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cMac : A Context-aware Mobile Apps-on-a-Cloud Architecture
Empowering smart devices by leveraging Platform as a Service (PaaS)

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Abstract

Smart hand-held devices like iPhone, iPad, Andriod and other mobile-OS machines are becoming a well known part of our daily lives. Utilization of these devices has gone beyond the expectations of their inventors. Evolution of Apple's iOS from a mobile phone Operating System to a wholesome platform for Portable Gaming is an adequate proof. Using these smart devices people are downloading applications from numerous online App Stores. Utilizing remote storage facilities and confining themselves to computing power far below than an entry level laptop, netbooks have emerged. Google's idea of Chrome OS coupled with Google's AppEngine is an eye-opener for researchers and developers. Keeping all these industry-proven innovations in mind we are proposing a Context-Driven Cloud-Oriented Application Architecture for smart devices. This architecture enables our smart devices to behave smarter by utilizing very less of local resources.

1. Introduction

Emergence of smart hand-held devices has triggered a new thought process among the industry and consumers. This innovation is recorded as a leap after PC revolution of late 80's. In response, new ideas, techniques and tools are being developed. Every technology company under this umbrella is determined to produce not only user-friendly but also resource-friendly customizable products. Not long ago in 2007, when Apple released the iPhone, it utterly changed the smart phone industry. An idea bigger than the phone itself, "The App-Store" emerged and now hosts more than 300,000 of Third-party Apps for Apple's products [1]. Users depending on their needs are downloading applications. Apple's official download count is more than 10 Billion [1]. IT Giants like Google, Amazon, Microsoft , Samsung etc. are following the trail and are not far behind in innovation.

Correspondingly another innovation has emerged and made an impact i.e. the concept of Cloud Computing. researchers have gone further and classified Cloud Computing in terms of utilization, Software as a Service (SaaS), Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) [2]. We see their implementations in the form of Amazon's Elastic Compute Cloud (EC2) [3], Google's AppEngine [4], Microsoft's Azure Platform [5], Apple's mobileme Service [6] and many more.

This paper attempts to establish a coupled utilization of Cloud Computing particularly PaaS and usage of smart hand-held devices. We present a perspective of smarter utilization of these technologies with our cMac Architecture.

This paper is organized as follows: Section 2 briefly explains our motivation behind cMac; Section 3 presents a birds-eye view on the proposed architecture of cMac by discussing the client and services hosted on the Cloud; Section 4 concludes this paper.

2. Motivation

We are living in a smarter planet with smarter environments to interact. Our computing needs have raised the bar of living standards and is pronounced as 5th basic utility (after water, electricity, gas and telephony) [7]. We need data depending on the context i.e., our localized utility of information. In-short, we would like to hold one device that changes its state depending on our needs.

Envision, if a user moves from his study room to a TV lounge, his handheld phone automatically becomes a Remote Control for his smart TV. Whenever he enters in a library, same device loads applications in context to reading and studying like dictionary, thesaurus, his book reservations, list of new arrivals, books that he might be interested in or some recommendations from his social book-club. A device, that has agility to our mobility. Rather than proposing this agile platform on device's hardware or OS level, we introduce this nimbleness on application layer.

3. Context-aware Mobile Apps-on-a-Cloud Architecture

PaaS is an abstraction of unlimited resources that are available over protocols [8]. We want to utilize this immense resource for a smarter use. The Cloud has the strength of

scalability, security and reliability which favors the cMac concept. cMac leverages PaaS for a smarter utilization.

cMac is an implementation of PaaS that hosts Application Services & Data Stores as shown in Fig 1. This Architecture interacts with an application pool (App Pool) that hosts self made and third party applications and preserves application state over the Cloud during mobility.
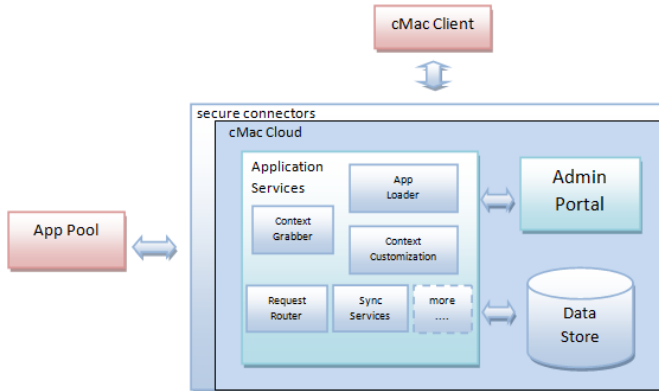

Figure 1. cMac Architecture

cMac Client interacts with cMac Cloud using secure connectors. With reference to his context, a set of applications is loaded over the clients hand-held device. cMac Client enables customization by providing CRUD operations on a context and its associated set of applications.

cMac promotes the idea of utilizing Cloud's computing resources. Applications are executed on the Cloud and preserved with their execution state with the ability to rollback over the Cloud's Data Store. However cMac client facilitates its applications to utilize interfaces provided by the product's underlying OS.

3.1. cMac Services on the Cloud

cMac Application Service layer primarily hosts request routing services, context grabbing and customization services, application loading services and Client-Cloud sync services. This layer provides a higher-level of abstraction for the server roles and is responsible for Cloud side transparency.

cMac Application Services ensure the client's event registration and responds with the instance of candidate object to be utilized. An event can be a change of context to a change in context or a new context definition. Every Context has 1-1 relationship with a set of applications from the App Pool.

As illustrated in Fig 2. ContextGrabber receives the cMac Client's context information through secure connectors. This information includes location coordinates, location tag and client's user-Id. Location coordinates and tag is verified for an available context. If found, request is routed to AppLoader which generates the application list to be loaded. This application list is passed to AppPool which returns the collection of application instances to be loaded on client's device. After a successful load of applications, their states are loaded. Sync services manage state synchronization between client and the Data Store.
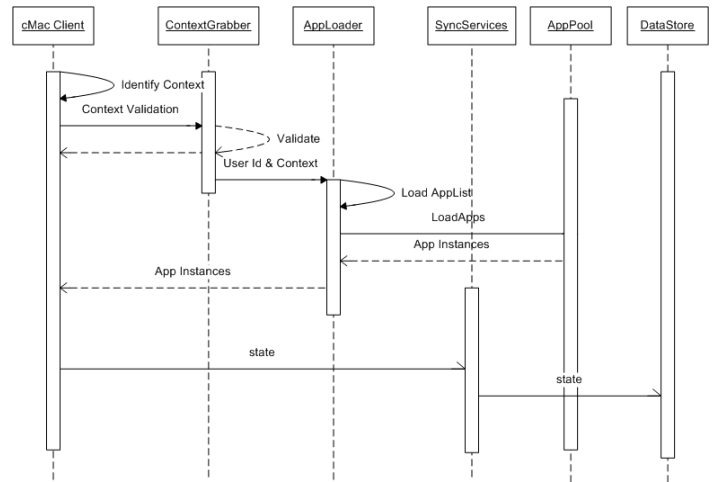

Figure 2, cMac System Interaction Diagram

3.2. cMac Client

IT industry has already given us rock-solid mobile Operating Systems lead by Apple, Google and Microsoft. Ample research has been in place to provide a user-friendly environment to end-users. cMac Client uses compatible adapters for multiple mobile OS deployment. The target level is the Application layer of any mobile OS environment.

cMac Client gets installed as an application software, providing the environment for the visibility of the applications from the App Pool. Through the underlying adapters cMac Client utilizes the device resources, which includes the tools and technologies required to identify clients location in the surrounding environment. Most of the smart devices today are well-equipped with location identification technologies and embedded equipment like GPS, Sensors and Wi-Fi. This provides ease of identification of user's location for cMac Client to determine a candidate's context.
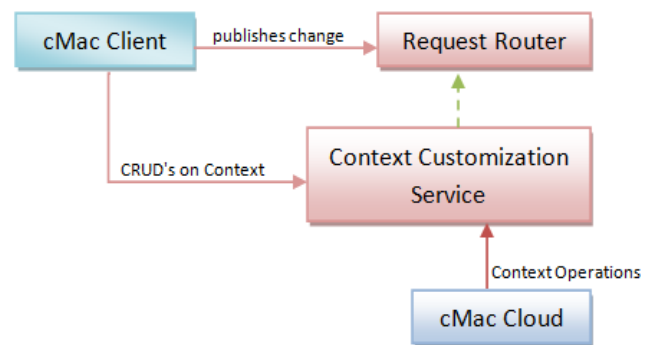

Figure 3. cMac Client-Server Conceptual Model

cMac Client Software uses Context Customization services to register a list of applications associated to a particular location as shown in the Fig 3.

cMac Client implements a publish-subscriber model with request-routing services. This method registers an event when the client location changes or when the state (inclusive of data) of the applications needs to be synchronized with the Data Store on the Cloud.

4. Conclusion

In this paper we proposed a coupled solution of smart hand-held devices with PaaS model over Cloud. This coupling facilitates the idea of context awareness to our devices and empowers them to behave smarter with personalized user experience. This architecture can be scaled to any intelligent computing platform but the precise usability of a hand-held device will bring the true essence of its implementation. Applications of this concept and architecture is developers imagination.

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