Chapter 8
Transporting the Cloud

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ABSTRACT

Cloud computing is consistently proving to be the dominant architecture of the future, and mobile technology is the catalyst. By having the processing power and storage remotely accessible, the main focus of the terminal is now related to connectivity and user-interface. The success of cloud-based applications greatly depends on the throughput experienced by the end user, which is why transport protocols play a key role in mobile cloud computing. This chapter discusses the main issues encountered in cloud networks that affect connection-oriented transport protocols. These issues include, but are not limited to, large delay connections, bandwidth variations, power consumption, and high segment loss rates. To reduce these adverse effects, a set of proposed solutions are presented; furthermore, the advantages and disadvantages are discussed. Finally, suggestions are made for future mobile cloud computing transport-layer designs that address different aspects of the network, such as transparency, congestion-intensity estimation, and quality-of-service integration.

INTRODUCTION

Mobile Cloud Computing is a large-scale network architecture in which computing power, software, storage services, and platforms are delivered on demand to end users. This new concept brings a whole new set of applications to the Internet. There is a large amount of cloud-computing applications, and this figure is growing at a rapid pace. With the appropriate software, also referred in cloud computing as middleware, a mobile cloud-computing system could execute any program that a high-end computer can. These programs can range anywhere from a simple word processor to an advanced grid-computing simulator software. The cloud could even perform the functions of an advanced graphics card, returning the processed display information assuming it is aware of the users display configuration, eliminating even further complexity and cost from the mobile device.

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There are several advantages of deploying mobile cloud computing on a particular network. A few general advantages of launching a cloud network include:

- End-users can access data and applications from any location and at any time, through any link to the Internet. Data and applications will not be confined to one location (e.g. university, enterprise or home) allowing a ubiquitous access.
- Client hardware cost will drop drastically, and the need for upgrades will become less frequent.
- Corporations running licensed software can have a centralized processing grid that allows access to its employers reducing licensing costs.
- Organizations with server and massive storage needs can save physical space, energy consumption and managing costs, by hiring these cloud-computing services. By utilizing cloud-computing services, consumer organizations will save money on support, as streamlined equipment, in general, have fewer problems than fully integrated systems.
- Finally, if the service provider has a grid computing system, then the client can take advantage of the network's parallel processing power.

The advantages mentioned earlier will depend greatly on the performance of the backbone network that is linking the client and the cloud service provider (CSP). If the exchange of information is unsatisfactory, mainly determined by the throughput of the connection, the client will be discouraged from employing cloud-based services. For this reason the transport layer plays a critical role in mobile cloud computing, particularly connection-oriented transport protocols such as the Transmission Control Protocol (TCP). For self-containment reasons a brief explanation of the term connection-oriented is found in the Background section of this chapter. The most significant TCP parameters that determine the quality of a connection are throughput, delay, timeout, and segment loss rate. As it will be discussed further ahead, these parameters are correlated and changing one of them affects the rest. By intelligently managing these factors the TCP performance can be improved, hence improving mobile cloud services.

This chapter is organized as follows. The background section discusses the traditional transport control protocols and modeling techniques. The models subsection discusses the two most common throughput models, both based on renewal-reward theory. A quick mention of other types of models is made. It is a great basis for undergraduate students and it serves as a review for graduate students, professors and other professionals. The remaining sections are aimed to complement the knowledge of professionals, which include models, drawbacks, solutions and future work. The *Research in Mobile Cloud Computing Issues* section has drawbacks of TCP transmissions interlaced with the proposed solutions. This order facilitates the reading of a particular issue and some suggested solutions, may this be bandwidth-delay product solutions, wireless edge issues, service level agreement benefits, etc. The chapter concludes with future work suggestions.

BACKGROUND

Transport-layer connection-oriented protocols are mostly composed of TCP-based protocols. In the lexicon of this chapter, a TCP-based protocol (or simply TCP) is any protocol that employs the TCP segment format, regardless of the congestion-control algorithms implemented. A connection-oriented transmission, in short, is a virtual link between the end users. More precisely, this indicates there is an initial exchange of control messages (three-way handshake) with