Honey Bee Optimization based Resource Discovery Scheme for Vehicular Cloud Networks

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***Abstract*—Vehicular Cloud Network (VCN) is an up coming technology for Intelligent Transportation Systems (ITS) used for traff c management such as, storage, computing Internet, etc. in vehicles and road side infrastructures. Internet of Things (IoTs) and VCN are the key networking profound technologies of the up coming future wireless communication. Vehicular cloud networking is a complex system with a large number of shared resources. Vehicular cloud computing resource management requires intelligent algorithms for resource discovery, resource allocation and resource sharing. Resource discovery in vehicular cloud networking is a challenging issue because of the attaining accuracy in resource information when the vehicles are on f y and changes are frequent and unpredictable. We have proposed multi agent based honey bee optimization for eff cient discovery of resource in vehicular cloud networks in this position paper. In honey bee optimization technique, we have used multiple mating behavior based approach to solve cloud selection problem in vehicular cloud networks. Identif cation of the appropriate cloud resource in minimum delay is the main contribution of the proposed research work.**

I. Introduction

The way implementation of applications and storage information has made signif cant change in cloud computing. Cloud computing comprises of set of several virtual machines, computers and servers. Resource or application and data are placed in the cloud. Instead of placing the application programs and data on a personal computer the resource could be accessed through Internet [1]. Analysis, data storage, and computing services of scientif c through the resource pool technology and the distributed computing model are various application provided by cloud computing [2]. Varies services which are offered in cloud computing are : Infrastructure as a Service (IaaS), Platform as service (Paas),Software as Service (SaaS) [3].

Varies types of Intelligent Transportation System (ITS) are up coming, Vehicular ad hoc networks are one such class of ITS. There are two types of communication in VANETs. One is vehicle-to-vehicle (V2V) which is inter-vehicle communication and another type of communication is vehicle-to-roadside infrastructure (V2I) communication. VANETs are basically coordinate between drivers of vehicles as well as assist them communicate and to coordinate among themselves. This helps vehicle drivers to avoid any situations which are critical in nature. Through Vehicle to Vehicle (V2V) communication e.g., accidents, speed control, traff c jams, accidents unseen obstacles and free passage etc., [4]. To improve relieve traff c congestion, transport safety, enhance the comfort of driving and to reduce air pollution varies components in the ITS are connected. Traff c-related data which needs to be collected and to be stored poses a signif cant challenge to the vision of all connected vehicles [5]. Radio spectrum bandwidth, computation, and storage are constrained resources for vehicles in VANETs.

Fundamental requirement for emerging ITS applications are the large storage and complex computation. In-vehicle multimedia entertainment, vehicular networking, are such example. Supporting these applications for an individual vehicle is a diff cult task. A promising solution is required to share the storage resource and computation among all the vehicle or nearby (physically close to each other) vehicle. This paradigm is called as Vehicular Cloud Networks (VCN). Cloud computing with information centric networking is the VCN technology. VCN consist of a group of vehicles with the capability of sensing the required resource, computing the information and communication and sharing of resources dynamically.

Combination vehicular ad hoc network (VANET) and cloud computing provide VCN model to serve the various application to vehicle driver at low cost. There are various objectives of VCN. Some of them are minimization in traff c congestion, travel time, road accidents, environmental pollution, and effective usage of computational power at low cost. The way in which implementation is performed in conventional cloud in a traditional network is different from VCN due to VANET challenges such as vehicle density, mobility, etc.

Some of the challenges need to be addressed in VCN are

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f exible mobile architecture (mobility of the vehicles affects on the available computational capabilities and storage resources), robust network architecture (support for dynamic varying network conditions), service based network architecture (existing TCP/IP may not be eff cient), scopes for new services (scalability for emerging applications), and intelligent resource management schemes (to handle resource identif cation, allocation, scheduling, etc.). Resource management is one of the major issue in VCN due to VANET issues and challenges. Heterogeneity in resources, inter-dependencies in data centers, and load variability and unpredictability are some of the issues to be addressed.

Eff cient and intelligent Resource management techniques are very crucial for VCN performance, functionality and cost. As VCN is a complex system of large number of shared resources, frequent unpredictable requests are expected. Resource management strategies in VCN require complex policies and decisions for multi-objective optimization. Multi agent based honey bee optimization for eff cient discovery of resource in vehicular cloud networks is proposed in this position paper. In honey bee optimization technique, we have used multiple mating behavior based approach to solve cloud selection problem in vehicular cloud networks. Identif cation of the appropriate cloud resource in minimum delay is the signif cant contribution of our proposed research work.

Related works are discussed in Section II, the rest of the paper is organized as follows. Proposed multi agent based honey bee optimization model for resource discovery in VCN is presented in Section III. Finally, Section IV concludes the future scope of the work.

II. Related Works

A framework model for selection of cloud service providers known as SelCSP is proposed in [6]. Estimate interaction and trustworthiness are combined in SelCsp. Direct interactions or from feed backs related to reputations of vendors method is used to compute the trustworthiness. Service level agreement (SLA) guarantees transparency in service provider competence. SelCSP framework do not address the Risk based service provider. To address multi-objective optimization problem in cloud environment, two-stage ranking model is also known as PROMETHEE is proposed in [7]. Classical Pareto-optimization method is used to develop PROMETHEE which provides ranking and selection among Pareto optimal candidates. Two-stage ranking model is used in Block nested loop algorithm to f nd and return top-k candidates for the cloud service selection is discussed.

Ranking criteria for cloud providers and its framework is proposed in [8]. For obtaining the criteria weights in the process of selection of a CP a decision making framework is presented. Analytical network process (ANP) and decision making trial and evaluation laboratory (DEMATEL) methods are used in the decision framework. DEMATEL is based on the hybrid approach. Quality of Service (QoS) based on an improved Artif cial Bee Colony (ABC) approaches proposed in [9]. A greedy neighborhood search strategy for ABC which is based on the approximation approach to achieve an analogical space search to that of continuous functions. Simplicity of ABC preserved while optimal continuity is achieved in the proposed work by the author. Cloud Service ranking and selection using linear Programming technique is discussed in [10]. Cloud service ranking using Linear Programming (LP) is based on the dynamic ranking and selection of cloud services considering both quantif able and non-quantif able QoS parameters to provide an appropriate service that satisf es almost all requirements.

Vehicular clouds and Internet of vehicles from smart grid to autonomous is proposed in [11]. The Internet of Vehicles is a distributed transport fabric. The Internet of vehicle is capable making intelligent decisions based environment situation. Internet of Vehicles will have various application such as storage, communication, learning capabilities. Various services required by the autonomous vehicles shifting of own application in vehicular cloud is presented in [12]. The author also presented different interfaces automation of the cloud.

By using accessibility information and automation complex interfaces can be automatically recreated on the web. Multi criteria decision analysis (MCDA) method proposed for cloud service selection [13]. MCDA presenting a taxonomy through extensive literature review, analyzing and summarizing the cloud computing service selections in different scenarios. MCDA model consist of different components. Analyzing and summarizing the cloud computing service selections in different scenarios is proposed in the MCDA techniques and also MCDA techniques presents a taxonomy through extensive literature review.

Rough sets is used provide the evaluation parameter for cloud selection is addressed in [14]. Rough set theory is discussed which is based on the assessment method of parameters and importance in cloud services. Importance of cloud services parameters is highlighted in the the proposed work by the author. Users choose their appropriate cloud services in the rough sets is based on the credible reference. Multi criteria decision analysis method is addressed for comparative analysis of cloud is proposed in [15]. IT industry and cloud computing providers are chosen for questionnaire survey. The proposed work by the author discuss the selection criteria as well as the analytical relationships are explained.

Vehicular Cloud Networking (VCN), where vehicles and adjacent infrastructure merge with traditional Internet clouds. Such VCN to offer different applications ranging very complex applications to low sized applications are discussed in [16]. Vehicular cloud, Infrastructure cloud and traditional Back-End (IT) cloud are different types of cloud, VCN is composed off theses clouds. VCN make changes the way of network service provisioning by bringing the mobile cloud model to vehicular networks, where as ICN changes the notion of data routing and dissemination. Vehicular Cloud Networking (VCN) on top of VCC is discussed.

Honey-bee mating optimization algorithm application is proposed in [17]. Optimization algorithm which is based Honey bee mating behavior is swam based approach. Many search algorithm is based on the the process of marriage in real honey-bee. Agent-based systems are using Honey bee methods. The Best Linear Unbiased Prediction (BLUP)-Animal Model is proposed in [18]. BLUP model is based peculiarities of honey bee genetics and reproduction. BLUP-Animal model is to obtain the accurate prediction of the genotype by using the records of relatives and weights of maternal (queen). Breeding values for queen and worker effects on colony traits are estimated in the model, while estimating these parameter it also simultaneously considers the environment effects.

Less f exible for dynamic simultaneous requests, lack of intelligence in resource handling and low scalability are the limitations of existing resource management schemes in VCNs. Multi agent based honey bee optimization for eff cient discovery of resource in vehicular cloud networks is proposed in this position paper. In honey bee optimization technique, we have used multiple mating behavior based approach to solve cloud selection problem in vehicular cloud networks. Identif cation of the appropriate cloud resource in minimum delay is the main contribution of our proposed research work.

III. Multi agent based Honey Bee Optimization Model for Resource Discovery

This section describes the vehicular cloud network environment, honey bee optimization and multi agent based resource discovery agency of the proposed work.

A. Network Environment

Vehicular Cloud Network (VCN) architecture as depicted in f gure 1 which consider a three tier architecture. Vehicular Cloud (VC) is considered as tier-1, where the resources are shared among vehicles using vehicle-to-vehicle (V2V) communication only. Tier-2 consists of Infrastructure Cloud (IC) formed by Road Side Unit (RSU), where the vehicles have access to cloud services. Traditional Cloud (TC) exists in the Internet domain. Vehicles access the many resource available in the TC . TC has spread over the large geographical area.

B. Honey Bee Optimization

Honey bees are characterized as swarm and possess swarm intelligence. Honey bee colony consists of three types of bees, namely queen, drone (male bee), and workers (female worker) [19]. Queen is the mother of colony. Only queen honey bee is capable of laying eggs. Drone is the father of the colony and produced from unfertilized egg. Worker is produced from fertilized egg. Functionalities such as feeding the colony, maintaining broods, building combs, searching and collecting food are some of the functionalities are carry out by the worker.

Only once during the life cycle of the queen bee mating happens. Virgin queens mate with several drones while f ying at these drone-congregating areas, while males mate just once and die. Mating starts with the dance of the queen which is considered as initialization process. Drones follow and mate with the queen during the f ight. Mating of a drone with the queen depends on the different parameters such queens speed and their f tness. Sperms of the drone are stored in the spermatheca of the queen. The queen lays eggs, after which she lays unfertilized eggs when spermatheca is discharged [20].

C. Software Agents

Intelligent programs which are autonomous in nature are called agent programs. Depending on the situation of the environment, agent program act on the environment. They achieve their goals by using knowledge [21] [22] [23] [24]. Either at a host system, network, a user via a graphical user interface, a collection of other agents, or perhaps all of these combined agent can sense the environment. Agents are classif ed in different ways such as single agent and multi agents. In a single agent systems agents interact, coordinate and cooperate to perform a dedicated task. In a multiple agent system agents interact, coordinate and cooperate to perform a set of multiple tasks. Mobile agents are multi agent systems, which roam in the network to achieve their goals [25].

The advantages offered by using Mobile Agent based Network Management (MANM) include network traff c reduction, intelligence, automation, fault-tolerance, and robustness. In the proposed system, data dissemination can also be performed with message passing (i.e., without mobile agents).Agents can migrate in the environment. The agent based coordination mechanism used here is particularly attractive. Such mechanism is for collaborations in intermittently connected environments. Agents can migrate in the connected back bone environment while a user is disconnected from the environment. The main task of the network to perform coordination actions at other nodes. Using mobile agent has many advantage such advantage arises while waiting to ensure the precondition for a coordination operation at a remote node. The mobile agent based approach obviates the need of either maintaining a connection or making repeated attempts until the required precondition is satisf ed in contrast to simple message.

D. Honey Bee Optimization based Multi Agent System for Resource Discovery in VCN

In this section, we address mobile agent based approach with honey bees mating optimization algorithm (HBMO), which could have been used for resource discovery in Vehicular Cloud Network (VCN). Proposed multi agent model comprises of static and mobile agent. Components of agency and their interactions are as shown in f gure 2. Agency consists of knowledge base, static agent (Vehicle Manager Agent, VMA) and mobile agent (Queen Mobile Agent, QMA).

1) Knowledge Base (KB): Information of vehicle IDs, cloud IDs, available bandwidth for communication,vehicle status (connected/disconcted to network) are comprises in KB, KB is accessed or updated by VMA and QMA.
2) Vehicle Manager Agent: It is a static agent based on Honey Bee Optimization mechanism that runs on a node (vehicle and cloud server). QMA and knowledge base, controls and coordinates activities of agency. This agent

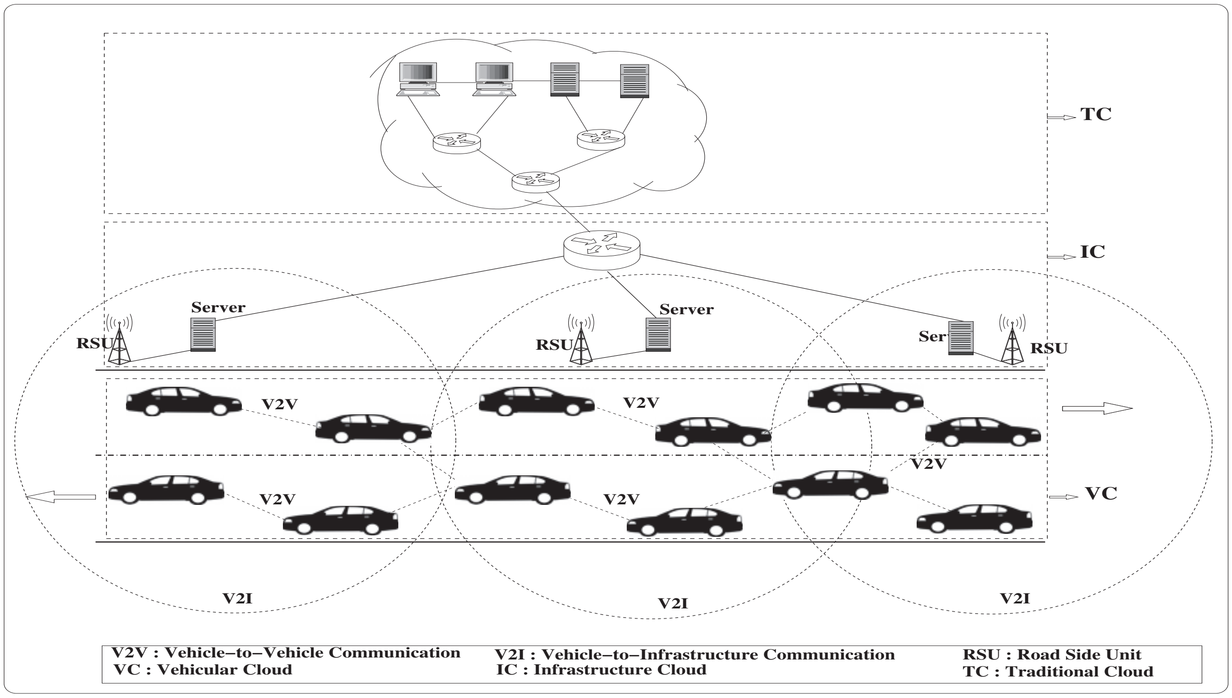

Figure 1. Vehicular Cloud Network Environment

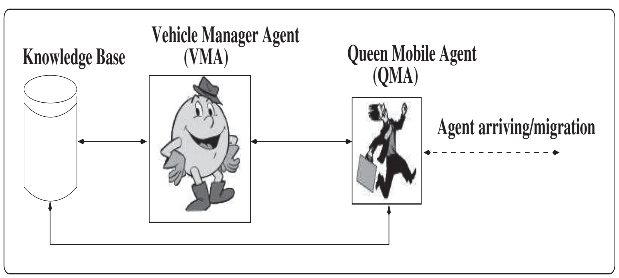

Figure 2. Multi agent System Model

triggers QMA for discovering resources in vehicular cloud, infrastructure cloud and traditional cloud.

3) Queen Mobile Agent (QMA): QMA is a mobile agent. QMA is to discover the available resource in vehicular cloud. QMA searches the available resource in infrastructure cloud and traditional cloud. It is driven by VMA that travels around VCN by creating its clones (a clone is a similar copy of agent with different destination addresses). QMA updates knowledge base (KB) in coordination with VMA for each visited cloud service provider. QMA follows the direction of waggle dance to the target cloud services, movement is dictated by a biased random walk towards the destinations. In the biased random walk, the inherent direction is given by the parameter β.
β is def ned as shown in equation (1)

$$\beta = \beta_{base} + \mu L \tag{1}$$

Where β_{base} is the natural error in the QMA navigation, μ is the conf gurable parameter (number of clouds visit restriction), L toxic level in the QMA (QMA may fail to navigate in cloud because of the navigation error).
The probability of travelling in the correct vertical direction (towards infrastructure cloud i.e., IC and traditional cloud i.e., TC) is given by equation (2).

$$P_v = \frac{d_v}{d_v + d_h}(1 - \beta) + \frac{\beta}{4} \tag{2}$$

Where P_v is the probability of identifying the correct cloud in vertical direction, d_v is the vertical position between the source vehicle and its target cloud, d_h is the horizontal position between the source vehicle and its target cloud, and β is the navigation error in four quadrants (assuming QMA moves in 360^0 of 90^0 four quadrants).
The probability of travelling in the correct horizontal direction (towards vehicular cloud i.e., VC) is given by equation (3).

$$P_h = \frac{d_h}{d_v + d_h}(1 - \beta) + \frac{\beta}{4} \tag{3}$$

Where P_h is the probability of identifying the correct cloud in horizontal direction.

Multi Agent System Model Operational Sequence: All vehicles have GPS facility (is assumed) and all vehicles are loaded with digital road map. VMA in each vehicle has knowledge of connected cloud service providers. Operation sequence of proposed agency is as follows.

- Whenever a vehicle needs service from cloud, VMA triggers QMA.
- QMA roams in all connected vehicular clouds, infrastructure clouds and traditional clouds.
- QMA encapsulates required services information in each visited cloud. In each visited cloud service provider, QMA selects and updates only the cloud service provider having alleles (desired cloud service provider) will approximate based on binomial expression as given in equation (4).

$$P_{(Y=y)} = \frac{n}{\lambda} p^y q^{n-y} \quad (4)$$

Where n is the total number visited cloud service provider, λ is the total number of desired cloud service providers, p is the proportion of desired cloud service providers that are identical to required cloud service providers and is usually $p = \frac{2}{k}$, and q is the proportion that is non identical is $q = 1 - p$.

- Encapsulated desired cloud service providers information is delivered to VMA and updated in KB by QMA.
- VMA calculates the probability of best cloud service provider among the desired cloud service providers as shown in equation (5).

$$P_{(Y=y)} = \frac{C_n}{t_n} C_p^y C^y - 1_{p-1} \quad (5)$$

Where C_n =total number of clouds, t_n=total number of services, C_p is the cloud service provider with maximum services, and C_{p-1} is the cloud service provider with minimum services.

IV. Conclusion

There are many cloud service providers in the environment, each cloud providers offers different services with different levels of performance, cost and quality in VCN. Selecting an appropriate service provider for a cloud customer is a major challenge in VCN, as each cloud provider offers different services. We have proposed multi agent based honey bee optimization for eff cient discovery of resource in VCN. In honey bee optimization technique, we have used multiple mating behavior based approach to solve cloud selection problem in VCN. Identif cation of the appropriate cloud resource in minimum delay is the main contribution of our proposed work. Performance effectiveness of the proposed scheme is to test, it is planned to simulate using standard simulator and compare with the existing standard approaches.

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