



# Integrating the Meteorological Data into a Smart City Service Using Cloud of Things (CoT)

R. Surendran<sup>1</sup>(✉), T. Tamilvizhi<sup>2</sup>, and S. Lakshmi<sup>3</sup>

<sup>1</sup> Center for Artificial Intelligence & Research (CAIR), Chennai Institute of Technology, Chennai, India

surendranr@citchennai.net

<sup>2</sup> Department of Information Technology, Vel Tech Multi Tech Dr. Rangarajan Dr. Sakunthala Engineering College, Chennai, India

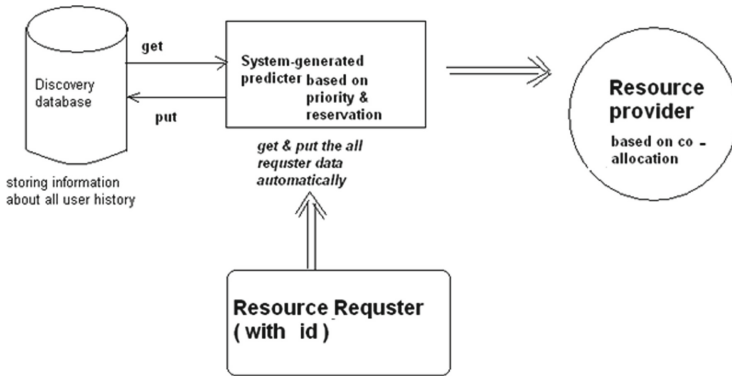
<sup>3</sup> Department of Physics, Chennai Institute of Technology, Chennai, India

**Abstract.** The Cloud of Things (CoT) offers consistent and adaptable access to the global resources and data. It is being achieved through data integration and resource co-allocation techniques. The data integration is a process of collecting the data from various resources. The users are requesting the meteorological data to propose the smart city service. The proposed smart city service integrates the meteorological data from the meteorological towers. The data centers acts as a broker between the service requestor and the provider. If the requested data unavailable, the nearest tower collects from other towers using co-allocation technique. The resource co-allocation technique involves the analysis of available towers based on the user's request. The meteorological towers hold the weather forecasting data and distribute it across the wide geographical areas. This includes temperature, humidity, precipitation, wind speed and atmospheric pressure. These data are heterogeneous in nature which makes data integration through MapReduce technique and virtual machinery. This research work produces accurate and faultless forecast data for the user through CoT techniques. The proposed work experimental results are proved that the service will be a time and cost effective one for the smart city.

**Keywords:** Cloud of Things · Resource monitoring technique · Meteorological data · Data integration · MapReduce · Virtual machine

## 1 Introduction

The Cloud of Things (CoT) is a combination of Cloud Computing and Internet of Things. The resource management technique of CoT consists of resource requisition, resource allocation, resource monitoring, resource matchmaking, resource scheduling and resource brokering. Figure 1 represents the design of allocating the resources to the requestor is based on the system generated prediction and the resource requestor requests the resource through Cloud portal [1]. The resource broker provides an efficient service for the resource requestor and provider service. It resents as system generated prediction. The system generated prediction works with respect to the priority and reservation.



**Fig. 1.** System generated prediction based resource co-allocation system

In the data integration service, weather data requested peoples are called as resource requestor. The data centers are called as the resource providers. The system generated prediction is act as a resource broker. The data integration process is working based on MapReduce concepts. The scheduling queues are involved to predict the resource allocation for the requestor. It has data storage facilities from the discovery database. It stores current data as well as user history. If the resource goes unavailable/failure to respond to the requestor, the co-allocation plays the vital role here. The response time may be varied for every resources with respect to the distance. The system generated prediction is used to select the matched resources for the requestor from the resource provider. This process is called as resource co-allocation system. This resource co-allocation system matches with meteorological data integration process.

The Climatology and Weather Forecasting is vital on account that it helps to decide the future local weather expectations. Through the location of latitude, one can decide the probability of precipitation and snow accomplishing the surface. We can additionally be in a position to perceive the thermal energy from the solar that is available to a region. The Climatology is the scientific method through which one can find out about climates, which suggests the climate stipulations over a duration of time. The need to gather real-time meteorological data to be used in forecasting is regularly popular and essential to the protection of lifestyles and property. Indeed, one can discover observers or applications of automated instruments tasked with series of meteorological data spread, frequently densely, throughout many nations of the world. A meteorological tower is a facility, on land with instruments and tools for measuring atmospheric prerequisites to grant data for weather forecasts and to find out about the climate. The measurements taken consist of temperature, atmospheric pressure, humidity, wind speed, wind direction, and precipitation amounts. Wind measurements are taken with as few different obstructions as possible, whilst temperature and humidity measurements are stored free from direct solar radiation, or insolation. Manual observations are taken at least once daily, whilst automatic measurements are taken at least as soon as an hour.

A measurement tower or meteorological mast (met tower), is a free standing tower or an eliminated mast. Generally a met tower will have anemometers, wind direction vanes, temperature and pressure sensors, and other measurement devices attached

to it at various levels above the ground have been used in weather observation data for wind speed, wind direction, relative humidity, temperature, pressure and background nuclear radiation. Meteorological data have been used in countless types of analyses with unique goals. Meteorological towers are the structures supplying non-stop in situ information within the lower atmospheric layer. Met masts are imperative in the improvement of wind farms, as particular understanding of the wind speed is essential to comprehend how a good deal electricity will be produced, and whether or not the mills will live to tell the tale on the site. Measurement towers are also used in other contexts, for instance near nuclear power stations, and by Automated Surface Observing System (ASOS) stations.

The Meteorological Towers are placed in different region for weather forecasting. These are examined on industry standards to eliminate all the faults. The Meteorological monitoring towers are often the first physical structures evident at proposed green field nuclear sites. New construction at existing nuclear facilities may necessitate the moving of a meteorological monitoring tower due to space considerations. Aging towers may need to be replaced if they have not been properly maintained. Tower siting considerations, power and communication issues must be addressed before construction can begin. Other tower construction management tasks that need to be considered include Federal Aviation Administration (FAA) and Federal Communications Commission (FCC) considerations, site access, local and state permitting and tower engineering based on soil conditions.

The meteorological monitoring tower should be located at an elevation near that of the finished plant grade. Topography and obstructions must be considered for tower placing. In concerning wind sensors, Regulatory guide indicates that the sensors ought to be situated over level to open territory [2]. To provide accurate temperature measurement, the tower should not be located near heat or moisture sources such as large parking lots or water bodies. At a proposed nuclear facility, one would not want to place the tower so close to the proposed plant site that construction activities could impact the meteorological measurements.

Other tower siting considerations would include accessibility, not only for the construction of the tower but for maintaining the tower and the meteorological equipment once the tower is erected and providing data [3]. After siting criteria considered, the exact tower location can be determined. The precise tower location is required for surveying the site and for locating where soil boring. To provide accurate temperature measurement, the tower should not be located near heat or moisture sources such as large parking lots or water bodies [4].

## 2 Related Works

The existing data integration processes are need to improve with modern technologies like Artificial Intelligence, Machine Learning, Cloud Computing, Internet of Things, Big data. The data integration process starts with data collection. Then collected data are stored and maintained separately in the cloud storage. The resource providers are only considering the resource allocation process. Also have some limitations in the existing system. Such as.

1. Queue handling issue for the large number of request from the user.
2. Time and cost is the challenging task to balanced priority with advanced reservation technique.
3. The database connectivity problem may exist due to insufficient data, while system generated prediction system.

Alfonso Quarat et al. integrate the weather data for smart city in Transport Territory and Tourism (TCUBE) project [5]. Service Oriented Architecture (SOA) and Web service concepts are play important role in this work. The advantage of the work is high accuracy for minimum number of data. The disadvantage of the work is not suitable large amount of data. ArcDualKc model developed for integrating the forecast meteorological data [6]. The benefits of this model is reliable results of spatial weather data determination. Limitation of this model is need to be improve the accuracy for the remote sensing data. Jairam Singh Yada et al. created snow cover pattern methodology for one region [7]. The advantage of the work is efficient meteorological data sets integration. The disadvantage of the work is need to utilize many QoS factors to integrate high level.

Sleiman Farah et al. integrate the meteorological weather data with respect to the climate change [8]. The pros of the work is high energy saving technique and also reduce the annual heating rate. The cons of the work is need to utilize huge number of data sets. The integral regression model was developed to predict the temperature based on meteorology data [9]. The benefits of the work has been predicted weather data dynamically at any time. The Drawback of the work is need to be improve with modern techniques like Quantum Computing, Artificial Intelligent. Machine Learning, Cloud Computing, Internet of Things. Sasalak Tongkaw designed a mobile application to collects durian resources [10]. The information can be utilized for carrying out a geographic data arrangement of durian asset the executives and the nearby insight of Thai durian grounds-keepers by planning to utilize a similar data set framework. This work was implemented through System Development Life Cycle (SDLC), Waterfall model and Geographic Information System (GIS). The advantages of this work it clarifies a durian varieties study structure in detail. The disadvantage of this work is experimental setup and results not shown properly for the researchers.

Martin JánosMayer aggregates the meteorological datasets and then improve the reliability of photovoltaic design models [11]. This work utilized the following methodologies. Such as Optimization techniques, Data aggregation process and Differential evolution methods. The benefits of this work is high accuracy on simulation and optimization processes. The downside of this work is the aggregation methods not suitable for variety of datasets. Masayuki Maki et al. developed the weather prediction data using cloud computing techniques [12]. The Visualization technique is a vital role in this work to analysis the radar data. This works provides the access of multimedia data efficiently. The limitations of this work is its take more time and cost. Dynamic Memory Manager helps to find the hardware for the Real-Time Systems in the queue management [13]. The work focuses the memory management process with help of queue process. This work is helping to develop the scheduling technique for the proposed work. Maran et al. studied the wind energy location prediction between meteorological stations and this has been highly motivated for the proposed study [14].

### 3 The Proposed CoT Based Meteorological Data Integrating Service

The Proposed CoT based meteorological data integrating service utilize the MapReduce technique. Data center as a resource provider to handle the monitoring, execution, data storages for system generated prediction in specified cloud environment [15]. It provides efficient data integration service from the meteorological towers based on their nearest location and availability of the data. Here to achieve the time and cost constraint based on the MapReduce technique. In this proposed work, designing three major modules to access the meteorological tower information. Such as resource requestor, resource broker and resource provider [16]. The resource requestor is acting as a mobility node allocated in dynamic location based approach. In this architecture of Fig. 2, resource requestor act as a user. User have to submit their query to the resource broker. Resource Requestor are representing in mobility nodes. The mobility node allocating in dynamic manner [17]. This requestor only submit the task to the resource broker. The resource broker will forward the request to resource provider. The resource provider will take care of remaining implementation process. The resource providers supply the meteorological tower weather report to the requestor.

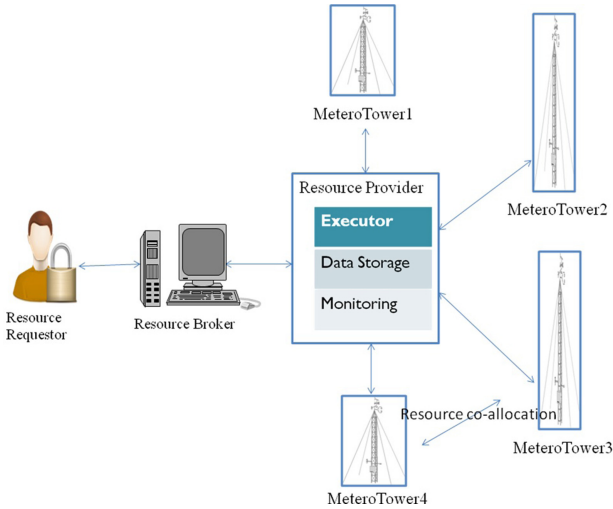


Fig. 2. Architecture for the proposed CoT based meteorological data integrating service

The resource provider implements the main three task in resource sharing. Such as executor, data Storage and monitoring. The executor executes the operational conversion based on user’s requirements. For example Fahrenheit to Celsius conversion, Celsius to Fahrenheit conversion. The data storage maintains data for centralized server to provide data transformation from resource provider to resource broker. Resource allocation done by the monitoring approach. It directs the resource requestor to access data from the specified and nearest tower. The Meteorological Tower contain weather reports for every day

order. Such as like temperature, wind, pressure, humidity, status, chance of precipitation. This will be the details presented in meteorological tower weather forecast. By use meteorological information, acquired from calculation, to recover the information in group procedure. Here, rehearse this methodology continuously climate to share the tower (Location based) information in incorporated worker component. This refreshed each hour out of every day. It's more valuable to recover the information in Time utilization.

Recommending this cluster based approach to resolve time constraint problem and also it can be handled both queue overflow and dynamic allocation technique. But in elastic based scheduling only handle resource allocation in priority scheduling concept and hence queue overflow may be existed. This can be solved by partitioning based cluster method. In elastic scheduling technique, data storage separately designed and resource provider only implementing the resource co allocation process. This two problems have been solved by designing resource provider with data storage, executing conversion operation, monitoring via resource allocation and resource co allocation techniques.

In elastic algorithm only evaluate based priority, in MapReduce algorithm also take care to find nearest tower location and data availability by implementing shortest energy path via partitioning based cluster approach. The study are of Tamil Nadu having met towers about 42 meteorological stations, are situated in the southeast corner of the Indian Peninsula (Fig. 3). This cluster contains group of nearest location tower in Tamilnadu (India). Example location 1 Chennai tower, location 2 Thandalam tower, location 3 Hosur tower under group a cluster. Here location 1, 2, 3 are Tamilnadu (India) regions. Through this can improve the time constraint and dynamic resource sharing efficiently.

The present study uses the met mast information have been downloaded from the website of <https://www.indianclimate.com/show-data.php>. and the geographical locations have been tabulated in Table 1.

### 3.1 Methodologies Used in Proposed Research Work

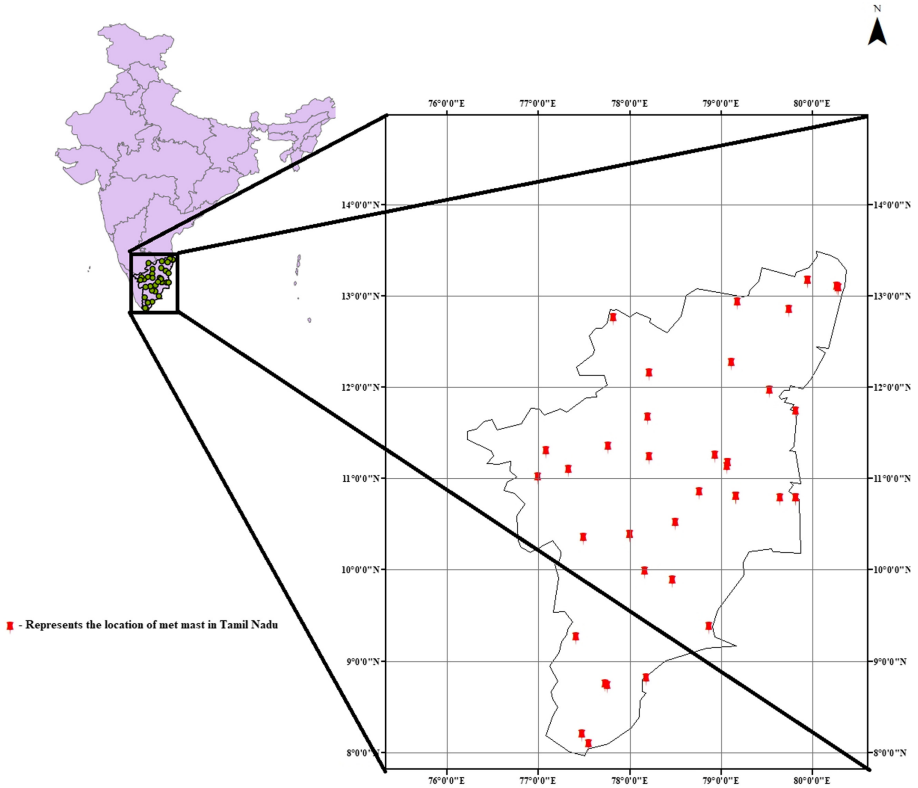
The proposed work is achieving the time and cost constraint, for allocating the resources to the user. The system generated prediction done by clustering mechanism, resource provider directs the process to co allocation based on cluster group of tower. Here scheduling done by partitioning method, so no issues about queue will exist. The proposed work implementation done in dynamic mobility node model. Meteorological tower based cloud of things service contains following tasks in step by step.

Step 1. User Base from any location submit the task through cloud portal.

Step 2. Automatic system generated prediction scheduling

Step 3. Resource Co-Allocation and Monitoring

- i. Initialize the requestor to submit the job.
- ii. Find the towers which are having shortest distance in cluster
- iii. Check the Latitude and Longitude position of tower with mobility nodes coordinates.
- iv. Compare which Latitude and Longitude tower position matching with mobility node Position.



**Fig. 3.** Depiction of Tamil Nadu is a state in South India

- v. Take Latitude and Longitude position in ascending order and match with mobility Node position.
- vi. Using partitioning method, we can match Latitude and Longitude position going to Verify.
- vii. After verifying the shortest path, based on present data's of each Tower will display.
- viii. If data not found loop will exist, till data find from cluster towers (Resource Co allocation).
- ix. Repeat step vii to implement user query.

Step 4. Resource provider (Data Center) will respond to requestor (user base) via resource broker (system generated prediction).

### 3.2 Experimental Results of the Proposed Research Work

This section deals with the results of the proposed system and its analysis. The essential hardware requirements are cloud server/super computer, virtual machine and various sensors for the real-time implementation. The virtual machines are created through

**Table 1.** Places of met towers in Tamil Nadu

S.No.	Places of met towers in Tamil Nadu	Latitude (degree decimal)	Longitude (degree decimal)
1	Chennai	13.07	80.28
2	Kanyakumari	8.08	77.55
3	Thanjavur	10.78	79.17
4	Thandalam	13.15	79.95
5	Thanjavur	10.78	79.17
6	Balakrishnapuram	10.37	78.00
7	Ariyalur	11.15	79.08
8	Thoothukudi	8.80	78.18
9	Naranapuram	9.25	77.42
10	Ramanathapuram	9.37	78.87
11	Kanjirangal	9.87	78.47
12	Kannanpathy	8.18	77.48
13	Madurai	9.97	78.17
14	Balakrishnapuram	10.37	78.00
15	Periyampatti	10.33	77.50
16	Meenaveli	10.50	78.50
17	Tirunelveli	8.73	77.73
18	Tirunelveli	8.71	77.76
19	Tiruppur	11.08	77.33
20	Thanjavur	10.78	79.17
21	Thiruvarur	10.77	79.65
22	Nagapattinam	10.77	79.82
23	Chennai	13.07	80.28
24	Chennai	13.08	80.27
25	Thandalam	13.15	79.95
26	Olaiyur	12.83	79.75
27	Chenganatham	12.92	79.18
28	Hosur	12.74	77.83
29	Kilnachiattu	12.25	79.12
30	Anichampalayam	11.95	79.53
31	Cuddalore	11.72	79.82
32	Settikarai	12.13	78.22

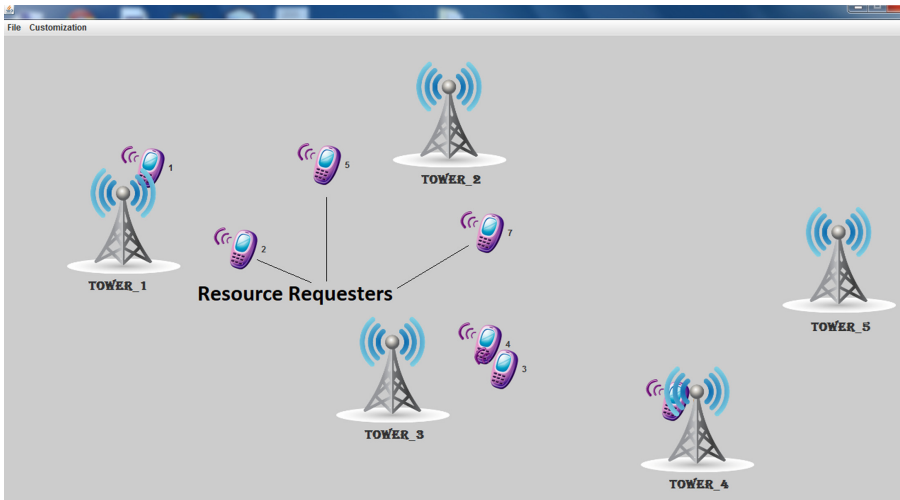
*(continued)*

**Table 1.** (continued)

S.No.	Places of met towers in Tamil Nadu	Latitude (degree decimal)	Longitude (degree decimal)
33	Salem	11.65	78.20
34	Odappalli Agraharam	11.33	77.77
35	Perali	11.23	78.93
36	Ariyalur	11.15	79.08
37	Nochikulam	11.12	79.07
38	Namakkal	11.22	78.22
39	Kuppanur	11.28	77.08
40	Coimbatore	11.00	77.00
41	Nagapattinam	10.77	79.82
42	Vengur	10.83	78.77

vmware tool. It plays a major role for load balancing, scheduling and resource allocation. The various sensors are wind speed and direction sensor, Humidity sensor, radiation sensor, precipitation sensor, modem and data logger. The software specification of the proposed work is front end platform as a Netbeans, programming language as a Java and Backend data base as MySQL.

The cloud infrastructure provided from CloudSim simulator. In Fig. 4, when tower location is identified process and get initiated for the smart city. Then resource broker starts the communication between resource requestor and resource provider.



**Fig. 4.** Mobility resource requestor and towers locations for the smart city

Resource requestors (1–10) are initialized, and ready to submit the task to resource broker. The Resource requestors are allow to submit the task through cloud portal. The requestors can retrieve weather related data from any. The Resource broker collects the Resource requestor’s requests. The Resource broker connect with resource provider for the task computation. The Resource requestor can choose the information to recover and furthermore pick which day information need to recover. For example access wind information and resource provider measures the query and recognize which tower is closest one to get to the information. This most limited energy way execution done by observing method, which one is under the piece of resource supplier. The tower 3 represents most limited one to react resource requestor 3.

The Meteorological tower represents the Data center in the cloud network. The Resource Requestor represents the User base. The Configure Simulation of Data center and User base in the cloud network. It’s shown in Fig. 5. User base Configuring attributes are Name, Region, request per Hour(Hr), Data size per request(Bytes), Peak Hours start(GMT), Peak Hours end(GMT), Average peak users, Average off-peak users. Data centers Configuring attributes are Name, Region, Architecture, Operating System, Virtual Machines Cost per VMs/Hr, Memory Cost (\$), Storage Cost (\$), Data Transfer Cost(\$),Vms Count, Image Size, Memory and physical HW units have been shown in Fig. 6.

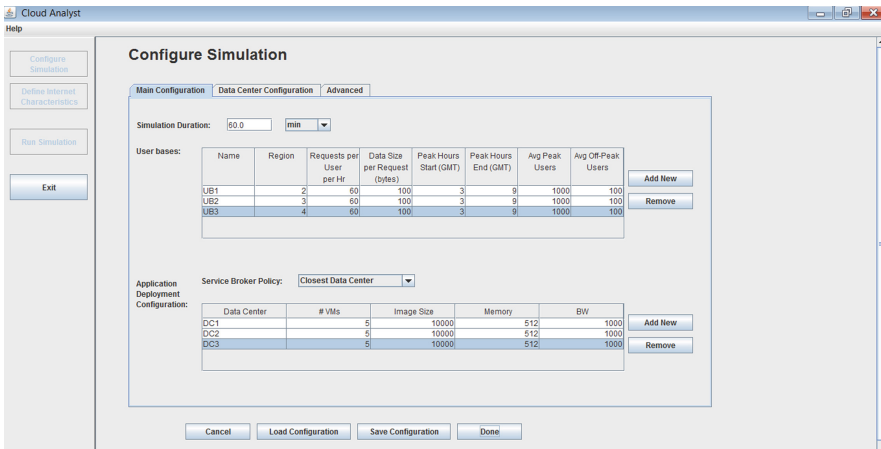


Fig. 5. Configure simulation of user base in the cloud

After calculating the shortest path of specified tower, the resource monitoring check the data. The shortest path tower is allocating data to the user in the cluster. Here tower 3 is the first shortest path in the cluster group, but it doesn’t contain wind data in Fig. 7.

Based on the count of User base and Data center selects the load balancing policy for data analyses. If the count is less selects the Round Robin, throttled techniques. Else the count is high selects MapReduce technique. MapReduce is a technique to handle the massive amount of data to integrate and analyze. The MapReduce technique contains two steps one is mapping process and second one is reduce process. The mapping is a process

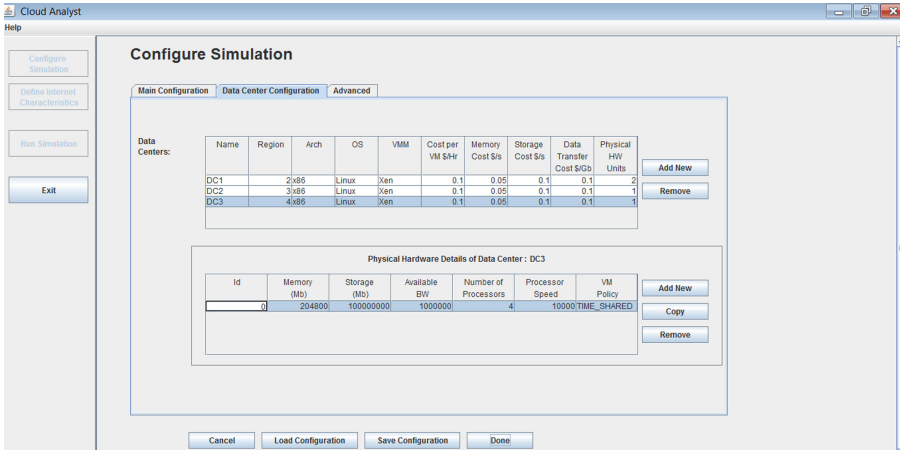


Fig. 6. Configure simulation of data center in the cloud network

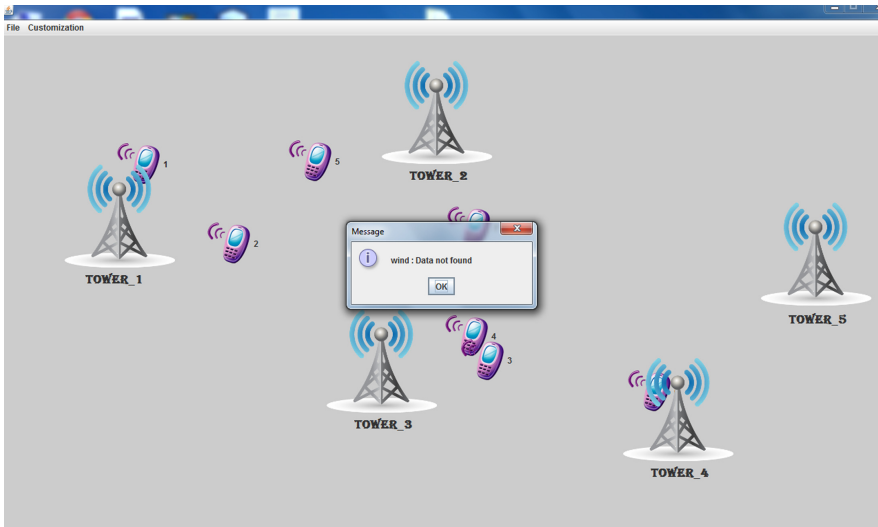
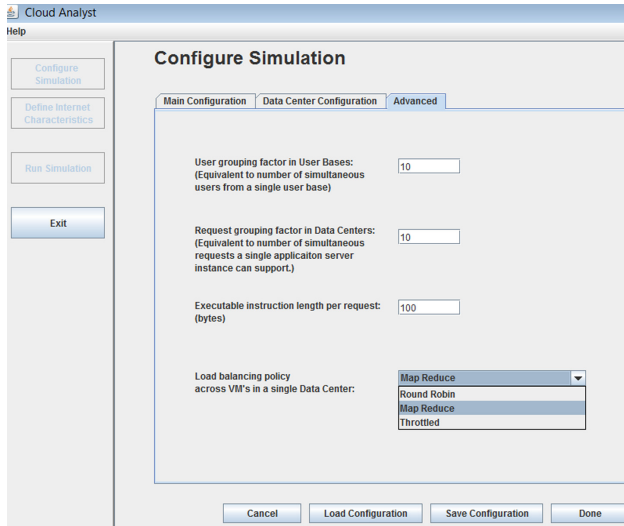


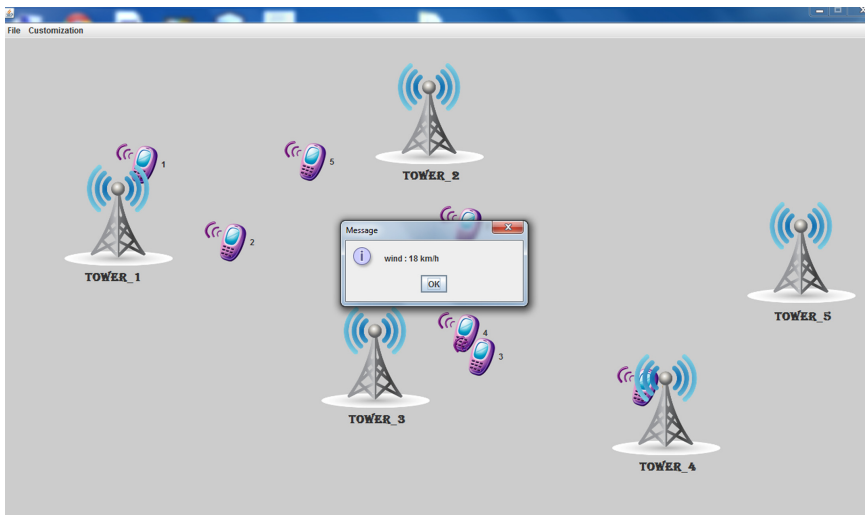
Fig. 7. Wind data not retrieved from shortest energy path tower 3 for requestor 3

to collect the unprocessed data, then split and mapping the data. The reduce process is used to sort or shuffling the data into valuable information. Apply the MapReduce technique to the cloud environment in Fig. 8. The co-allocation task has been given to the tower 5 by resource provider. Tower 5 is the next shortest one to access the wind data for requestor 3.

Resource provider retrieves the wind data from the data storage. It will validate the query for implementing the process. Example wind speed is 18 km/hr has retrieved tower 5 for requestor 3. Here cloud migration technique plays a vital role for the resources in the internet as shown in Fig. 9. Executer performs conversion operation, when user wants



**Fig. 8.** Apply the MapReduce technique in the cloud network



**Fig. 9.** Wind data retrieved from tower 5 for requestor 3

to retrieve temperature data. Executer converts Celsius to Fahrenheit or Fahrenheit to Celsius conversion.

The Region wise Data centers (DC1, DC2, DC3) and User Bases (UB1, UB2, UB3) positions are represented in Fig. 10. In Fig. 11, The Internet Characteristics have been displayed as delay matrix and Bandwidth matrix. The available bandwidth (Mbps) between regions have been displayed for the meteorological data integration. Transmission delay (ms) between regions are displayed for the meteorological data integration.

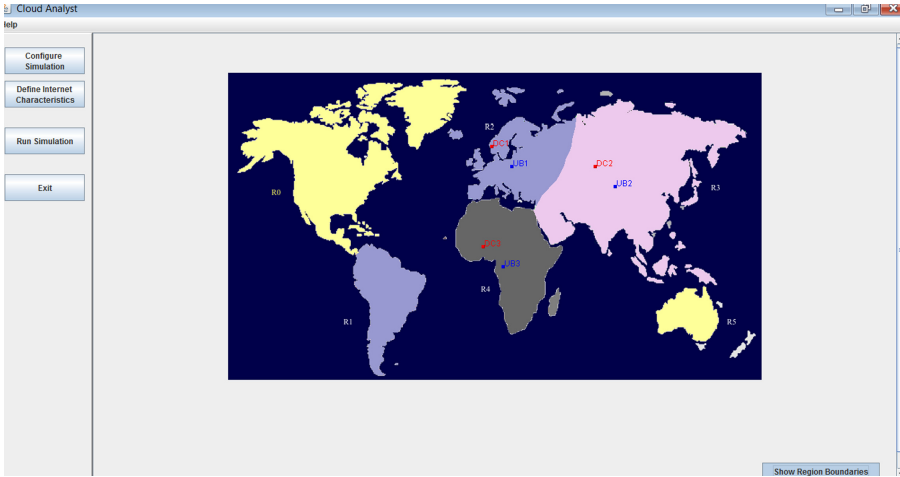


Fig. 10. Region wise user base and data center

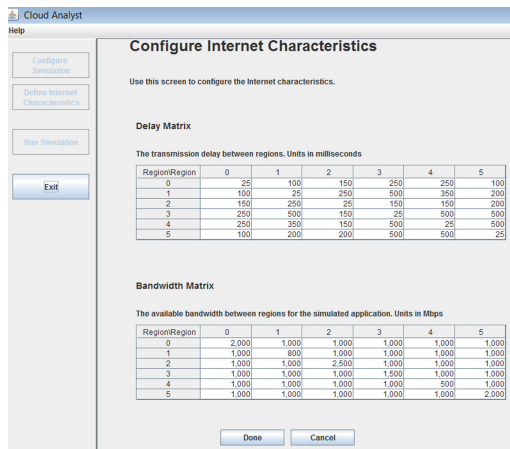
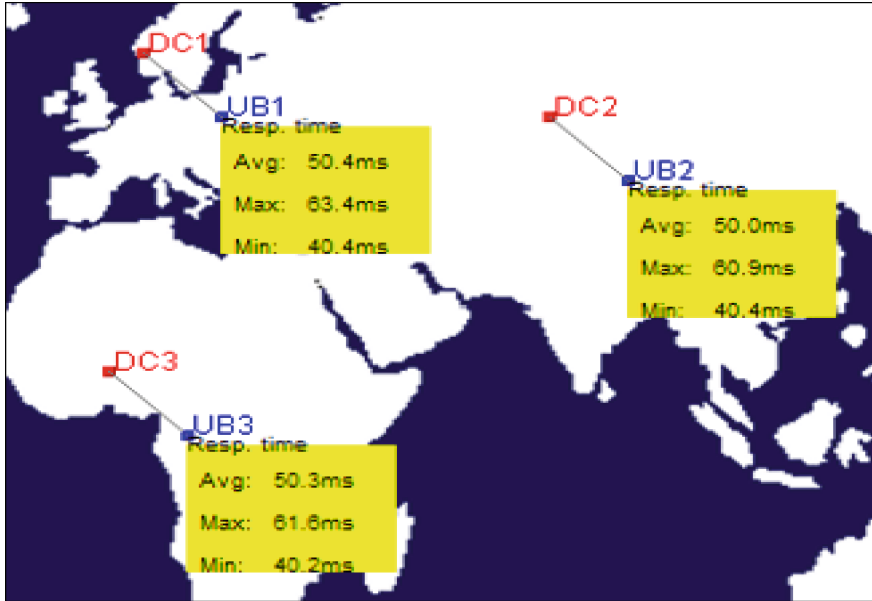


Fig. 11. Internet characteristics

The simulation result of the proposed work is shown in Fig. 12 with respect to the response time factor. Table 2 shown the Response time for User Base (UB1, UB2, UB3) by Region wise. Table 3 shown the Data center (DC1, DC2, DC3) processing time for User Base (UB1, UB2, UB3) request by Region wise. Here Overall Response Time for the User Base request is determined in Table 4. Data Center processing Time with Average, Minimum, Maximum level (units in ms) also calculated in Table 4.

The cost is the second important Quality of Service factor to analyses the meteorological data integration in Table 5. The smart city is calculate the grand total cost from Eq. 1. Summation of Virtual Machine Cost (1 to n) and VMC Data Transfer Cost (1 to



**Fig. 12.** Simulation result of the proposed work

**Table 2.** Response time for user base by region wise

User base	Average (ms)	Minimum (ms)	Maximum (ms)
UB1	50.4	40.4	63.4
UB2	50	40.4	60.9
UB3	50.3	40.2	61.6

**Table 3.** Data center processing time for user base request by region wise

Data centre	Average (ms)	Minimum (ms)	Maximum (ms)
DC1	0.36	0.012	0.67
DC2	0.43	0.013	0.63
DC3	0.46	0.023	0.71

**Table 4.** Overall response time and data center processing time for the user base request for the smart city service

Time	Average (ms)	Minimum (ms)	Maximum (ms)
Overall response time	50.2333	40.3333	61.9666
Data center processing time	0.4166	0.016	0.67

**Table 5.** The grand total cost for the data integrating service

Data center	VM Cost \$	Data transfer cost \$	Total \$
DC3	0.43	0.03	0.43
DC2	0.37	0.05	0.37
DC1	0.48	0.04	0.48

n) for the User Base requests (Table 5).

$$\sum_{i=1}^n VMC_i + DTC_i \tag{1}$$

where VMC represents Virtual Machine cost.

DTC represents Data Transfer cost

Total virtual machine cost: 1.28\$

Total Data transfer cost: 0.12\$

Grand Total: 1.4\$

**Table 6.** The performance evaluation between proposed CoT based meteorological data integrating service with existing SOA based weather data integrating application

Factors	Proposed CoT based meteorological data integrating service	Description of proposed system	Existing SOA based weather data integrating application	Description of existing system
Overall Response time	50.2333 ms	Overall Response time for User Base getting through cloud portal	67.86 ms	Overall Response time for User Base getting through web portal
Data center processing time	0.4166 ms	Virtual Machines utilized for the computing	0.71 ms	Physical Machines utilized for the computing
The grand total cost for the data integrating service	1.4\$	Cloud based resource management save the cost	1.95\$	Service Oriented Architecture measure the cost

(continued)

**Table 6.** (continued)

Factors	Proposed CoT based meteorological data integrating service	Description of proposed system	Existing SOA based weather data integrating application	Description of existing system
Virtual Machine cost	1.28\$	VMware based virtualization cost is counted here	1.83\$	Web service cost is counted here
Data transfer cost	0.12\$	Internet cost for data transfer through Internet of Things (IoT)	0.23\$	Internet cost for data transfer through Web Technologies
Technique used for integrating	MapReduce	If the data count is high selects MapReduce technique	Round Robin, throttled	If the data count is low select the Round Robin and medium select throttled

The Proposed CoT based meteorological data integrating service is compared with the existing SOA based weather data integrating application with respect to the various working attributes in smart city service displayed in Table 6.

## 4 Conclusion and Future Direction

The Proposed CoT based meteorological data integrating service is enhanced the data integration process using MapReduce technique. The proposed service simulates the user base and data center in cloud environment with region wise. The techniques utilized for data integration is data collection, monitoring, matchmaking, scheduling and resource co-allocation are given in module explanations. We investigate this approach based on tower position, tower capability, and distance from the mobility node to resource broker. Especially towers are triggered by resource providers monitoring approach. When requestors submitting the task to tower data are processed by resource provider and resource broker will transmit the request to user. The Proposed CoT based meteorological data integrating service handle user base requests to allocate resources in shortest energy path distance. The experimental results shows the efficient data integration process with respect to the time and cost. The future direction of the work is to develop as a real-world cloud environment.

**Acknowledgements.** The authors acknowledge that they received no external funding in support of this research work. Surendran R (40%), Tamilvizhi T (30%) and Lakshmi S (30%) conceived of the presented research work. Surendran R and Tamilvizhi T. developed the theory and performed the computations. Lakshmi S collects the related data for processing. Surendran R and Tamilvizhi

T. encouraged Lakshmi S to investigate data and supervised the findings of this research work. All authors discussed the results and contributed to the final manuscript. The authors would like to thank Chennai Institute of Technology and Vel Tech Multi Tech Dr.Rangarajan Dr.Sakunthala Engineering College for providing us with various resources and an unconditional support for carrying out this research work.

## References

1. Alsabbagh, K.J., Alkaabi, A.A., Surendran, R.: University campus indoor navigation for android devices using augmented reality and A\* Search algorithm (UCIN). In: 3rd Smart Cities Symposium (SCS 2020), pp. 257–263 (2021). <https://doi.org/10.1049/icp.2021.0890>
2. Heo, J., Song, K., Han, S.U., Lee, D.-E.: Multi-channel convolutional neural network for integration of meteorological and geographical features in solar power forecasting. *Appl. Energy* **295** (2021). <https://doi.org/10.1016/j.apenergy.2021.117083>
3. Sagl, G., Bernd, R., Thomas, B.: Contextual sensing: integrating contextual information with human and technical geo-sensor information for smart cities. *Sensors* **15**(7), 17013–21703 (2015). <https://doi.org/10.3390/s150717013>
4. Zheng, Q., et al.: Integrating spectral information and meteorological data to monitor wheat yellow rust at a regional scale: a case study. *Remote Sens.* **13**(2), 278 (2021). <https://doi.org/10.3390/rs13020278>
5. Quarati, A., et al.: Integrating heterogeneous weather-sensors data into a smart-city app. In: 2017 International Conference on High Performance Computing & Simulation (HPCS), pp. 152–159 (2017). <https://doi.org/10.1109/HPCS.2017.33>
6. Longo-Minnolo, G., Vanella, D., Consoli, S., Intrigliolo, D.S., Ramírez-Cuesta, J.M.: Integrating forecast meteorological data into the ArcDualKc model for estimating spatially distributed evapotranspiration rates of a citrus orchard. *Agric. Water Manag.* **231** (2020). <https://doi.org/10.1016/j.agwat.2019.105967>
7. Yadav, J.S., Misra, A., Dobhal, D.P., Yadav, R.B.S., Upadhyay, R.: Snow cover mapping, topographic controls and integration of meteorological data sets in Din-Gad Basin, Central Himalaya. *Q. Int.* **575–576**, 160–177 (2021). <https://doi.org/10.1016/j.quaint.2020.05.030>
8. Farah, S., Whaley, D., Saman, W., Boland, J.: Integrating climate change into meteorological weather data for building energy simulation. *Energy Build.* **183**, 749–760 (2019). <https://doi.org/10.1016/j.enbuild.2018.11.045>
9. Ji, Z., Pan, Y., Li, N.: Integrating the temperature vegetation dryness index and meteorology parameters to dynamically predict crop yield with fixed date intervals using an integral regression model. *Ecol. Model.* **455** (2021). <https://doi.org/10.1016/j.ecolmodel.2021.109651>
10. Tongkaw, S.: Management information systems and geographic information system for managing durian resources. *Ann. Emerg. Technol. Comput. (AETiC)* **5**(5) (2021). <http://dx.doi.org/https://doi.org/10.33166/AETiC.2021>
11. Mayer, M.J.: Effects of the meteorological data resolution and aggregation on the optimal design of photovoltaic power plants. *Energy Conv. Manag.* **241** (2021). <https://doi.org/10.1016/j.enconman.2021.114313>
12. Maki, M., Kim, Y.: Visualizing weather radar data from volcanic eruption clouds. *Data Brief* **35** (2021). <https://doi.org/10.1016/j.dib.2021.106942>
13. Kohútka, L., Nagy, L., Stopjaková, V.: Hardware dynamic memory manager for hard real-time systems. *Ann. Emerg. Technol. Comput. (AETiC)* **3**(4) (2019). <http://dx.doi.org/10.33166/AETiC.2019.04.005>

14. Maran, P.S., Ponnusamy, R., Venkatesan, R, Singh, A.B.: Wind energy location prediction between meteorological stations using ANN. *GlobalNEST Int. J.* **16**(6), 1135–1144 (2014). <https://doi.org/10.30955/gnj.001462>
15. Ewelle, R., Francillette, Y., Gouaich, A., Mahdi, G., Hocine, N.: Network aware traffic adaptation for cloud games. In: *Proceedings of CloudCom-Asia 2013, International Conference on Cloud Computing and Big Data, FuZhou, China* (2013). <https://doi.org/10.1109/CLOUDCOM-ASIA.2013.79>
16. Ewelle, R., Francillette, Y., Mahdi, G., Gouaich, A.: Network traffic adaptation for cloud games. *Int. J. Cloud Comput.: Serv. Architect. (IJCCSA)* **3**(5) (2013). <http://dx.doi.org/https://doi.org/10.5121/ijccsa.2013.3501>
17. Dixit, A., Yadav, A.K., Kumar, S.: An efficient architecture and algorithm for server provisioning in Cloud computing using clustering approach. In: *2016 International Conference System Modeling & Advancement in Research Trends (SMART)*, pp. 260–266 (2016). <https://doi.org/10.1109/SYSMART.2016.7894532>