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A System to access IRNSS data from different Receiver stations using Cloud Computing

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Abstract: ***Data storage on hard drives of laptop/ datacentres has become a relatively outdated technique as it involves risk of data backup, increase in price due to additional hard drives and management of the data. The world is now progressing with latest technologies with storage on hard disks and datacentres being replaced by the storage on the cloud. When data is generated in continuous form, no matter how small it is, there ought to be a provision to store the data in a place where safety is ensured and storage capacity never runs out. Also since the data is very crucial and we cannot take a chance of data falling in wrong hands, permission to access the data is given only to the authorized users thereby ensuring safety of the data. These things can be ensured using cloud computing which is the best platform for maintaining, storing and monitoring the data. In case of IRNSS/ NavIC data, a requirement of collecting and storing large quantity of scientific data exists. Apart from this a number of stations across the country are involved in this mission from where these data are to be stored. They are also normally required to be accessed by other users in the country. The scientific parameters obtained from the satellite are stored in the C drive of laptop by means of Receiver. The paper aims to device a system wherein the laptop will be replaced by a gateway and the storage in the C drive will be replaced with the storage in the cloud. The data coming from the satellite will be accessed by the gateway and after certain period of time, the data will be stored onto the AWS cloud thereby eliminating the need of laptop and additional hard drives.***

Index Terms: ***AWS, Cloud Computing, IAM, IRNSS, ISRO, S3***

I. INTRODUCTION

Indian Regional Navigation Satellite System (IRNSS) [Ref] is a constellation of Indian satellites which will collectively provide precise real time position and timing services. Under a Memorandum of Understanding JAIN (Deemed-to-be University) has been provided with three IRNSS/NavIC receivers for conducting various scientific studies since 2014. Data are being continuously recorded at the Jain University campus as well as during various field campaigns. The data generated by these satellites is huge and storage of this data for various analyses and research studies is a major concern.

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The signal coming from the satellite is received by the antenna and the IRNSS User Receiver logs these scientific parameters in the C drive of the laptop. Even though the C drive has Giga Bytes of capacity, it will soon run out of storage space as the data logged every week is in Giga Bytes. To make space for new data the previously obtained data is generally copied to other drives in the laptop and when all the drives in the laptop are filled the data is finally transferred to a hard disk having Tera Bytes of capacity. Maintaining and monitoring of these hard disks is a major problem, and, further, if the hard disk gets misplaced or lost there is no means of retrieving back the lost data; the cost of buying hard disks also comes into picture. Hence Cloud Computing plays a major role here.
Amazon Web Services (AWS) is the cloud used in this project. It occupies market share of 31% as compared to its other competitors. It has flexible pricing model wherein user has to pay only for the services that they are using, in case of Elastic Cloud Compute (EC2 instance) user will be charged per hour and not for the entire day. AWS allows its users to calculate well in advance the charges they would incur if they were to use some of the required services. The charges can be calculated by using simple monthly calculator. For calculating storage charges for services like Simple Storage Service (S3) user has to enter the amount of data that they intend to store (Gigabyte's, Terabytes' etc.) and accordingly the charges will be displayed.

Numerous universities and research institutions in India are have also been operating the IRNSS SPS-GPS User Receiver under similar collaboration with SAC/ISRO., Information obtained from satellites varies from university to university based on their location/position. Research scholars pursuing their PhD in this field may need data from different universities for their research work, they have to contact ISRO SAC requesting for the data from concerned university. Depending on the requirement ISRO SAC will instruct the concerned university to upload their location data received from the IRNSS Receiver to the specified FTP link. This process is tedious and time consuming as no common platform is available for the users to get the data from all the universities. The proposed system aims at removing this barrier by storing the scientific parameters obtained from IRNSS SPS GPS User Receiver to the AWS cloud where the data will be automatically maintained, monitored and backed up by the cloud provider. Although AWS is a secure cloud storage, it offers additional services for securing the data stored in the cloud. The two services used here are Simple Storage Service and Integrated Access Management. The details about these services will be provided in further sections of this paper.

II. BLOCK DIAGRAM OF THE EXISTING SYSTEM

The information originating from the satellite reaches the antenna placed on to the rooftop. The antenna is placed such that it gets a clear unobstructed view of the open sky to the extent possible. This enables the receiver placed inside the NavIC lab to track maximum number of satellites out of the ones available. The receiver pushes the data on the hard disk drive of the computer every second and for the user to see this data, Accord Software & Systems, manufacturer of the receiver have provided the IRDAS software (running in the laptop, provided along with the receiver) for user interface.

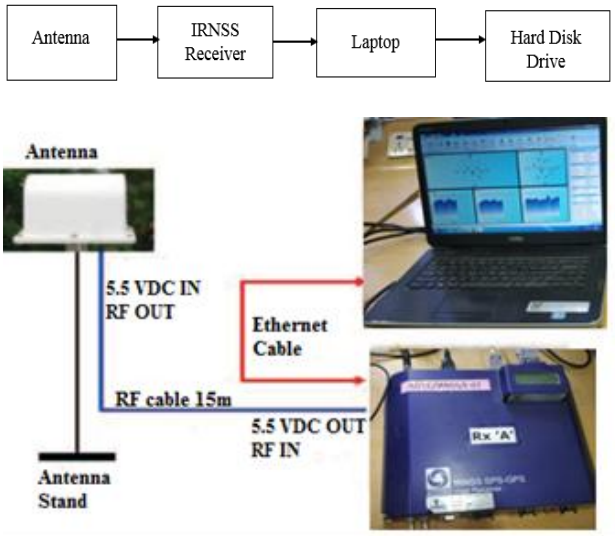


Fig. 1. Block Diagram of existing system

By default the data gets logged in to the C drive of the laptop as shown below.

Fig. 2. Data logging in session folder

A. Data Logging inside C Drive

The antenna receives the satellite signal and the data is logged inside the C drive of the system. Both the GPS as well as IRNSS data is logged in the system for every second thereby having the same TOWC count. Since we have two frequency bands in IRNSS, both S band and L5 band data are logged in separate file. IRNSS parameters and GPS parameters are two separate folders in which data is logged. There are six different files in GPS parameters namely—DOPB, POSB, SATB, TIDB, CONB, CLKB.

There are twenty five different files in IRNSS parameters namely--- ACKB, CLKB_IR, CLKB_IRGP, CLKB_IRL5GP, CLKB_IRSGP, CLKB_L5, CLKB_S, CONB, DOPB_IR, DOPB_IRGP, DOPB_IRL5GP, DOPB_IRSGP, DOPB_L5, DOPB_S, POSB_IR, POSB_IRGP, POSB_IRL5, POSB_IRL5GP, POSB_IRS, POSB_IRSGP, RNBB_L5, RNBB_S, SATB_L5, SATB_S, TIDB.

The folder structure for data logging is shown in Fig. 3.

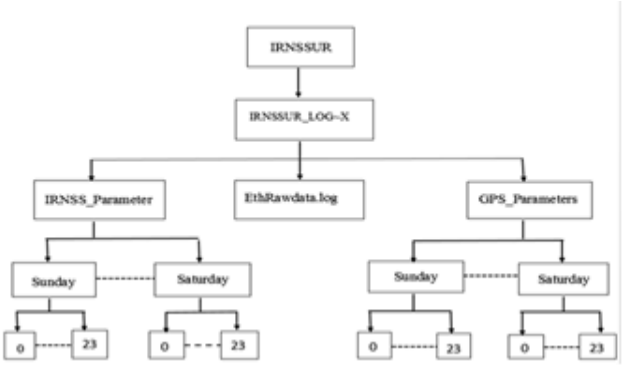


Fig. 3. Folder structure for data logging

III. SYSTEM DESIGN AND IMPLEMENTATION

In order to replace the laptop with pi and to access the real time scientific data from the receiver using pi, it is essential for the pi to be equipped with the required operating system and the IRDAS(Indian regional data analysis software) for viewing the data logged inside pi. After Installation of the required operating system and Ethernet port configuration we finally have our software running on Pi as shown in Fig. 4.

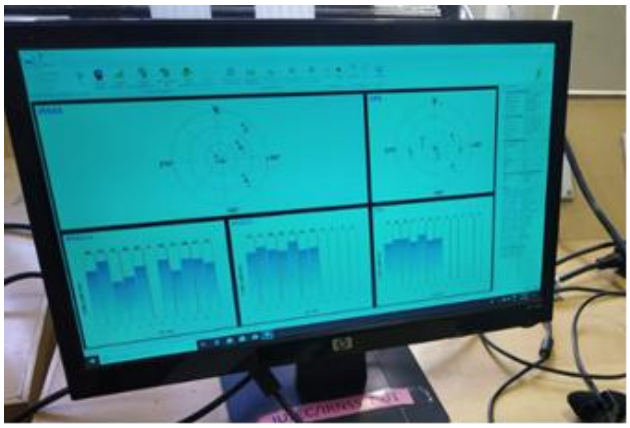
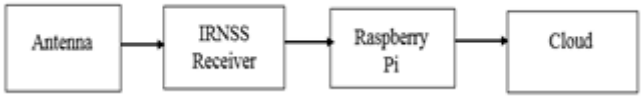


Fig. 4. Installation of IRDAS software on Pi

IV. PROPOSED SYSTEM



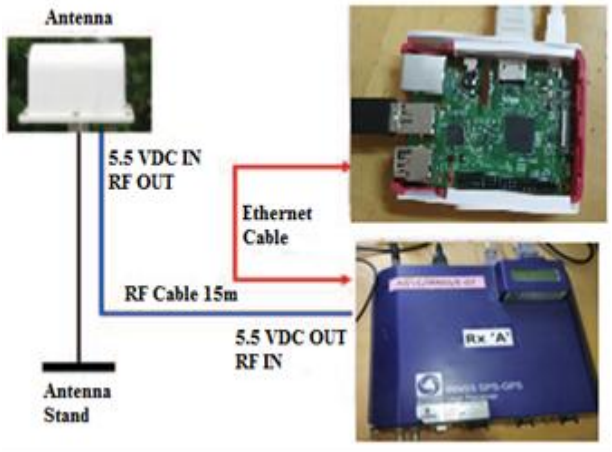


Fig. 5. Block Diagram of the Proposed System

The information originating from the satellite reaches the antenna placed on to the rooftop. The real time data from the Receiver gets logged inside the Raspberry Pi and for the user to see this data, Accord Software & systems, manufacturer of the Receiver have provided the IRDAS software (running in the Pi) for user interface. A trigger is set such that after every week the data will be sent to the cloud. On comparing the proposed system with the existing system it is seen that the laptop is replaced by the Pi as shown in Figure 5 also the data is no longer stored on drives, it's stored on the AWS cloud. The working of the proposed System is depicted in Fig. 5.

V. FLOW CHART

The real time information is getting logged inside the pi ceaselessly and after every week the data will be sent to the cloud. To send data to the cloud proper internet connection is required hence we make use of USB 3.0 to RJ45 Gigabit Ethernet Network Adapter which will use one of the USB port of the Pi. A trigger is set such that after every week data is pushed to the AWS cloud automatically by means of python coding, the flow chart for the same is as follows:

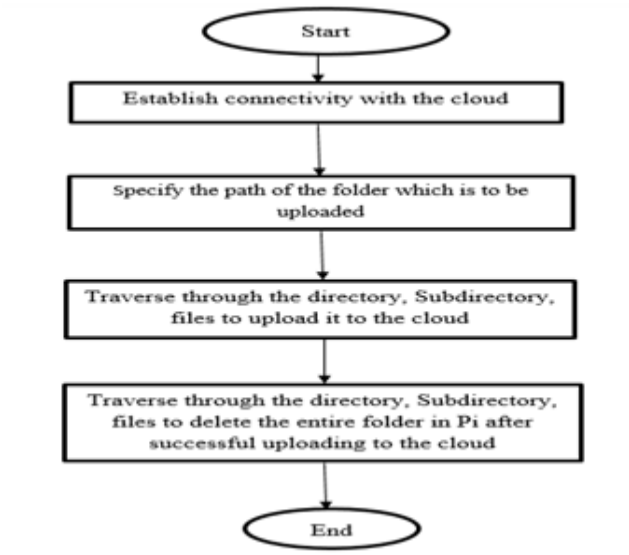


Fig. 6. Flowchart

VI. AWS CLOUD STORAGE

Amazon Web Services (AWS) is the leading cloud provider in the market, it alone occupies a market share of 31 percent and it has compute capacity of 6X its competitors. AWS provides many services in different domains like Compute, Storage, Database, Networking and Content Delivery, Security, Application, Machine Learning and so on. Any new service is first launched in the N. Virginia region and is then updated in other regions.

A. Simple Storage Service (S3)

Amazon Simple Storage Service (Amazon S3) provides IT teams and developers durable, secure and scalable object storage at an extremely minimal cost. One can store and recover any measure of information, anyplace and whenever on the web over a basic web interface. One can write, read and erase files ranging from zero to 5 TB of data. S3 is versatile and allows simultaneous write and read access to information by various clients or application threads.

B. Integrity and Access Management (IAM)

Integrity and Access Management (IAM) helps to manage users, groups and credentials for the purpose of security like permissions for using specific services, access keys, and passwords, along with that it also provides additional approaches that control which AWS assets and administrations clients can get. An AWS account is created when a new user signs up for AWS (also called as root users and account is called as master account), for which the user has a username (email address) and a password.

C. Creation of bucket and IAM user in the cloud

A bucket is created in s3. Name of the bucket is receivera (Receiver "A").

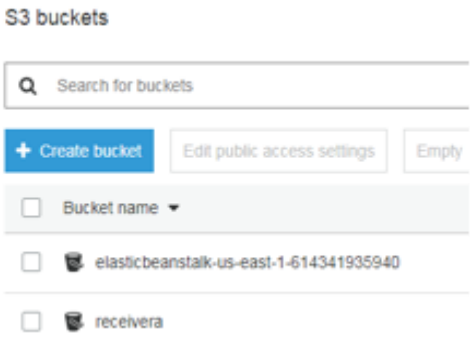


Fig. 7. Bucket name- receivera (Receiver "A")

An IAM user is created with permissions to access the files in the bucket receivera (Receiver "A") and to read the objects inside the bucket.

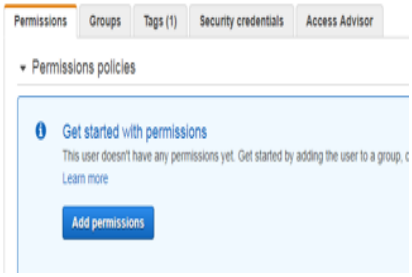


Fig. 8. Permissions granted to the user

Fig. 9. IAM user creation Successful

VII. RESULTS AND DISCUSSION

A. *Folder upload to the cloud*

The real time data originating from the satellite which was earlier received by the laptop and stored on hard drives is now received by the pi and stored on the AWS cloud. After every week a trigger is set wherein the data is moved to the AWS S3 bucket by traversing through the folders as shown in Fig. 3 by means of python code.

Fig. 10. Main Folder Upload to cloud

IRNSS_LOG~X is main folder to get uploaded, where X is the number of week as seen in Fig. 10.

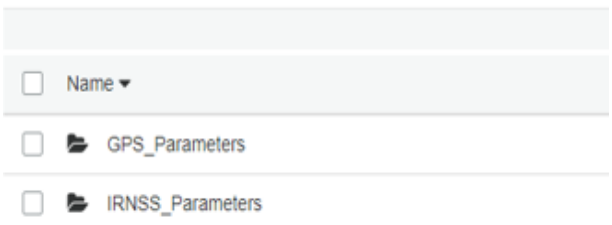


Fig. 11. Subfolder inside main folder: GPS and IRNSS parameters

Inside the main folder we have the date folder with IRNSS_Parameters and GPS_Parameters as the sub folders as seen in Fig. 11.

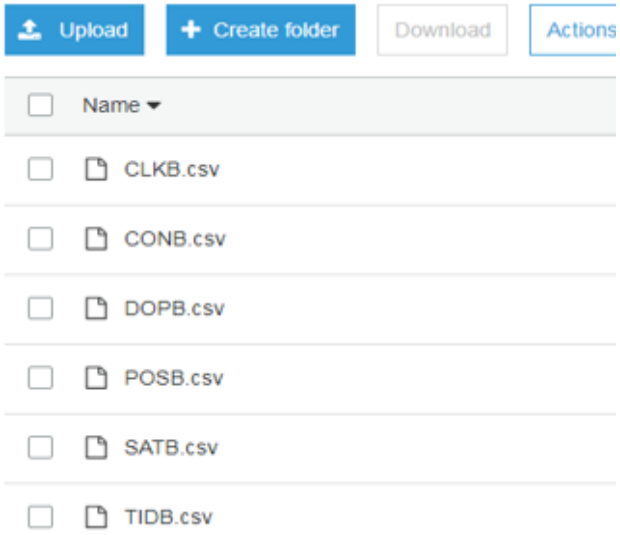


Fig. 12. Data logging in hour folder- GPS parameters

Fig. 12. shows the different files logged inside the hour folders for GPS.

B. *Data logging inside Pi*

As seen in Fig. 13. IRDAS (Indian Regional Data Analysis Software) Software is running successfully on Raspberry Pi also successful data logging is taking place inside the Pi thereby establishing a connection between the pi and the Receiver.

The real time data from IRNSS Receiver is being successfully collected by the pi as Fig. 13. shows the data logging inside the pi.

The laptop is replaced by the pi thereby reducing the cost of the system. The data will be collected and stored inside the pi and after every week the data stored inside the pi will be pushed to the cloud by means of python coding, hence this system has managed to make the data available at a common platform only to the authenticated users. Hence there is no need to contact ISRO SAC requesting for contacting the universities to upload the required data to SAC. Moreover the storage on Hard disks have been completely eliminated.

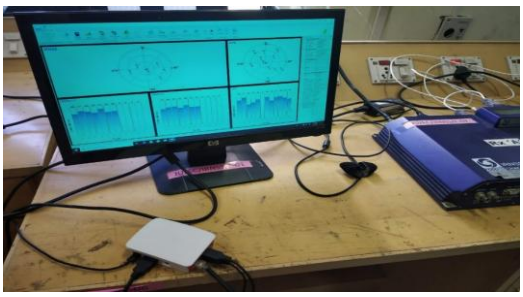


Fig. 13. Data logging inside pi

VIII. CONCLUSION

The real time collection of data using pi has been successfully accomplished. The limitation of storing of the data on the hard disks is overcome by the proposed system wherein the data instead of getting stored on hard disks is stored on the cloud every week without any manual intervention. To the exploration researchers pursuing their PhD in this field, the scientific information obtained from the satellite is very important for completing their research work and sometimes they have to travel to distant universities to collect the required data or contact ISRO SAC to arrange the data from the concerned university. This is a tedious and time consuming process and this limitation is overcome by the proposed system, wherein the data is made available at a common platform only to the authenticated users.

FUTURE SCOPE

This work is implemented specially for old receiver. Running of the IRDAS software for old as well as new receiver was done successfully, but since the manner in which the data is getting logged is different and due to time constraint the code for sending the data to the cloud was written only for the old receiver. In future the same code can be modified to be able to work with the new receiver. There are numerous universities in India which are having access to the Receivers (old as well as new). The same work can be implemented for receivers in different universities so that a common platform is available for the users to access the data. The authority to access the data from the cloud will be given only to trusted people.

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