A Cloud-Based Event Processing Technique for Measuring Metrological Parameters of Rain Streams using SaaSand Analytics

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Abstract: Global Navigation Satellite System (GNSS) constellations such as Global Positioning System (USA), GLONASS (Russia), Galileo (European Union), BeiDou (China) transmit radio signals continuously on multiple frequencies for PNT applications on or above the globe. On the other side IRNSS(India) and QZSS (Japan) are the regional navigation systems with limited service area. The combination of multiple constellations with quality signals improves robustness and stability of position,navigation and time measurements. Hence, this research work investigates signal quality to identify strong/ important signals and geometry of the satellites for the combined use of global and regional constellations over the Indian region. Real-time signal observations of multiple GNSS were collected by 'Septentrio PolaRx5' receiver stations installed at GPCET, Kurnool (15^0.47'N, 78^0.04'E). From the results, it is found that the user over this region can receive signals from a minimum of 60 satellites with Position Dilution of Precision (PDOP) value less than unity.

Index Terms— multi-GNSS, DOP, Carrier to noise ratio

I. INTRODUCTION

Climate science and Meteorology are the two key research areas committed towards the weather prediction not impacting the human survivable.The atmospheric science is a brad research are facing many research issues and some are Climate change prediction, air pollution, dynamics of wildfire, wind and mountain meteorology, tropical meteorology, wind and weather forecasting system and hydrometeorology. To address these issues effectively a new scalable architectural modelisnecessaryto maintain data acquisition, storage and analysis of massive data is one of the interesting things.This paper discussed the legacy computing approaches for larger data sets limited to on premises.to extend the storage, processing and post processing activities, we proposed new cloud-based event processing paradigm to analyse the atmospheric information robust way.

The rain fall study is important to understand the water resource levels under ground and useful to predict the high raining events for agriculture, drinking waters for humans.South-West and North East monsoon are the two important periodic winds, which show high impact on the rain. In general, the South-West (SW) monsoon spreads over the state from June to September and North-East (NE) monsoon from October to December. In this paper we used vertical profiles of rainfall measured with Micro Rain Radar (MRR) deployed at Kadapa (14.47° N; 78.82° E), a semiarid tropical site in Andhra Pradesh, India for the period from 2009 to 2015.Many authors are studied about rain meteorological parameters and contributed the storage, processing and analytical approaches are supports on-premises applications and not suitable for modern larger scale forecasting applications.

Related work

The Ground-based remote sensing instruments based on different physical principles and working at different wavelengths of the electromagnetic spectrum are diversely sensitive to the different atmospheric properties[1,2].The experimental & modelling activities are proposed by YVU with active support of ISRO to understand the monsoon, and also atmosphere processes/dynamics, more especially the precipitation thorough round the clock observations using remote and in-situ sensors [3]. The tropical raw data is in massive size and need big data kind technology required. The big data have high computing capabilities Like : Able to reads a wide variety of data from larger unstructured data sets, Reads data sets whose above the software tools limits, greater data management and analytics, adapt scaling approach for robust analytics[4].The processing system should relies on hypothesis based prediction, parallel algorithms and light weight integration approaches[5].The modern bigdata analytics usage and it's algorithms usage to process the atmospheric raw data well explained [6].

Experimental Setup & TestBed

The overall research carried out at two experimental sites located at YVU Campus Kadapa (14.47° N; 78.82° E), a semiarid global site in Andhra Pradesh, India. Experimental setup 1 covered 3 acres' land, whereas experiment 2 carried out around 100 acres of land. We utilized Semi-arid-zonal Atmospheric Centre (SARC) observational and modelling facilities from Dept. of Physics, YVU Campus. The overall experimental setup and computing facilities presented in the below Fig.1, Fig.2 and Fig.3.

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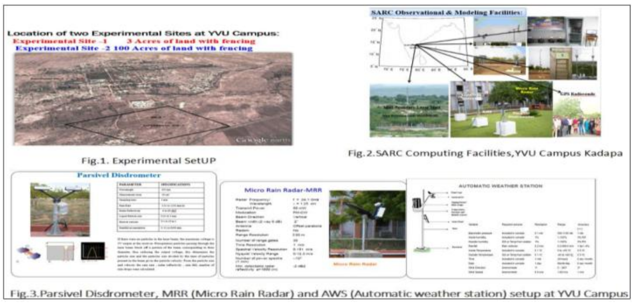

Proposed Methodology Architecture

In above experimental system, MRR and AWS reads the dynamic rain fall meteorological parameters and uploaded in to on premises system. The recorded parameters values are stored in the pre-defined file(.mrr) with fixed length of the parameters Defined. MRR records the rain fall data in very second and hosted in a single file. The generated file from MRR is illustrated in the following figure. Once the data acquisition happens into on premises the data willed be parsed into on-premises tables. The on-premises tables data will be transformed using the third party ETL tools like Mule Soft to another on-premises / Cloud based applications. The transformations are configured in mule and extracting the data from the on-premises table. The Mule identify the number of events occurred during the period of time and process massive raw rain data. The synchronized rain fall events will process by configured set of batch jobs in the cloud environment. The extracted required parameters information will pass to Bigdata Analytics or to any third-party data analytics to forecast the weather data and rain fall information. We used SaaS as Salesforce and for analytics used Tableau and Birst. The Tableau and Birst are handy tools to visualize the processed information more look and feel. The proposed implementation adapted standard 4-stage IOT solutions architecture shown in the below Fig.3.

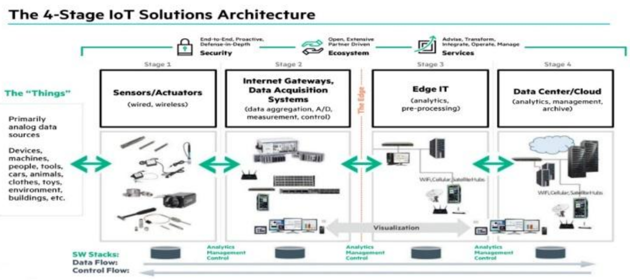

Fig.3.Adapted Architecture (Courtesy : https://www.hpe.com by Tom Bradicich)

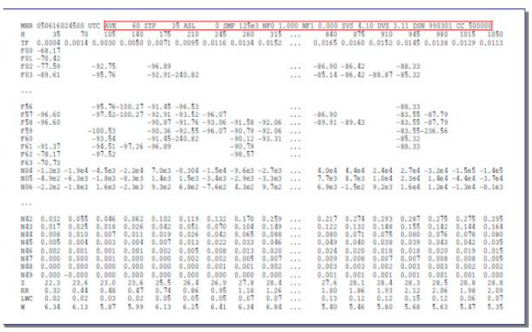

Fig.4.MRR file format

Data Analysis & Results

The MRR Raw data is parsed using Python and Java and deserialized into the On-premises data tables. The processed information of data table is synchronized with Mule and hosted in the cloud SaaS applications. The SaaS Job process the large table data in the Bulkify way and extracted the required measuring rain meteorological parameters. These parameters information plotted with data analytics tools (Tableau / Birst analytics). The sum of the plotted analytic snapshots illustrated in the following Fig.5. and Fig.6.

Fig.5.Hourly Weather Report Forecast

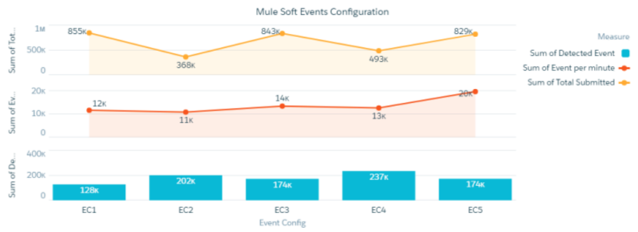

Fig.6.Events are analysed and detected by MuleSoft

II. CONCLUSION

IOT based weather applications like Atmospheric physics required scalable landscape to load, process and visualize as per the scientific requirements to predict weather changes more quickly to avoid natural hazards (Cyclones / Thunderstorms,., etc).This paper explains the land scape / architecture to provide scalable infrastructure to maintain and process the massive rain fall information during the monsoon / cyclone seasons. The proposed approach is low cost experimental setup and access the information globally without stick on to on-premises. Data analytics is the important to forecast / analyse the massive rain data easily, in this paper we used cloud-based analytics tools to visualize the data effectively.

Theproposed scalable landscape not only limited to atmospheric physics and can extend or enhance for large scale IOT applications like, weather forecasting, disaster management, Resource survival, WSN and so on. The experimental results are satisfactory to detect more rain events and save lot of time to analyse the raw data.

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