code Availability: Available upon reasonable request.

Declarations

Conflict of Interest: The authors declare no competing interests.

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