AN EFFECTIVE USAGE OF CLOUD APPLICATION DEPLOYMENT IN MOBILE COMPUTING ENVIRONMENT

[1]Santanu Dey, [2]Jayasimha S R
[1]PG Student, [2]Asst. Professor
Department of Master of Computer Applications,
RV College of Engineering, Bangalore, India.

***Abstract*:** Cloud computing technologies are helping mobile platforms to achieve abilities beyond their scope. As we know that mobile device specifications are at an all-time high and most of the complex computing tasks can be easily handled on a mid-range mobile device nowadays. But along with that comes the extra headache of always upgrading to a better device. This can be eradicated by the latest advancement in cloud technology and how they can be implemented in a mobile environment. The objective of this work is to make a seamless mobile environment experience where the user need not worry about the hardware limitation of his mobile device and can independently use the services one requires without any hassle. And finally, this paper puts forth a few of the examples of the mobile application that embraced MCC(Mobile Cloud Computing) and a brief case study on how the adaptation of MCC affected the application use cases

***IndexTerms*:** Mobile Cloud Computing, Cloud Computing, Mobile environment, Cloud Applications.

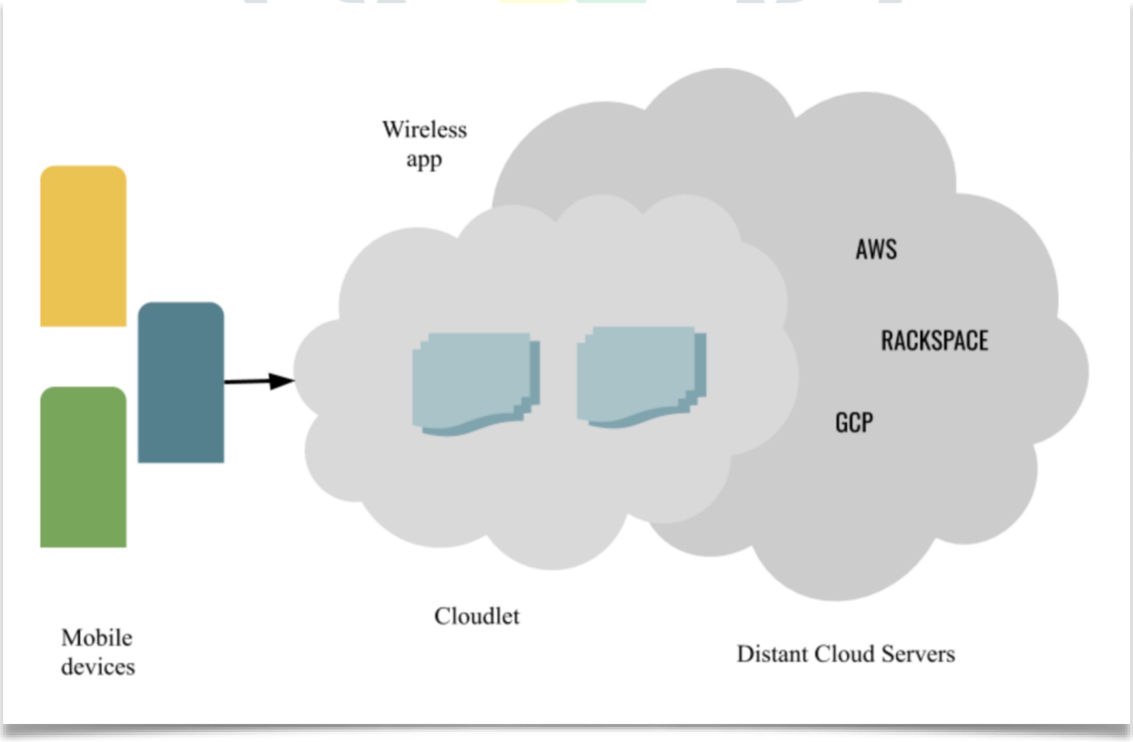
1.0 INTRODUCTION

Consumer electronics have seen a gradual rise when it comes to mobile technologies with the total number of 61.51% mobile phone users out of which 45.05% of users being smartphone users[1]. Along with that comes the rapid development of advanced mobile applications. However, smartphone computation capabilities are limited by the hardware they are provided with. A rapid leap in development ideologies might result in more demanding hardware specifications.

MCC or Mobile Cloud Computing is an emergent technology that can be used to develop service applications. This has also led to various mobile applications being developed that used cloud resources for processing and storage purposes[2]. The inspiration behind this work centers around the concept of leveraging finite tools for connectivity in such a way that people can make the best use of their mobile devices. Resource-intensive activities should be transferred to the cloud such that limitations on personal devices are mitigated.

Hence the key goals of this paper are as follows:

- Identify mobile app shortcomings when it comes to intense computing and resources
- Explore existing solutions for these limitations



- Investigate MCC in terms of a particular scenario and use case

Fig. 1: (a) three tier architecture for mobile cloud computing

Figure 1(a) gives a brief idea about the three-tier architecture that explains the concept of MCC and how it can be used to implement in a mobile environment. It shows how a bunch of mobile devices operate over Wireless apps and can access the distant cloud servers for their usage.

2.0 Related Work

MCC was defined by Kovachev, Cao and Klamma [3] as: "Mobile cloud computing is a paradigm for straightforward elastic enhancement of mobile app functionality by pervasive cellular connectivity to cloud storage and processing services, with context-conscious contextual adjustment of offloading to alter operational environments while maintaining usable sensing and mobile device interactive functionality."[12]

They mention how smartphone usage has improved in terms of functionality due to the issues that currently exist such as low processing power, device memory, CPU, etc. being solved.[4] Hence, apps may be built to be easier and less bloated than the applications they would operate[5]. MCC is a philosophy that seeks to minimize these limitations by expanding smart device capabilities through the use of cloud infrastructure, as necessary. Resource-intensive activities can be delegated to the cloud or other services to reduce the limitations on mobile devices. In MCC, data collection and retrieval takes place outside of the mobile computer, whereas in cloud computing, data storage is typically just local[6].

Several current systems have been suggested for doing this. Some of such architectures are also classified in augmented execution, application mobility, elastic partitioned/modularised applications, and ad hoc mobile cloud.[13]

1. Augmented execution: Smart app operations are offloaded to the cloud to address the drawbacks of mobile apps, such as computing capacity, battery life, and memory. Virtual machine technologies facilitate this form of design by disabling such overlays, moving them to the cloud and enabling them to restart.[14]
2. Application mobility: Application mobility is focused on the principle of process migration which enables processes to be halted, migrated to another computer and resumed seamlessly.[15] The distinction in this and Augmented Execution is that migration will occur in various underlying network technologies in device versatility.

Fig. 2(a) application mobility across different devices

Figure 2(a) shows us how applications can be mitigated across various platforms such as a mobile, tablet, Desktop as well as laptop and share the same instance.

3. Elastic/Partitioned Modularised Applications: By using elastic partitioned applications, the software is partitioned into modules such that they can be dynamically run independently on a server. [16]
4. Ad-hoc Mobile Cloud: The downside to unloading computation is its reliance on the network, which ensures that if the link is not functional or if it is unreliable, it is not possible to unload and restart the execution to the transaction.[17]

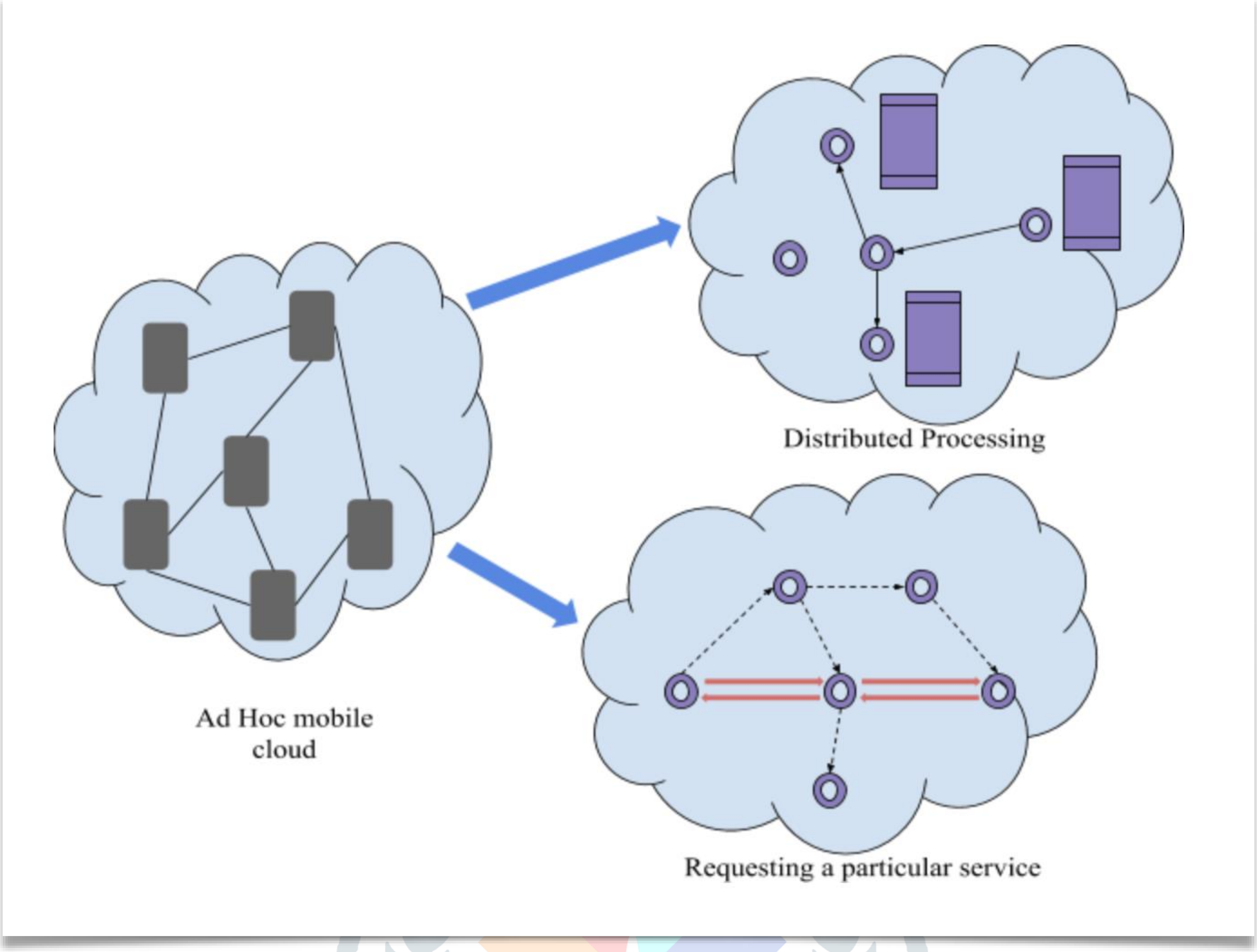


Fig. 2(b) ad hoc cloud and working mode

Figure 2(b) represents the ad hoc cloud infra and the two working modes that it provides to the user. Where one part is the ad hoc part and the other two describes how processes are distributed

3.0 Obstacles and problems

The cloud is computationally efficient, although mobile devices have minimal computing resources. And we've got to do them. We first illuminate some of the crucial obstacles.

3.1 Obstacles

- Three service models are supported in cloud computing i.e. Software as a service (SaaS), Platform as a Service (PaaS) and Information as a Service (IaaS). Yet so far only SaaS has been introduced in mobile cloud services as mobile devices have inadequate disk space, memory, weak display, and processing resources.
- Absence of specifications [7] or absence of universal specifications is another hurdle to mobile cloud infrastructure, contributing to issues such as reduced scalability, poor delivery of resources and lock-in by service providers.

3.2 Potential problems

- Resource shortage for smart apps: For addition, phones and tablets have fewer computing ability, reduced storage space, low display and small batteries relative to personal computers.
- Bandwidth and latency of the network: Another problem with mobile cloud computing is reduced capacity and strong network latency. Coverage for 4G wireless networks may be restricted by cell tower capacity in certain places where low-power signal transmission contributes to reduced coverage and higher latency.
- Quality of network and intermittency: Constant and easy Internet access must be assured in mobile cloud computing. The mobile app is still linked to the cloud whenever or wherever the consumer chooses to be related.
- Privacy concerns: Smart devices utilize clouds for computational services and software. Nowadays, smartphones have built-in special protection apps to shield them from misuse. The Google Security Policy Program provides the facility for users to remotely lock or delete details from a compromised or damaged mobile computer.[8]

4.0 Results and Discussions

4.1 Google Photos: Google Photos is a picture uploading and storage tool that Google has created. It offers users easy, unrestricted storage of photographs up to a limit.

Effect of MCC on Google Photos can be stated as:

- MCC enables users to back up and store their image in google clouds
- Photos and Videos uploaded to the cloud can be used to produce personalized contents using AI
- Uploaded content is also categorized and image search is enhanced

Fig. 4.1(a) Google Photos interface

In figure 4.1(a) we see the search bar of google photos where we can search using categories, location, names, etc

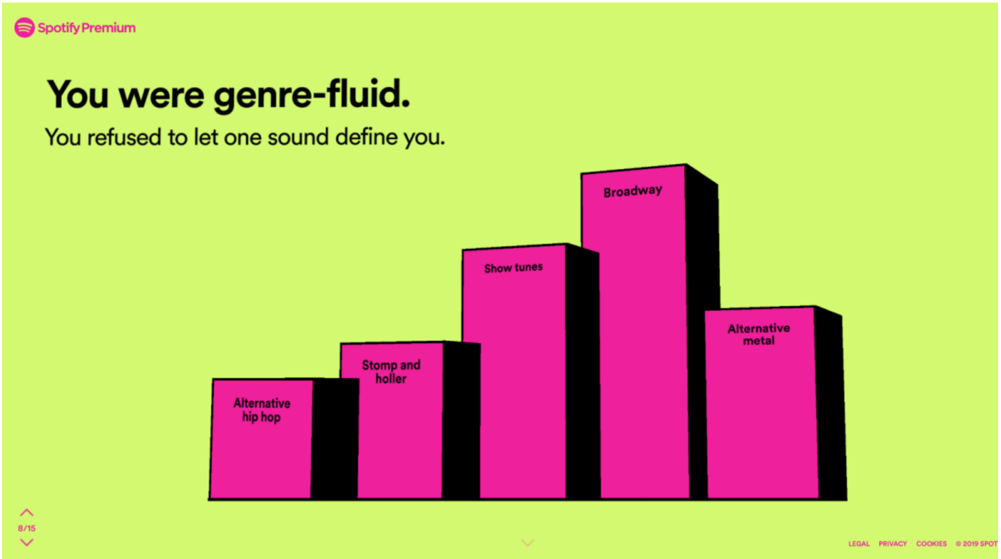
4.2 Spotify: Spotify is a digital music, podcast, and video streaming service that gives you access to millions of songs and other content from artists all over the world. [9]

Effect of MCC on Spotify: [10]

- Heavy customizations on personalized recommendations
- Dynamic interface specific to users
- Users no longer had to store music locally
- Wide range to discoverability for the users

Fig. 4.2(a) Land-in page of Spotify

Figure 4.2(a) is the landing page of Spotify where it gives a highly personalized home screen where all the contents are pulled from



the MCC and gives a highly personal application

Fig. 4.2(b) Spotify year wrap statistics[19]

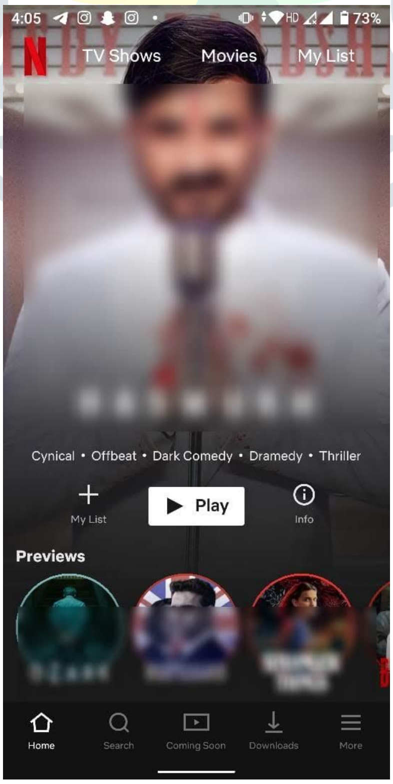
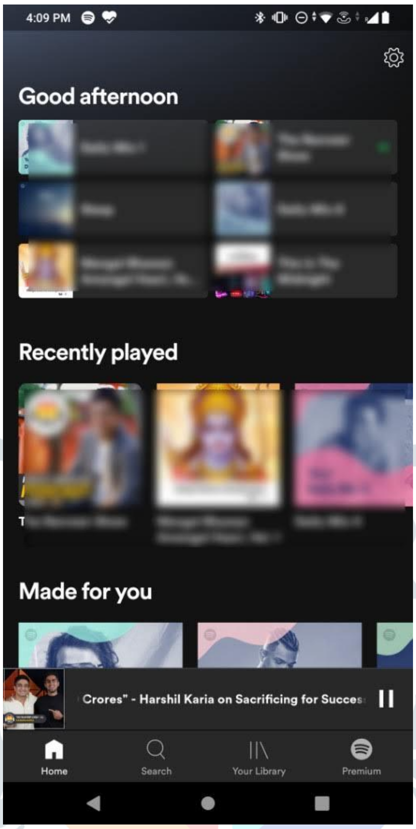


Figure 4.2(b) displays a graphical representation of Spotify's year-end wrap where it gives the user an overview of their usage activity

4.3 Netflix: Netflix is a subscription company that enables its subscribers to view a diverse range of award-winning Television shows, videos, films and more on dozens of network-connected platforms.[11]

Effect of MCC on Netflix:

- Streaming of Video content directly from the cloud
- No local storage of video content
- Personalized recommendations based on AI



- Personalized Artworks generated through Machine Learning Algorithms

Fig. 4.3(a) Land-in page of Netflix mobile app

Figure 4.3(a) gives the home screen of a Netflix mobile app similar to Spotify and similarly is highly personalized to the user. And all the contents are pulled in from the cloud storage.

5.0 Findings

- Traditional apps need to be developed forever, particularly as compared to their native web equivalents. They are typically published in one large box, and the scalability model leaves a lot to be desired. Cloud citizen, on the other side, conforms to a structure built to optimize durability. This achieves so by repetitive behaviors.
- The design used by conventional apps makes a connection between the device and the Shell. This reliance allows transition and scalability a complicated and risky problem. The architecture for cloud-native applications is built to enable developers to use APIs as a way of abstracting from dependencies. The primary explanation for this is to help teams work on what counts–tech.
- For conventional software, the organization’s activities must obtain the finished program code from the developers and execute this in development.DevOps of native cloud frameworks allow all the difference here. It's a mix of individuals, systems, and resources. The outcome is a partnership between developers and operations that results in a seamless transition of completed device code to output. This allows the operation to be more efficient and quicker.

6.0 Conclusion

This paper analyzes current empirical results on mobile data infrastructure and explores cloud-based mobile data infrastructure solutions. The problems and difficulties of mobile data networks in mobile cloud infrastructure would be raised for potential study. Using established work, we conclude that MCC is a valuable strategy for the expansion of computing and energy in mobile devices. The advantages of MCC may be obtained by someone who allows good use of their cell phone, whose usage extends beyond mere messaging and calling, and who constantly accesses the Internet by their smartphones. This paper states few of the applications that benefited from the MCC scene being introduced and also how it has entirely changed the user experience of mobile applications.

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