Data Replication in Mobile Computing

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We certify that we have read this thesis and that in our opinions is fully adequate in scope and quality as a thesis for the degree of Master of Science of Philosophy.

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المستخلص

أصبحت الحوسبة المتنقلة من الضروريات لبعض الأعمال العامة وذلك منذ سنوات قليلة، حيث توفر الحاسبات المتنقلة والالتزام مع وجود الشبكات الغير متصلة الحصول على المعلومات التي يحتاجها المستخدم بغض النظر عن مكان تواجده. وتأخذ الحوسبة المتنقلة على عاتقها بعض التحديات في حقل البيانات نتيجة لضعف الموجات وقلة عمر البطارية إضافة إلى تكرار حدوث قطع الاتصال.

وقد أحدث التقدم في مجال الحوسبة المتنقلة بعض الاهتمامات في حقل استنساخ البيانات كتكنيكولوجيا تهدف عموما إلى الزيادة في إتاحة تداول البيانات. وينبع الاهتمام بتقنية استنساخ البيانات في بيئة الحوسبة المتنقلة من باب وجوه توافر مصدر محلي للبيانات عند تكرار قطع الاتصال. وهناك الكثير من الأبحاث التي ركزت اهتمامها من أجل الحصول على ميكانيكية جيدة لاستنساخ البيانات. مفهوم استنساخ البيانات المتفائل ظهر على السطح ليسمح لمستخدمي الأجهزة المتنقلة الوصول إلى البيانات التي يحتاجونها بسهولة على الرغم من حدودية الاتصال مع الشبكة.

يقوم هذا البحث بتقصص بعض الأنظمة الموجودة والتي تستخدم مفهوم استنساخ البيانات المتفائل في دعم تطبيقات الحوسبة المتنقلة. كما يقوم البحث بتطبيق استخدام استنساخ البيانات ويعرض لأهمية استخدام وتطبيق الحوسبة المتنقلة في مجال الرعاية الصحية.
Abstract

Mobile computing is rapidly becoming a common requirement for working before few years. Mobile computers along with development in wireless communication networks provide users to access information independent of their physical locations. Mobile computing poses new challenges to database community due to low bandwidth and battery life as well as frequent disconnections.

Recent advances in mobile computing have motivated some interests in data replication. Replication is a general technique to increase the data availability. Data replication is especially important in mobile environments, since frequently disconnected must rely on local resources. Much work has been done on providing efficient data replication mechanisms. Optimistic data replication has appeared to allow mobile clients with limited network connectivity to access global application data.

This research will examine several existing systems that use optimistic data replication to support mobile applications. The research also will present a case study that used a replication technique and shows the importance of applying the mobile computing on the health care sector.
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In the last few years, the use of portable computers has been spread through in wide range and in many fields. The extended advancement of wireless communication and rapid promotion of portable computer have led to a new paradigm called nomadic or mobile computing.

However it is important to differentiate between the terms “wireless” and “mobile”. While the two terms are commonly used interchangeably, Mobility does not necessarily require wireless communication and not all wireless communication technologies are mobile.

Wireless refers to the method of transferring information between a computing device, such as a personal data assistant (PDA), and a data source, such as a database server, without a physical connection. Mobile simply describes a computing device that is not restricted to a desktop. A mobile device allows users to complete computing tasks without being connected, to the network [2].

Mobile computing provides users the ability to access the desired data and information wherever they are, to help them do their tasks. In mobile environment, the users should be able to keep the connection to the network even while they are moving. Users carrying their portable or mobile computer (as PDA) equipped with a wireless network, are capable of accessing information in a global network to unbounded mobility of users.
Many workers and professional people use mobile computers for their works in: sales, health care services, educational fields etc, in order to send or receive data at the moment they need and where they are in any place. Also when mobile users access to a wireless network, they can download any electronic documents, query a remote database, and send or receive electronic mail.

Mobile database has become a popular expression that allows users to access large databases remotely. The databases on both mobile and fixed hosts are shared resources in seamless way. Data are also available anywhere independent of the availability of the fixed network connection. Mobile Database lets to Add, Delete, Find, or Edit records in tables or stored queries.

1.1 Thesis Objectives

In a mobile environment it is important to have data replication mechanism that allows the instance copies to migrate from one site to another. Replication services allow data to be stored at multiple sites to achieve acceptable performance and availability levels. Additionally the replication service guarantees that all replicas (copies) represent the same set of updates. Many existing replication systems are not capable of adequately handling mobile computing.

Replication in mobile environments requires fundamentally different solutions than those used on stationary environments, because mobility presents new and different computing paradigm.

This research will demonstrate the effects of mobile computing environments on database replication by:

- Study the issues and environment of a mobile computing and discuss database replication concerning their strategies, advantages, and disadvantages from the perspective of mobile computing.
- Examine the issues of optimistic replication strategy for mobile computing environments by investigating some of the existing replication systems namely: Coda, Bayou, Roam, and Merge Replication.
- Develop a prototype application utilizing from a selected replication methodology in a healthcare industry especially as a selected case study. The design and implementation of the system will be based on a handheld computer for use by physicians in a hospital in terms of gathering patient's data in a simple and fluid manner.

### 1.2 Thesis Overview

This thesis is organized in six chapters. Following this introduction, **Chapter 2** is divided into two primary sections. The first section presents an overview of mobile computing while the second section is dedicated to present an overview of database replication.

In **Chapter 3** the three common replication models are briefly described. Then eager and lazy replication strategies are presented. The two dissimilarly replication categories: pessimistic and optimistic replication, are also described.

**Chapter 4** is dedicated to study four of the existing systems of optimistic replication. These systems are Coda, Bayou, Roam, and Merge Replication. The four selected systems are compared at the end of this chapter.

In **Chapter 5** a selected case study in health organization has been introduced. The benefits of using handheld computers in healthcare as well as its limitation are presented. The investigation, structure, design, and replication method of our problem are all discussed.

**Chapter 6** summarizes the conclusion of this thesis, and proposed some suggestions for future works.