Cloud Computing Applications and Platforms: A Survey

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Abstract: The implementation of cloud computing application takes the higher necessity, especially after suffering from modern problems, such as providing proper funds for social service and purchasing programs. For that, the cloud computing applications propose a promising solution to solve such issues. In this paper, we will discuss the implemention of cloud computing over Smart Grid system; a reliable, cost effective guaranteed and efficient system, it is expected to be Long Term Evolution (LTE): which allows larger pieces of spectrum, or bands to be used furthermore with more coverage and less latency and the third technology is Vehicular network: which is an important research area because of unique features and applications that offers. In this survey, we will present an overview of the smart grid, LTE and the vehicular network when they get integrated with cloud computing, in addition we will highlight the open issues and research direction which faces these technologies with cloud computing implementing in terms of Energy management, Information management for smart grid. In terms of applying cloud computing platforms for 4G Networks to achieve specific criteria and finally in terms of Architectural formation and Privacy and security for Vehicular cloud computing.

Keywords: Cloud computing, Smart grid, 4G, Vehicular networks, Vehicular cloud computing.

1. Introduction

Cloud computing is a promising computing pattern which offers facilities and common resources on demand over the web [1, 2]. Cloud computing provides three remarkable services which are: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Service as a Service (SaaS) [3-5].

In Infrastructure as a Service (IaaS) Storage and virtualization are supported, as well as many other services supported such as: computing, networking, existing hardware and saving data are also within IaaS. In the underneath layer of the framework, both machines and hardware are virtualized and offered as assistance to users to set up (OS) and run software applications. That is why this layer called Infrastructure as a Service (IaaS).

Platform as a Service (PaaS) is in charge of delivering and developing frameworks coding to IaaS. In this layer, operating systems (like: Android) are existing, in addition to database management and IP Multimedia Subsystem (IMS) are involved. Many functions are integrated in this layer such as: distributing storage, parallel programming designing, the administration system for arranging spread file systems and management tools for cloud computing. The most important customers for this layer are the developers [6].

Finally, Software as a Service (SaaS): This layer is responsible for delivering various kinds of applications plus the interfaces for the end users, the user can reach the services via the internet, then users can pay the fees based on their consuming to that service. That is why, this service known as Software as a Service (SaaS) [7]. Figure 1 shows the cloud computing infrastructure.

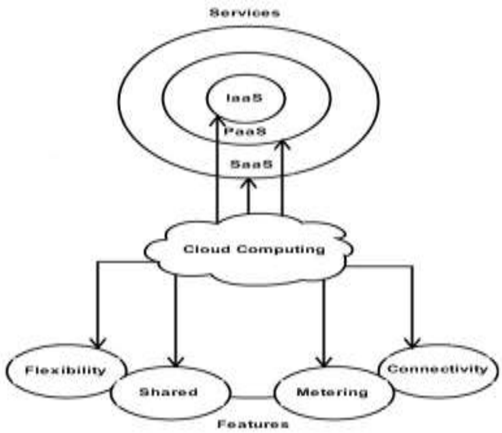

Figure 1. Infrastructure of cloud computing.

In Cloud computing the can be classified based on pattern's deployment as: private public, community and hybrid [3].

1- Private Cloud: this cloud belongs to an organization, the information which available in this cloud can be accessed by the organization only.

2- Public Cloud: it is owned by a service provider. Public user can use this kind of clouds.

3- Community Cloud: almost like the public cloud, the community Cloud has extra additional features to provide a service to groups of organization with their requirements are almost the same.

4- Hybrid Cloud: which is extension from public, private and community cloud [5].

The advantages of using cloud computing are: flexible nature, shared architecture, metering architecture and connectivity services. For flexible nature, it means that the size of cloud computing size is able to extend and reduce its size. For shared architecture, it refers to cloud computing ability to support the shared architecture. While for metering architecture refers to the ability of cloud computing to provide metering system to the users. Connectivity services implies that cloud computing can work on the current internet network system [6]. The categorization of cloud computing application is shown in Figure 2.

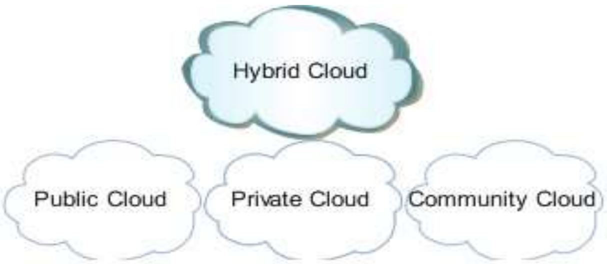

Figure 2. Category of cloud computing applications.

1.1. Motivation

With the evolution of recent technology of smart grid systems, providing bi-directional communication utilities and information treatment in real-time as well is required.

The smart grid is upgraded from the electrical grid, which collects information such as: suppliers and consumer behaviors via analogue or digital information and communications technology. Smart grid is aiming to improve competence, reliability, cost and constantly of the electric power generating.

LTE is wireless communications technology, this technology was developed from GSM/UMTS standards. LTE has founded to achieve better performance in terms of capacity increasing, higher wireless data networks speed and less latency. VANET depending on MANET, it is using vehicles as nodes to establish mobile network. With VANET every vehicle is even acts as a router or a single node which enables the vehicle to communicate with each other for a certain region. Once the vehicle is out of the covering area that means it is out of the VANET network, also a new vehicle can involve with VANET network if once they are in the coverage area, thus a mobile internet network is established.

In the Smart Grid, LTE and VANET the cloud computing and information treatment in real-time as well is required, as well as the cloud computing applications are strongly needed; we will highlight the urgent needs of the cloud computing briefly:

a) Need to multiply devices in common platform: Multiple devices are implanted in smart grid environments like: Home device's applications, smart meters, sub-networks, micro grid, sensors and communication network devices [8]. To achieve high power supply performance, we need a suitable protocol model to provide support for these devices.

b) Information management: it is an essential concept in smart grid model [9, 10]. Thousands of smart meters are diffuse in the normal city environment, so a suitable data management technique is required to handle the huge data which generated from smart meters.

c) Layer architecture: smart grids consist of many different layers: networks, communications, power distribution and power generation [11]. Smart grid should be able to provide support to the cover of communication network underneath the power network.

d) Heterogeneous architecture: Demand, response, distributed generation as well as a real-time pricing model, plays a role in smart-grids heterogeneity, so heterogeneous architecture has a special character in smart-grids [12].

e) Security: efficient authentications and authorization methods are needed to secure the privacy of the users.

These techniques are: data outage, threat detection and cyber-physical attack [13, 14] to encourage the users to participate, implementing robust and suitable privacy is needed to be done [6].

f) Centralization: centralization is the main character in the modern mobile cellular network (LTE). Usually, operators implement a centralized network, which means very high bandwidth is required. Consequently, the delay problem will show up because of network resource squandering. To bypass bottlenecks, achieve better utilize of available resources and reduce the delay time issue, a shared distributed mobile network architectures are required. The cloud computing comes with decentralized computing, smart storage, on-demand and flexible Pay-as you-Go services for both operators and users [15].

g) The growth and evolve of cloud computing, it is now one of the efficient ways to solve the problems that related to data large size because of increasing demand from users. As well as cloud computing is effective to manage the requirements of high bandwidth and long communication paths between customers and servers in the modern present day cellular networks. Furthermore, avoiding bottlenecks and improving utilize available resources is could be done using the cloud computing model.

h) A vehicular network is an important research area because of unique features and applications which offers. More communications system is expected to be included in Vehicular networks such as: storage and more sensing power. A significant role in managing the traffics in roads and also safety, these features are offered by Vehicular cloud computing, which is hybrid technology. Mobile ad hoc networks, wireless sensor networks, vehicular ad hoc networks, and cloud computing are the elements of the vehicle cloud computing which is a fresh hybrid technology [7].

i) Vehicular cloud computing offers economic and realistic options to achieve and that enables Vehicular networks to manage the vehicles control be achieved [7].

For the rest of the paper is organized as follows. We show the challenges (without cloud computing) and the benefits of integrating cloud computing on Smart Grid, Existing Cloud computing in LTE and vehicular network with applications and platform examples in Section 2. In Section 3, we highlight the research direction, open issues and problems for cloud computing applications in Smart Grid, Cloud Computing Platforms for 4G Network and Vehicular Cloud Computing. In Section 4, we show our contribution in this paper. Finally, we conclude this paper in Section 5.

2. Solution Concept with Cloud Applications for Smart Grid, LTE and VANET

In this section, we highlight the problems and issues that affect the performance for smart grid, LTE and vehicular network, then we show the improvement of performance when a cloud computing concept is implemented. Then we explain how cloud computing can solve these issues. Finally, this paper presents three applications as examples to give further information for a solution that cloud computing offers.

2.1 Smart Grid

A smart grid can consider as a combination between electric power and bidirectional communication [16]. The Smart grid is able to deliver the power to the end user, with high performance and efficient mechanism because of the union between integration and communication technology. This paper presents two problems related to smart grid, which are Energy Management System and Information Management then we shows how cloud computing avoids these issues. For smart grid this paper presents problems related to Energy Management System and Information Management.

2.1.1 Energy Management Challenges**:** It is a main issue in smart grid. This problem was addressed by the researchers incorporating the implementation of different applications like: Home Energy Management System (HEMS) and Building Energy Management System (BEMS).

Demand Response: fossil fuel is used in stand-by generations which are very common to use, as well as high implementation cost and harming the atmosphere with carbon. Virtual generation is better to use, a new mechanism is doing this which known Demand Response (DR). With this technique, users are able to schedule their devices on the peak-off hours and thus, the cost will be minimized. Customers can have more options while they have grid, storage, and self-generated energy. When virtual energy is implemented the storage platform via micro-grids can save their excess energy, while other micro-grids can consume the saved energy to fulfill the customers demand for power. In the conventional smart grid architecture (without clouds), there are several problems as detailed below [17-20].

- Cyber attacks (DDoS) could be caused because of Master-Slave architected (without clouds) architecture.
- Any failure in Master-Slave architecture could lead to system failure, this existing problem is not existed in cloud computing.
- Can serve as a limited number of users (customers)
- Because of limited memory and storage, the serving of such large number of the customer will be challenging.
- Stability issues as well as management will be required.

2.1.2 Information Management Challenges: In a normal city ambience, thousands of smart meters are diffused at the deployment side. To effectively handle such massive data, a useful technique is required. Millions of smart meters are deployed in a city, to handle huge data size, an efficient technique is needed. That could be achieved during cloud computing due to:

- Well fitting between requirements of information processing and storage mechanisms for cloud applications.
- Shared Information from different elements, the providing and demanding state situation can be done through cloud computing.
- Cloud computing is able to process and manage a massive data size with lower cost [6].

2.1.3 Energy Management solution with a cloud: In concept of Cloud-Based Demand Response (CDR), the Energy Management System (EMS) and smart meters will be the slaves, while the master will be utilized. The data-centric communication, publisher/subscriber will be used by the CDR, whereby two cloud-based demand models are suggested (a) data-centric communication and (b) topic-based group communication rather than typical IP-centric communication. An overhead problem exists in the demand-response model [17] this problem occurs in the private cloud when the size of the network is small [6].

Developing a cloud-based application model is needed for both sizes of network (Large-Small) to solve the overhead problem. Energy management can be also listed with the implementation of dynamic pricing. (a): Peak demand and (b): dynamic pricing.

To reduce cost, optimize resources and manage servers, the Virtualization would be one of the most efficient techniques to achieve that [19]. A framework to integrate cloud computing applications for micro grid management form different modules proposed by Rajeev and Ashok [19]**.** To swiftly integrate and analyze information streaming from several smart meters simultaneously, a scalable and efficient software platform is required and thus the smart grid infrastructure can be deployed globally [18]. The authors in [18] have mentioned that cloud platforms are well performed so these platforms are able to support such a huge data. In environments like these, cloud platforms are major components because:

- Cloud is flexible and smooth enough to avoid high costs, which come from the utility during peak hours.
- Power usage in during real-time and cost information can be shared.
- Cloud services monitoring process enables specific data sharing with third party. The solutions that clouds can offer relied on service-oriented architecture (SOA) and enterprise service bus (ESB) have discussed in [21]. SOA and ESB are flexible, efficient, on demand and scalable.

SOA depending on producing applications with the implementation of cloud applications that can be performed using the (ESB) model. Various sorts of mobile agents like Data Mobile Agent (DMA) and State Mobile Agent (SMA) can cooperate together to satisfy customer's expectations.

Multiplied user and multiplied energy source power can be participating together in the conventional smart grid system [22].

SaaS has been used by cloud computing, the authors discussed about dynamic demand response (D2R) to produce such a smart demand-side management system to minimize the peak-load. D2R acts like a smart tool which increases the reliability. The advantages of D2R as listed below:

- Demand is periodically forecasted.
- To achieve reliable and efficient smart grid architecture, a proper information strategy is selected.

2.1.4 Information Management solution with cloud: A different service for smart grid information management is provided by cloud data warehouse [23].

In multi-dimensional data analysis, the customers have various principles for power consuming, so it is needed to establish a new software platform employing cloud data-warehouse. The warehouse deals as data storage for whole components. The authors in [24] have proposed a cost optimization for different domains such as (broker), as a programming module, the broker domain acts.

Plug-in Hybrid Electric Vehicle (PHEV) owners can access real time price/state and charge/discharge their vehicles anytime they want. The utility can know where PHEVs are located and the amount of energy is needed. So the total charge-optimization is thoughtful for the smart grid model [24]. The communication and optimization components are used by cloud data to support Advanced Metering Infrastructure (AMI). AMI for micro-grid exploiting cognitive radio network in the cloud data center [25]. AMI ables to support PHEV and the main pros for that it is able to work with existing Base Transceiver Station (BTS) cellular service. While Ethernet protocols are not supported by AMI.

(IaaS) used by [26] to process the smart meter of data streams. While (PaaS) used in real-time distributed data management and parallel processing of information.

Relies on the load on micro-grids, a dynamic pricing pattern is implemented in the existing smart grid system [27]. Cloud computing services are used to save the real-time information from the smart meters [28].

2.2 Smart grid application in cloud computing

The demand response application is an ideal example to show how smart grid can manage the power and information better in cloud computing platform.

2.2.1 Demand response (Energy Management System): In this application, the power customers vigorously involve in balancing the supply and demand detour [29]. Relied on real-time price or stimulant price indication, end user could willingly decrease their electric power spending. Occasionally *"negawatt"* the virtually produced electricity from demand response is named, in the matter of that the decreasing of the load is on a par with to electricity generation of the same amount. Many ways are available to achieve demand response. Lead load control where the avail amelioration process is the easiest one to apply. A suitable demand response model is decisive as well as the optimization algorithm. We have five main necessities for the demand response model as the followings:

-*Security*: An interaction is needed in demand response between the utility and users. Safety is mandatory between the utility and users during message swapping. Else the demand response against cyber attack will be weak and that leads to intimidate grid constancy [17].

-*Reliability*: No a single point of insufficiency or bottlenecks should be occurred in demand response, such as: the server breakdown.

-*Scalability*: A huge number of users, comprising internal customers, can involve in the plan due to demanding response should be scalable.

-*Speed*: The greatest defying than ever is linking providing and demanding is more defying as more re-usable energy sources such as solar photo voltaic and wind farms with mutable power throughput are presented in smart grid.

A primary extra service for the power grid is got by the rapid demand response.

-*Efficiency*: If is desired to fulfill the objectives of all partakers utilities lessens the cost of achieving demand response, users get the most out of their gains, and the arranger exploits the social benevolence if demand reaction relies on market mechanism [17].

2.3 LTE NETWORK

LTE is the rising technology after UMTS 3G, which is based on WCDMA, HSDPA, HSUPA, and HSPA. Unlike UMTS which is considered as a replacement for GSM, LTE is upgraded from UMTS which will enable users to download and upload data at high speed rates. For LTE we show two problems, the first one is related to hardware implementation while the second one is about quality of service (QoS) of performance.

2.3.1 Hardware implementation challenges: Neither expert boxes nor interconnections are established in telecommunication networks. They totally know about the processes implicated in running a huge scale. They found that computing infrastructure is preserving heterogeneous pools of general-aim hardware, middleware frameworks, and applications after ten years of testing. Lack of unification in both computing platforms and management processes are the problems of source of network and inventory management. Agents are expected to be progressively more applying a cloud computing approach to hardware management in order to guide their operations after this case [30].

2.3.2 QoS performance challenges: LTE deployment put constrains with demands on network performance. Because the very fast services that LTE can provide, the number of users expected to be increased [31]. Typically, network operators use the centralization model in 4G networks, centralization requires higher bandwidth as well as long communication links, and thus centralization is responsible in 4G cellular networks for many issues like network wasting recourses, more delay and bottlenecks.

2.3.3 Hardware implementation solution with cloud: Agents will arrange palaces which full of hardware resources that equipped in main areas at both the core and edges of their networks in Telco Cloud case. Telco clouds can offer settled and standardized medium to the agents. That will assist to decrease validation and checking requirements upon hardware or network improvements. In addition, the rising of Telco Clouds allows to service providers to provide a novel class of trustworthy hosting service demand response, storage, and processing resources with efficient service-level ensures. Telco Clouds have the possibility to aggrandize the telecommunication industry's conventional service wallet: Cloud-enabled operators will be capable to exploit their hardware and network infrastructures to host their user's software [30].

The clout on their own network's management plan is the main competitive feature of a Telco Cloud operator. The management plan discloses networking QoS specifications which usually not obtainable in the situation of Internet-based cloud computing providers. With a minimum delay to computing resources, Telco Cloud supplier can provide while exposing a matchless level of control to third parties willing in great-performance hosting for their virtualized service infrastructure [30]. Telco Cloud suppliers can turn into Infrastructure-as-a-Service (IaaS) providers with a various value suggestion compared to the so-named over-the top laaS providers. laaS providers: a service that integrates dependable, warranted network connectivity together with flexible compute and saving data resources [30].

2.3.4 QoS performance solution with cloud: Cloud computing platforms such as Open-Stack, Eucalyptus and Open-Nebula that can be applied to 4G cellular network system to improve the QoS performance.
Cloud computing platforms come with effective solution which is replacing centralization with decentralized computing as well as offering smart storage, on demand, flexible Pay -as you- Go services including operators and users.

2.4 LTE platform in cloud computing

To implement LTE in cloud computing, to avoid (implementation hardware and centralization) problem, a suitable cloud computing platform is required. Open-Nebula is one of the main cloud computing platforms.

2.4.1 Open-Nebula (Decentralization): Open-Nebula [32] is cloud computing Toolset, which manages a data centre virtual infrastructure to create private, public and hybrid IaaS clouds in addition to storage, network, virtualization, surveillance, and security technologies to position multi-tier services.
Open-Nebula key features include the following things:
2.4.2 User Security Management: The authorization structure enables multiple-role support for several kinds of users and administrators, deputized control to authorize users, safe isolated multitenant environments, and straightforward resource sharing. Administrators have full access for managing of grouped users, so facilitating multi-tenant setting with multiple groups sharing the same infrastructure.
2.4.3 On-demand Provision of Virtual Data: A set of users can make and manage the computing, storing and networking capacity via Virtual Data Centers (VDC).
2.4.4 Control and Monitoring of Virtual Infrastructure: For VM image and template management, Open-Nebula has storage and warehouse subsystem, plus a full control of VM instance life-cycle and rolling for VM instance management. A broad network virtualization capability with traffic isolation, mobile network, definition of generic attributes to classify multi-tier services including of sets of internal connection in VMs and functionality for virtual network management provided by Open-Nebula.
2.4.5 Virtual Machine Configuration: In network terms, Open-Nebula provides elastic network classification together with the arrangement of firewalls and TCP / UDP ports.
2.4.6 Control and Monitoring of Physical Infrastructure: Deploying a public, private and hybrid clouds is one of Open-Nebula capability. Open-Nebula is very great and effective built-in monitoring subsystem and re-source part management to assign and track limit resource utilization.
As well as storage subsystem saves balance I/O operations between storage servers, or to classify diverse Service Level Agreements (SLA) policies and performance features for different VM kinds or users.
2.4.7 Standard Cloud Interfaces and Self-Service Portal: Open-Nebula is able to at once depict multiple cloud APIs including. Furthermore, it has a self-service provisioning portal to allow for normal end users to simply create, arrange and control compute, storage and network resources as well as it provides a graphical Interface [15].

2.5 VANET Network

VANET is derived from mobile Ad Hoc network (MANET). Because of its infrastructure less, VANET depends on certain nodes to handle routing packets and other network functions. VANET behavior is not the same of the MANET. The driver action will comply with the mobility as well as high velocity makes unique characteristics in inter-vehicle commutation (IVC) network. These characteristics will play a role for design resolutions in VANET networks. [33]. For vehicular network, we present issues which are related to the security and cost.

2.5.1 Cost challenge: High running costs is one of the main disadvantages in VANET; the reason behind this is the intensive mobility of the vehicle [34, 35] driver behavior is not easy to predict, thus the vehicle mobility level could be extremely high, especially in situations that cars move with great speed, which means that routers have to be updated often with high frequently to be able to handle the mobility properly and thus the cost can be increased due to extra routing [36].

2.5.2 Security challenge: Connecting an incorporation of Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communications is a recent kind of network which known as a Vehicular Ad Hoc Network (VANET). VANET offers early warning system from threats (threat detections warning) for drivers. Every single vehicle in V2V system usually is responsible for collecting data on the incidents depending on the response from the nearby vehicles. Unfortunately, by making untrue inferences, this system can cause a serious organized security attacks, which lead to more crashes incident and that means more treats. That is why, a remarkable security study has been drawn to solve this issue in VANET [37-41].
2.5.3 Cost solution with cloud: Vehicular Cloud Computing (VCC) takes the process from cloud computing to serve VANETs drivers with Pay As You Go method with low cost and efficiency**.** Pay As You Go means that customer will pay in computing method instead of actual real payment, this payment will be implemented in cloud computing. This concept is based on utility computing, this way of payment provides the customer with various options like: scaling, customizing and saving computing resources such as:

(software and storage). The customer charging will be depending on resources charges which offered the services. In public clouds, applying Pay As You Go could be different from one layer to another.

For instance, when the customer is using server, the charging will based on power consumption and usage of that server, while for Software as a Service (SaaS) the pricing will depend on the using of the software features as well as the customization that a customer made.

2.5.4 Security solution with cloud: Three methods were proposed to defend vehicular networks versus intentional re-get of the zone of vehicles by hackers which are: plausibility checks [42], logic reception beacons [43] and tamper proof GPS [44]. In addition, reactive and proactive security concepts are two kinds of ways to offer data-centric safe and verification in the vehicular networks. As well as through vehicles, the safety of location information and localization may be offered.

Three kinds of model to legitimize and to merge the location information in a Vehicular Cloud (VC) which are: An active location integrity model is the first type, while the second type is known as is passive location integrity. Finally, the third type which namely a general location integrity model.

The authors in [45] suggested a way to examine if the correct locations of a group of connected vehicles by using the locations of encirclement vehicles which known as “Secure Relative Location Determination in Vehicular Network” (SRLD), while a localization method which relies on liquidation malignant data is mentioned by [40]. This method declares the inter-cell position information integrity of vehicles or using GPS and radar.

“Cross-layer Location Verification Enhancement in Vehicular Networks (CLVE) is the third style to offer safe localization. Yan *et al*. in [46] founded by declaring a location of the validation technique to make sure of vehicles locations.

In a three layers, this style is applied. These layers are: the physical layer, the network layer and the application layer.

“A Geographic Location-based Security Mechanism for Intelligent Vehicular Network” (GLM) is the final localization method; this style was suggested by [47]. To turn the location into a key (geo-lock), an encryption algorithm is needed, thus it’s possible to enhance the location error tolerance in vehicular networks.

2.6 Vehicular network applications in cloud computing

Vehicular cloud computing is consisting of MANET, VANET, WSNs and cloud computing. Here we will show how VVC can provide better managing in emergency situations and improving safety by minimizing crushes ratio subsequently less costs (fewer accidents).

2.6.1 Managing evacuation (management) and road safety message (safety/cost): VCs can be useful in evacuation situations; the data will be uploaded by a special team (asylums, nutriment, and water) to the main server computer [7]. Using smart transport system in one of the crisis management that proposed by [48]. VANET could provide gathered information which collected from the vehicle’s sensors (which are part of this VANET Network) and deploy the information swiftly. A new system which model consists of three layers is proposed by [49, 50]. These layers are cloud infrastructure as service, the smart layer, and the system interface. A simulation experiment is done by them which showed after the model being evaluated that performance in terms of improving crises evacuation arrangement characteristics is efficient.

For road safety, this can be done via huge wireless sensor network, VC can form dynamically. A question comes from the vehicle to the sensors on other cars in (nearby cars) to add more integrity and get an evaluation of the possibility road threat which is coming ahead, as well as the road situation such as: (speed, breakers and clear ice). Anyway, the coordination of safety measures and quicker solution information still not provided by modern VANET design [51].

3 Challenges and Future Research Directions

In this section, we will present two kinds of challenges and open issues in cloud computing applications for smart grid, existing cloud computing platforms for 4G cellular network and vehicular cloud computing.

3.1 Smart grid with cloud computing challenges

Smart grid cloud computing applications suffer from open issues in energy management and information management.

3.1.1 Open issues for energy management: Cloud applications, and several future opportunities for cloud-based energy management are discussed below with problems [6].

1- The small size problem in the private cloud applications. The heterogeneity of the multi-small cloud makes the implementation not easy to achieve for private cloud.

2- It is a huge problem how to exchange data between cloud and micro-grid because of the elastic nature that micro-grid has to deal with/without real time data.

3- Maintaining demand and supplying curve during peak hours when introducing cloud energy devices. Until now there is no framework to provide support for power storage system.

4- Exchanging power between micro-grid and cloud energy.

5- Inserting a virtual power stream controller for credible and efficient smart grid operation. It is required to come up with optimizing energy flow controller, which able to operate in any mode.

6- Combining PHEVs with cloud energy storage to minimize the demand from micro-grids during peak-time. That is mean, if PHEVs user wants to charge during the maximum consumption time, the charging price will be higher and this is a problem in the implementation of cloud power storage.

3.1.2 Open issues for Information management: Cloud computing is efficient to handle with smart meter data, but there are many challenges listed [6]:

1- Merging public cloud to private cloud for cost- effectual communication in smart-grid. The two main problems here are exchanging data between public and private cloud in addition to other issues related to the privacy and security.

2- Cyber-physical system should be built to keep the privacy of users safe for data traffic scheduling.

3- Because of heterogeneous communication architecture [12], multi-mobile agent integrated with cloud computing for gainful smart grid operation still a challenge.

4- Supporting multiple energy sources for large scale with interactive cooperation using cloud services.
5- Reducing delay in cloud applications.
6- Users get reliable and cost-effective services such as billing.
7- The entire system in smart grid could be affected if one protocol failures.

3.2 Existing clouds computing platform implementation for LTE challenges

There are many platforms which, if it is applied will help to solve the some of LTE issues which related to QoS, but these platforms need to be enhanced in terms of five criteria to be utilized successfully in LTE based cellular systems. The criteria are defined based on the context of the EU FP7 Mobile Cloud Networking project [52, 53] which are:
1- Virtualized foundational infrastructural resources are supported from the Radio Access Network, Mobile Core Network and Data Centre.
2- Synchronize function and coordination is supported.
3- Support monitoring facilities, preprocessing, distribution, storage, analysis and notification of metrics.
4- Virtual resources (e.g., Mobility Management Entity (MME) and Packet Data Network Gateway (PGW), and the Serving Gateway (SGW)) are supported by certain mechanisms.
5- Unified and appropriate interfaces on top of and between various cloud computing.
This paper spots the light on two platforms issues (Open-Nebula and Open-Stack). So based on these criteria, the main platform challenges based on the criteria are:

- Open-Nebula issues [15]

- Control and surveillance of physical infrastructure and on-demand thrift of virtual data centers (for criteria 1).
- Controls and surveillance of virtual infrastructure and virtual machine setup (for criteria 2).
- User privacy arrangement and default cloud interfaces and self-service portal (for criteria 3).
- On-demand Thrift of Virtual Data Centers, Control and Surveillance of Virtual Infrastructure and Virtual Machine Setup (for criteria 4).
- User privacy arrangement and default cloud interfaces and self-service portal (for criteria 5).

- Open-Stack issues [15]

- Calculations and Networking Unit (for criteria 1).
- Calculations and Networking Unit (for criteria 2).
- Control Panel (Dashboard) (for criteria 3).
- Calculations and Networking Unit (for criteria 4).
- Control Panel (Dashboard) (for criteria 5).

3.3 Vehicular network cloud computing challenges

Numerous significant unclosed cases and research problems, in addition research directions for felicitous VCC deployment and implementation. Vehicular cloud is engineered and prepared to work properly with the operating environment and the ingrained stresses. The challenges which are listed below are: Architectural formation of VC and Privacy and security of VC

3.3.1 Architectural formation of VC: Challenges contain problems related to the formation of the logical model of the VC and dealings with physical resources. Therefore the sharp exigency of arranging the mobility of the host and heterogeneity ought to be taken in mind for computing. Challenges containing issues which are related the form of the logical model of the VC that dealings with physical resources. That leads to take in mind for computing the sharp exigency of arranging the mobility of the host and heterogeneity, so we have the following aspects [7]:

Flexible mobile architecture: Mobility in nodes is one of the main characteristics which straight influences on the existing computational abilities and saving resources. The sensitive related protocol model and VC networking have to be improved to offer wiggle application and resource that can be used on the move.

Robust architecture: A Robust dynamic architecture first suggests by [54] relayed on Eucalyptus cloud system [55] and virtualization model to assemble the computational and storage resources. Bigger more affirmation and many researches are required for the emerging of virtual machines between automobile and effective vehicle visualization.
Service-based network model: Applications and new engaging technologies will not be served by TCP-IP stack sufficiently, so the utilize of service-oriented and component- based network model [56] with adequate learning, and chances and surveillance facilities so as to face with re-applicable and extendible applications and resources**,** so service-oriented and component-based transport protocol [57] is needed.
Scopes of Services: Controlling via VCC could be a good and sage option for new emerging services. Clues and context realization services which will be profited by the forensic examinations and the car insurance company to decrease the insurance claim can be gathered by Photo as a Service. Gateway as a Service [58] will integrate with the net more deeply.

3.3.2 Privacy and security of VC: According to [59], creating confidence relationships among many participants is an active part of a dependable communication and computation. They be met before, these vehicles that related to VC. Coveted and potential could be the proactive mission of launching an original trust relationship between vehicles. Olariu *et al*. in [59] explained VC as a group of cars which share the ability of calculation power, Internet access as well as storage to create traditional cloud computing [7].

Making sure of authentication of customers, guaranteeing the privacy of critical message by using the encoding algorithm, being sure to make location safe and localization (because the majority of applications in vehicular systems are based on location information) [7]. Offering data isolation to ensure the from the safety of saved data on the cloud and securing data access to retain stored data on the cloud against illegal access safe are the main security challenges of VC [60].

4 Contribution

In this paper, we highlighted integrating cloud computing applications in three different technologies which are smart grid, LTE and Vehicular network. For smart grid, we discussed how cloud computing can improve the services, challenges and implementation in two aspects: energy management and information management, while for LTE we showed the challenges which related to centralization which affect on the QoS as well as hardware implementation. For centralization, cloud computing can solve this issue with decentralized shared 4G virtual network, while for hardware implementation problem, Telco Cloud proposed to implement LTE for cloud computing, in addition we addressed open issues which related to implementing cloud computing platform over LTE for two main platforms. Finally, for vehicular network, we discussed the problems that VANET (without cloud computing) suffers in terms of cost and security and how cloud computing fixed these two issues, for cost, Vehicular cloud computing can solve this issue with Pay As You Go method, while for security, a three methods were proposed to improve the security which are plausibility checks, logic reception beacons and tamper proof GPS. Finally, we addressed research direction for two main problems for Vehicular cloud computing, which are: Architectural formation and Privacy and security.

5 Conclusion

In this paper survey, we presented three technologies which are: Smart Grid, LTE based cellular network and Vehicular network and how to integrate these technologies with cloud computing in order to achieve better performance in information management, energy management and latency management. Then we briefly presented examples about applications for each technology that integrated with cloud computing. Finally, we highlighted the main issues and challenges and clarified the research directions for them.

Cloud computing applications in smart grid are efficient and useful techniques to solve the problems which are related to traditional power grid management even though some technical issues which cloud computing is suffering from [61, 62]. The smart grid architecture gives more memory and storage as well as cost-optimization, when using cloud computing for energy management. Cloud data-ward can solve the issue of communication and information management in smart grid by processing massive data from millions of smart meters.

In LTE mobile network, we made an analytical study about three main existing cloud computing platforms which are: Open-Stack, Eucalyptus and Open-Nebula and showed how these platforms perform based on specific criteria. We have seen that none of these platforms fill fully the criteria.

Vehicular Cloud Computing, and from the convergence of robust applied vehicle resources, advances in network mobility, we have shown and highlighted a recent new aspect. In addition, we stated that VCCs can achieve important improvement in terms of safety, security and economic feasibility of our society. In a planned or sudden evacuation, there is potential harm to the mobile communication infrastructure, and federated VCs might help a resolution support system and provide an interim surrogate for the infrastructure.

The cloud computing application is the next technology which can offer feasible and doable solution to improve the social service and provide a better life.

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