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Utilization of Digital Contents through the Convergence of Cloud Computing and Hierarchical Mobile Networks

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Abstract

As digital contents are increasingly available over the Internet, the user's mobility also is scaling up as wireless networks are widely adopted. Although the Internet offers a convenient medium for the transmission of digital contents, some issues such as network conditions, computing resources and receiver heterogeneity may affect the QoS of such transmissions. Thus, the convergence of cloud computing for managing resources, computing allocations and provisioning compounded with the emergence of HMIPv6 will lead to a more robust solution with this QoS issues. The advantages of Cloud Computing and HMIPv6 are utilized to address the shortage in computation, memory, and energy resources to support advanced graphic processing functions in real-time, especially for high-resolution digital multimedia contents, as well as security vulnerabilities for wireless networks connecting mobile terminals. This paper presents a model for the accessing digital contents through cloud computing infrastructure and hierarchical mobile networks.

Keywords: *HMIPv6, cloud computing, digital contents, QoS*

1. Introduction

The continuous availability and wide geographic coverage of the Internet and the scaling up of user's mobility has made digital contents increasingly available. As the Internet acts as the main transmission medium for digital contents, the issues such as network conditions, computing resources and receiver heterogeneity have greatly affected the quality of service (QoS) for both real-time and non-real-time services it has to offer.

Thus, the convergence of cloud computing for managing resources, computing allocations and provisioning compounded with the emergence of HMIPv6 will lead to a more robust solution with this QoS issues.

This paper deals with providing a solution for the degrading QoS of digital contents transmission that can operate in a ubiquitous environment through mobile devices. This paper presents a model for the accessing digital contents through cloud computing

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infrastructure and hierarchical mobile networks. The model will provide faster digital contents transmission on user's mobile terminals, taking into account the necessary context information to ensure efficiency in terms of delay, functionality richness, and security robustness. The model take advantage of the convergence of cloud computing for managing resources, computing allocations and provisioning compounded with the emergence of HMIPv6 to address issues such as network conditions, computing resources and receiver heterogeneity may affect the QoS of such transmissions.

The rest of this paper is organized as follows: Section 2 explains the basic operations and the standard handover procedure of MIPv6 and HMIPv6; Section 3 provides an overview of cloud computing technology; the proposed model for the digital contents transmission through Cloud computing and HMIPv6 is outlined in Section 4; and the concluding remarks in Section 5.

2. From MIPv6 to Hierarchical Mobile IPv6

The Hierarchical Mobile IPv6 (HMIPv6) is designed and the proposed enhancement to reduce the amount of signaling between the mobile node, correspondent nodes, and its home agent for Mobile IPv6 to improve handoff speed for mobile connections [1, 2, 3, 4]. It introduces a new concept of adding a Mobility Anchor Point (MAP) that acts as a local home agent to Mobile IPv6 (MIPv6).

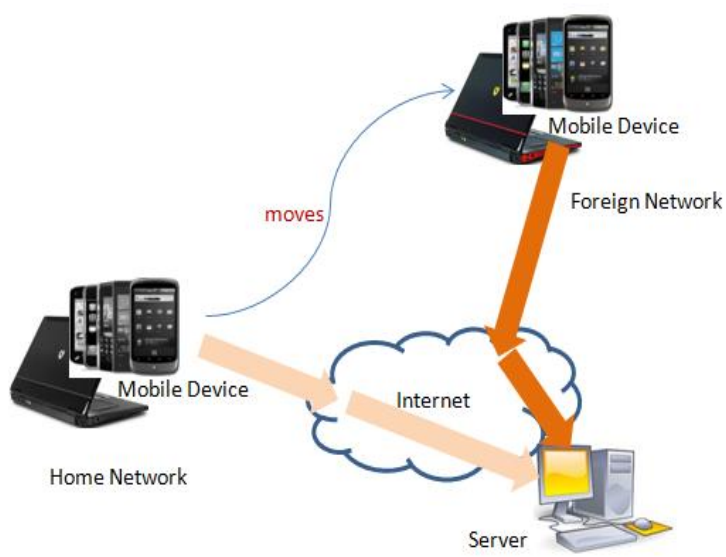

Figure 1. Mobile Ipv6

In MIPv6, the mobile nodes change their point-of-attachment to the home network without changing their IP address, thus, allows mobile devices to move from one network to another and still maintain existing connections [1]. The issue that MIPv6 defines a means of managing global mobility but does not address the issue of local mobility separately, but instead, it uses the same mechanisms in both cases, which in effect is an inefficient use of resources in the case of local mobility. The HMIPv6 adds another level that separates local from global mobility. In HMIPv6, the global mobility is managed by the MIPv6 protocols, while local handoffs are managed locally [5].

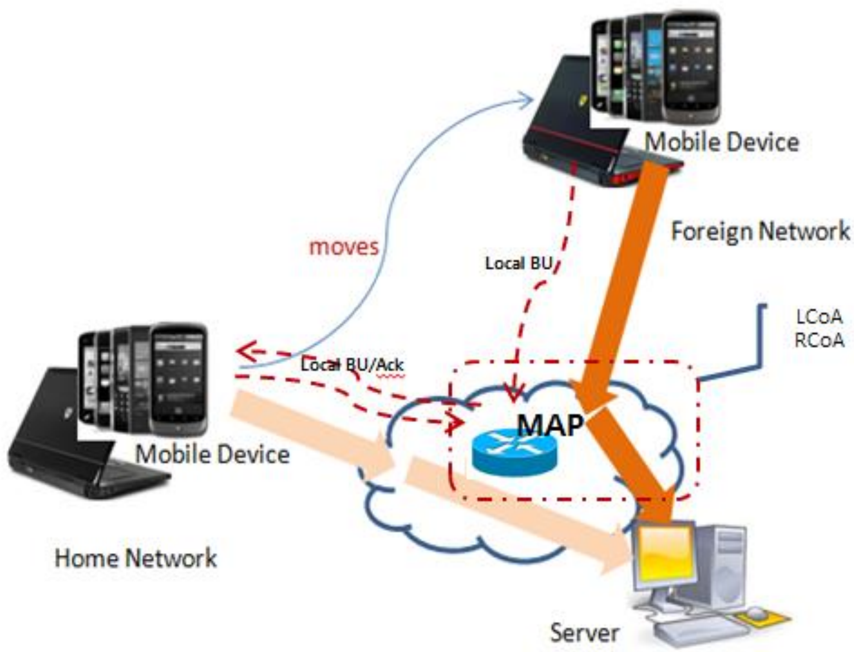

Figure 2. Mobile Anchor Point (MAP) is introduced in Hierarchical Mobile Ipv6

A new node called the Mobility Anchor Point (MAP) in HMIPv6 serves as a local entity (local HA in some aspect) to aid in mobile handoffs. The MAP, which replaces MIPv4's foreign agent, can be located anywhere within a hierarchy of routers. In contrast to the foreign agent, there is no requirement for a MAP to reside on each subnet. The MAP helps to decrease handoff-related latency because a local MAP can be updated more quickly than a remote home agent [5].

Using MIPv6, a mobile node sends location updates to any node it corresponds with each time it changes its location, and at intermittent intervals otherwise. This involves a lot of signaling and processing, and requires a lot of resources. Furthermore, although it is not necessary for external hosts to be updated when a mobile node moves locally, these updates occur for both local and global moves. By separating global and local mobility, HMIPv6 makes it possible to deal with either situation appropriately [5]. Every time the mobile node moves in MIPv6, the MN sends a binding update (BU) message to its home agent (HA) and correspondent nodes (CNs). The MAP can limit the amount of Mobile IPv6 signaling outside the local domain [2].

The MAP serves as an intermediary or proxy for the Home Agent (HA) in foreign network. As the Mobile Node (MN) enters a MAP domain, it can receive Router Advertisements that contain information for existing local MAPs. It then configures its current location through two care-of-addresses (CoAs), the regional CoA (RCoA) and an on-link CoA (LCoA). The RCoA is an address on the MAP's subnet based on the prefix in the MAP option of the router advertisement (RA) message sent by MAP. It is auto-configured by the MN when receiving the MAP option. The LCoA on the other hand is an address configured on an MN's interface based on the prefix advertised by its default AR. When an MN first enters an MAP domain, it sends a BU message to the HA and CNs through the MAP. While the MN moves within the same MAP domain, it only sends the BU message to the MAP. The MAP is essentially a local HA [2, 3, 4].

3. Cloud Computing

Cloud computing may refer to distributed computing over a network (typically the Internet) that refers to the use of computing resources (*e.g.*, hardware and software) that are delivered as a service as shown in Figure 3(a). It is the use of network-based services provided by real server hardware, and is served up by virtual hardware, simulated by software running on one or more real machines. The virtual servers do not physically exist and can therefore be moved around and scaled up (or down) on the cloud without affecting the mobile users [8, 9]. The cloud also focuses on maximizing the effectiveness of the shared resources. Cloud resources are usually not only shared by multiple users but as dynamically re-allocated per demand [8].

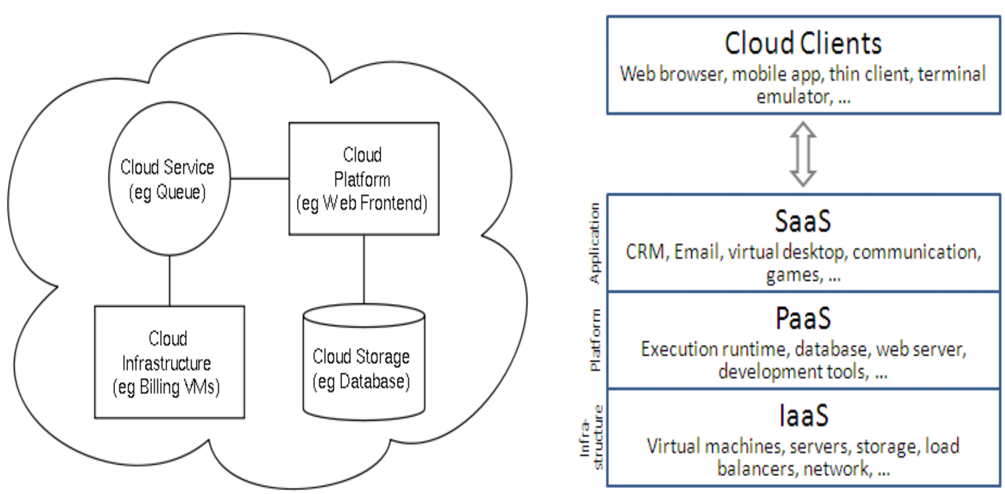

Figure 3. a) Cloud Computing Architecture; b) Cloud Computing Layers [6, 7]

Cloud computing also refers to the development and implementation of models for enabling omnipresent, convenient, on-demand access to a shared set of configurable computing resources (e.g., networks, servers, storage, applications, and services) [10].

Figure 3(b) shows the service offerings that cloud computing providers may offer and are classified according to several fundamental models: 1) infrastructure as a service (IaaS); 2) platform as a service (PaaS); and 3) software as a service (SaaS). IaaS is the most basic and each higher model abstracts from the details of the lower models. Other key components in anything as a service (XaaS) are described in a comprehensive taxonomy model published in 2009, such as Strategy-as-a-Service, Collaboration-as-a-Service, Business Process-as-a-Service, Database-as-a-Service, *etc.* In 2012, network as a service (NaaS) and communication as a service (CaaS) were officially included by ITU (International Telecommunication Union) as part of the basic cloud computing models, recognized service categories of a telecommunication-centric cloud ecosystem [9].

Cloud computing also considers cloud application deployment and consumption models in the form public, private and hybrid clouds. Public cloud applications, storage, and other resources are made available to the general public by a service provider. Private cloud is cloud infrastructure operated solely for a single organization, whether managed internally or by a third-party and hosted internally or externally. Hybrid cloud is a composition of two or more clouds (private, community or public) that remain unique entities but are bound together, offering the benefits of multiple deployment models [8].

4. Digital Contents Utilization

Accessing digital contents through the convergence of cloud computing and HMIPv6 is based on three major components: the digital contents server (considered as the sender); the cloud (over the Internet); and the client (comprised of mobile devices and considered as the recipient) (see Figure 4). As digital contents are requested, the Server implements security management, compression and an application-layer Quality of Service (QoS) policies and control. Security management will be in the form of encryption to provide assurance of data confidentiality, data integrity, authentication, and non-repudiation. Scalable coding for compression can provide provide content delivery and standardize the encoding of high-quality multimedia streams to adapt to different applications where content needs to be transmitted to many clients with different computational power. The compressed data will then be processed by an application layer QoS control before transmission.

The cloud is responsible for resource allocation and management based on SLA (Service-Level Agreements) allowing the optimal use of the shared resources by the different user categories. The transmitted digital contents from the Server are stored temporarily within the Cloud (Buffering). Queuing and traffic management is incorporated to support the execution of computing-intensive functionalities that cannot be run on user’s mobile terminals.

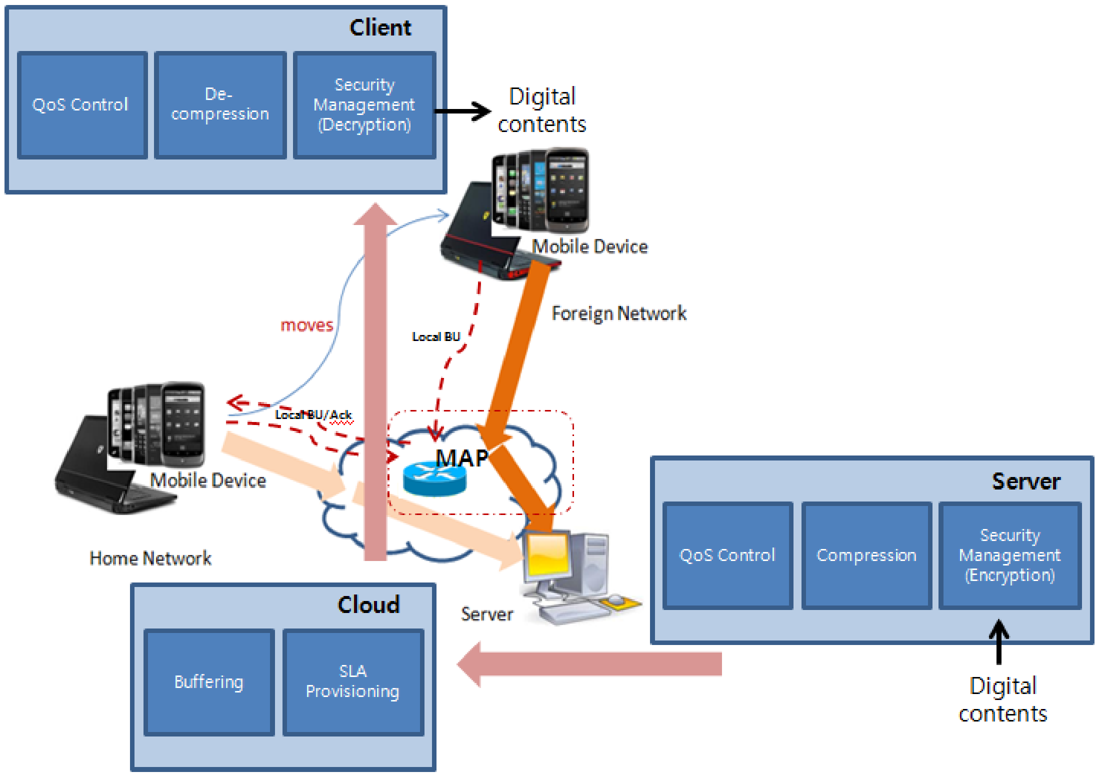

Figure 4. Digital Contents Transmission Model

The recipient will be the client's mobile terminal and should be capable of capable of acquisition, decoding, decompressing and decrypting management.

Although the Internet offers a convenient medium for the transmission of digital contents, some issues such as network conditions, computing resources and receiver heterogeneity may affect the QoS of such transmissions. Thus, the convergence of cloud computing for managing resources, computing allocations and provisioning compounded with the emergence of HMIPv6 will lead to a more robust solution with this QoS issues.

5. Conclusion and Future Works

This paper presents a model for the accessing digital contents through cloud computing infrastructure and hierarchical mobile networks. The model is based on three major components: the digital contents server (considered as the sender); the cloud (over the Internet); and the client (comprised of mobile devices and considered as the recipient). The main aim of this model is to provide a solution for the degrading QoS of digital contents transmission that can operate in a ubiquitous environment through mobile devices. The model will provide faster digital contents transmission on user's mobile terminals, taking into account the necessary context information to ensure efficiency in terms of delay, functionality richness, and security robustness. The model take advantage of the convergence of cloud computing for managing resources, computing allocations and provisioning compounded with the emergence of HMIPv6 to address issues such as network conditions, computing resources and receiver heterogeneity may affect the QoS of such transmissions.

Acknowledgements

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