Volume 4, No. 4, April 2013
Journal of Global Research in Computer Science
ISSN-2229-371X
REVIEW ARTICAL
Available Online at www.jgrcs.info

A STUDY ON IMPROVING CHALLENGES OF NETWORK WITH CLOUDLETS FOR MOBILE CLOUD COMPUTING

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Abstract- In the present paper we define the concept of combination of two technologies cloud computing and mobile computing that is Mobile Cloud Computing (MCC). Mobile Cloud Computing (MCC) can provide the benefit of both technologies. Cloud provides not only the Storage capacity but also the power of computing, processing and storing of different mobile application. We can access all data through mobile device using Mobile computing. Still there are some challenges related to Mobile Cloud Computing. In this paper we discuss various challenges of networks like Internet connectivity, bandwidth, latency, access speed etc for MCC. We also discuss the one solution mechanism cloudlet for the main network problem of latency that affects the enhancement of MCC.

Key words- Mobile Computing, Cloud computing, Mobile Cloud Computing, Mobile Device

INTRODUCTION

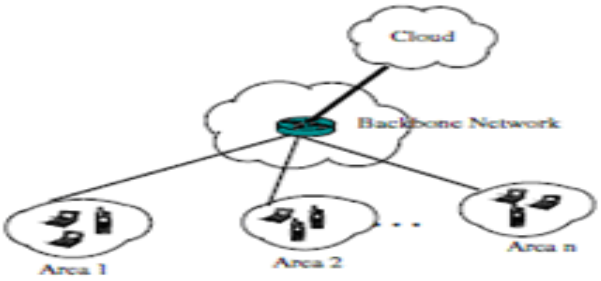
Mobile communication systems have shown an explosive growth in past couple of years [1]. This growth will continue as users enjoy the convenience of mobility. Nowadays, smartphones are becoming increasingly popular. In the fourth quarter of 2011, one witnessed a 47.3 per cent increase in smartphone sales from the fourth quarter of 2010 [2]. Such growth of mobile systems demands very efficient ways of communications for all kinds of applications. The most common applications of mobile systems are interactive in nature. File editing, video streaming, chatting are all interactive enterprise applications. As the capabilities of mobile devices advance (in terms of CPU power, network connectivity and sensors), people increasingly use them for other tasks such as emailing, GPS routing, Internet banking, gaming etc. Although many advances in technology, mobile devices will always be resource poor, as restrictions on weight, size, battery life, and heat dissipation impose limitations on computational resources and make mobile devices more resource constrained than their non-mobile counterparts [3]. Therefore, mobile devices still fall short to execute many rich media and data analysis applications that require heavy computation, and often also have (near) real-time constraints such as augmented reality (AR). One solution to overcome these resource limitations is mobile cloud computing [4]. By leveraging infrastructure such as Amazon's EC2 cloud or Rackspace, computationally expensive tasks can be offloaded to the cloud.

Divya Narain has also favored the fact that Cloud computing will soon provide a new way of developing, acquiring, and using mobile applications [5]. Execution of any mobile application is not going to be dependent on handset with advance configuration any more. According to Senior Analyst Mark Beccue for Mobile application developers, today's major challenge is the existence of such a wide range of mobile operating systems. They are generally left with two options either they write for just one OS or they just create many versions of the same application. In any mobile device for any application execution two basic significant requirements are of processing power and memory of that device capable of supporting that corresponding application. Scenario of Cloud Computing provides us this opportunity to execute our applications on servers instead of running them locally and favors us to overcome the handsets limitation of limited resources to a great extent. And also there will be no need for Mobile application developers to create many versions of same application. It's just the starting of a new phase of mobile application development; there is still a long way to go to achieve a new mobile world infrastructure involving cloud computing in its base.

Cloud computing has become the commonly used platform to serve all kind of applications. Cloud computing [6] is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

MOBILE NETWORK TOPOLOGIES FOR CLOUD

Current cloud-based mobile systems use a topology as shown in Figure 1. Each node in an area uses the backbone network to connect to the main cloud and to communicate with a node in the same area or in another area. However, such approaches of using the backbone network for every mobile communications can result in high latency. The bandwidth cost in 3G networks is higher than in WiFi [7]. Energy consumption of a mobile node using 3G/4G network is higher than a node using WiFi [8], [9].



[Figure. 1 Current Mobile Network Topologies]

Communication using backbone links may not be always present in some isolated areas, during rescue missions, uprisings and disaster scenarios [10]. More mobile communications using the same backbone network can also cause serious congestion at the backbone links and as a result, the average request (file) completion (transfer) time (AFCT) will be higher.

CHALLENGES REGARDING NETWORK

a. Inherent Challenges of Wireless Network: Cloud Computing can use Wireless network as base and it has its own intrinsic nature and constraints. Wireless connectivity is characterized by variable data rates, less throughput, longer latency and intermittent connectivity due to gaps in coverage. These challenges complicate its design for mobile devices even more in comparison to the fixed cloud computing.

While fixed broadband is supported by consistent network bandwidth. Sometime Subscriber mobility and uncontrollable factors like weather are also responsible for varying bandwidth capacity and coverage [11].

***b. Different Network Access Technologies*:** There is a need of accessing network whenever we implement cloud computing to mobile devices. In mobile world there are heterogeneous access scenario with different access technologies like WiMAX, WLAN, 3G, GPRS and so on, each one with their own schemes, policies, offerings and restrictions. Due to the existence of different access schemes we need seamless connection handover schemes (to avoid connection failure and connection reestablishment) when we move from one network access point to another network access point [12].

c. Delay in getting Response of application: Sometime we can not get fast response of applications. There are some factors which are responsible for overall delay that are:

a) Processing time at the data center
b) Processing time on the device
c) Network latency
d) Data transport time

Processing time involved is based on application and we can't do so much for it. But yes measures can be taken to improve the network latency. Long WAN latencies are a fundamental obstacle. Lagar-Cavilla et al shows latency can negatively impact interactive response in spite of adequate bandwidth. The reason for getting High network latency is distance of cloud from the mobile users. So for that one solution is keeping the applications as close to the users can reduce latency delay. Heavy data like video and podcasts if kept closer to the device then it will save bandwidth and cuts transmission delay. Similar is the case with highly immersive apps, such as real-time translation. Latency can be positively improved by allowing service providers to re-route internet traffic logically based on the location and cache capabilities, and can save bandwidth effectively.

***d. Bandwidth*:** Now a day accessing social media sites (e.g., YouTube, Facebook, etc) through mobile is increasing & becoming very popular. But these sites generally require more bandwidth in comparison to the traditional sites. If number of clients using social media of any organization increases then demand for modified network infrastructure capable of supporting wide-scale use of external and resource-intensive increases. It is organizations responsibility to plan for it and ensure that adequate bandwidth is available for widespread Internet use. Additional bandwidth can be achieved from hosting environments to cover surges in Internet or network activity. Memorandums of understanding (MOU) are developed between organizations and their respective hosting companies just to ensure that sufficient bandwidth is made available during surges of activity that may occur at an emergency event, time of heightened network activity, and with increasing popularity in social media [13].

In case of rich internet and immersive mobile applications, e.g. online gaming, that require high-processing capacity and minimum network latency cloud computing faces challenges due to low bandwidth of mobile network. So an improved network bandwidth is required so that data transfer within the cloud and other devices can be improved.

e. Lack of Speedy Mobile Internet Access Everywhere: In order to get speedy mobile internet access new technologies like HTML5 are being developed. They provide facility of local caching. Researchers are working to get a better way of accessing mobile web other than browser. Technologies like OMA's Smartcard Web Server and TokTok are being introduced just to provide a better access to mobile web.

In order to resolve connectivity problem existing with mobile devices, most of the providers are offering 4G/Long Term Evolution (LTE) services. These services provide advantages of data storage capacity, plug and play features, low latency, and they also supports both FDD and TDD using the same platform. According to the requirement, sometime LTE is also loaded on speed as it is capable of providing download peak rates of 100 Mbps and upload of 50 Mbps [14].

f. Seamless Connection Handover: In order to provide data communication using cellular network mobile operators are trying to set up Wi-Fi Aps on street so that offload traffic of Wi-Fi systems can be reduced, resulting in reduced cellular traffic congestion. But in this arrangement basic requirement is to provide seamless connection handover between access networks. Currently executing application is terminated or returns error when we move from one

access point of network to another access point of network or we move from Wi-Fi network to 3G-based cellular network due to occurrence of communication failure and connection reestablishment situation.

Problem of Communication failure is described as broken-pipe problem and it can be resolved by having communication channel with flushing zero window notification. And problem of connection reestablishment is defined by bind error, and can be resolved by implementing TCP port inheritance during socket reconstruction. No additional messages for channel clearing are introduced and no modifications are imposed on TCP protocol stack during TCP port inheritance. Approach of TCP inheritance is independent of the internal architecture of current 3G cellular networks as it is purely based on end-to-end architecture. By imposing Zero window advertising and TCP port inheritance our open network connections can be preserved and even server sockets also [15].

CLOUDLETS SOLUTION MECHANISM FOR NETWORK LATENCY PROBLEM

Clouds are typically far from the mobile user, and the high WAN latency makes it insufficient for real-time applications. To cope with this high latency, Satyanarayanan [16] introduced the concept of cloudlets: trusted, resource rich computers in the near vicinity of the mobile user (e.g. near or colocated with the wireless access point). Mobile users can then rapidly instantiate custom virtual machines (VMs) on the cloudlet running the required software in a thin client fashion [17].

As defined in [17], cloudlets are decentralized and widely-dispersed Internet infrastructure whose compute cycles and storage resources can be leveraged by nearby mobile computers. A cloudlet may be a cluster of multicore computers, with gigabit internal connectivity and a high bandwidth wireless LAN. A cloudlet can also be a very powerful multi-core server with Internet connectivity depending on the application scenario. Cloudlets have so far been proposed to assist mobile users, directly connected to them in terms of storage and processing [17]. In addition to assisting mobile devices associated with them in storage and processing, cloudlets can also be used to cache and transfer content to mobile nodes using affordable wireless technologies such as WiFi and WiFi repeaters [18],[7] and/or Flashlinq [19]. Flashlinq can give a wireless range of upto at least 500 meters. Cloudlet also simplifies the challenge of meeting bandwidth demand of multiple users, such as HD video and high-resolution images.

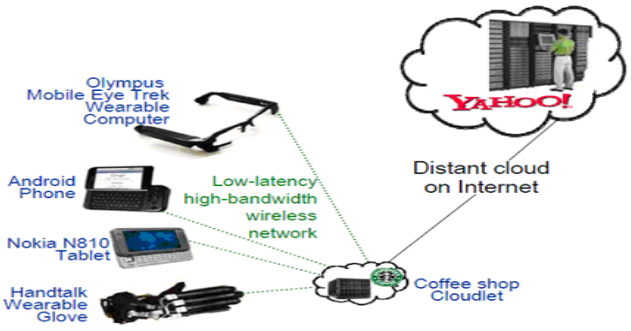


Figure 2: Cloudlet Concept

RESULTS AND DISCUSSION

With cloud computing there are some challenges. Main challenge of Network Latency we can improve through the use of cloudlet. Here in following Table shows the key Differences between Cloudlet and Cloud.

Table:1 Comparison of Cloudlet Vs. Cloud

	Cloudlet	**Cloud**
State	Only soft state	Hard and soft state
Management	Self-managed little to not professional attention	Professionally administered, 24*7 operator
Environment	"Datacenter in a box" at business premises	Machine room with power conditioning and coding
Ownership	Decentralized ownership by local business	Centralized ownership by Amazon, Yahoo!, etc.
Network latency	Need of Low LAN latency	Need of High Internet latency
Sharing	Few users at a time	100-1000s of users at a time
Distance	Near to the mobile users	Far to the mobile users

CONCLUSION AND FUTURE WORK

Mobile devices have a main drawback of Resource poverty that is a fundamental constraint. So for that we will go with the concept of Mobile Cloud Computing. Hear we add the cloud computing with the mobile computing. But with this concept there are some challenges with network are there. To avoid some of the network problem we provide the concept of Cloudlet.

Using cloudlet Mobile users seamlessly utilize nearby computers to obtain the resource benefits of cloud computing without incurring WAN delays and jitter.

So there is need to provide more focus and do research on the concept of cloudlet as a middleware for Mobile Cloud Computing.

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