# NEW TRENDS ABOUT MOBILE COMPUTING

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*Abstract*-In recent years, mobile computing has become the focus of vigorous research efforts in various areas of computer science and engineering. These areas include wireless networking, distributed systems, operating systems, distributed databases, software engineering, applications  development, just to name a few. This paper introduces the conceptual overview of mobile computing, its achievements, challenges and opportunities. The current status and ongoing research projects in mobile computing worldwide are detailed. The selected papers from these two workshops form the basis for this special issue of Australian Computer Journal.

**Key Words: mobile computing, wireless networks, data management, distributed systems**

## I. INTRODUCTION

Mobile computing is associated with mobility of hardware, data and software in computer applications. Mobile computing has become possible with convergence of mobile communications and computer technologies, which include mobile phones, personal digital  assistants (PDA), handheld and portable computers, wireless local area networks (WLAN), wireless wide area networks and wireless ATMs. The increasing miniaturization of virtually all  system components is making mobile computing a reality. Mobile computing - the use of a portable computer capable of wireless networking - is already revolutionizing the way we use computers. Wireless networking has greatly enhanced the use of portable computers.. It also enables continuous access to the services and resources of stationary computer networks. With

access to a wireless network, mobile users can download news or electronic documents, query a remote database, send or receive electronic mail, or even be  involved in a real-time video-conference with other users.

### 1.1 Wireless Networks and Hardware

The components of mobile computing infrastructure are illustrated in figure 1. The architectural model consists of two distinct sets of entities: mobile hosts and fixed hosts. Some of the fixed hosts, called mobile support stations (MSS) or home base nodes (HBN)  have a wireless interface to communicate with mobile hosts. Mobile hosts can connect to any other fixed host where it can register as a visitor. This node is called the visitor base node (VBN). The VBN routes all transactions, messages and communication calls to and from the mobile host to its appropriate HBN. The segment of a larger computer network or a geographical area controlled by a corresponding HBN is called its zone of influence. Fixed hosts and communication links between them constitute the static or the fixed network, and can be considered to be the trusted part of the infrastructure. Thus, the general architecture for the network with mobile hosts is a two tier structure: powerful and reliable fixed network with mobile support stations and a large number of mobile hosts, which are roaming within

and across multiple heterogeneous networks and are connected by slow and often unreliable wireless links.
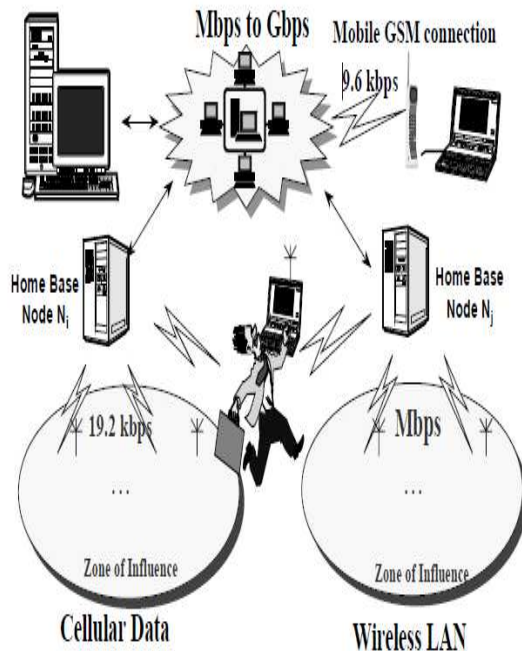


**Fig.1. Mobile Computing Environment**

Packet-switched data networks are more economical to operate than similar circuit-switched networks. They allow many devices to share few communication channels. Transmission speeds vary from 4800 bps to 19.2 kbps. However, the actual transmission time and throughput is determined by the network load and overheads, and cannot be precisely specified. Packet data networks are well suited for short data transmissions where the overhead of setting up a circuitous not warranted for the transmission of data bursts lasting only seconds or less.

**1.2 DataTac 5000 architecture**

Telstra Mobile Data network is based on Motorola's DataTac 5000. It uses the Motorola open protocol RD-LAP 19.2. The raw data rate is 19200 bps on 800MHz, 25kHz channel. Net data rate is estimated at 14,400bps. Wireless modem are half-duplex, ie,

radio cannot receive packets while transmitting. Telstra Mobile Data is believed to cover 70% of the Australian population, mostly in metropolitan areas. Telstra Mobile Data supports fleet connectivity where one host application communicates with up to thousands of wireless modems (terminals). On Telstra Mobile Data there are three protocols involved: Standard Context routing (SCR), Native Control Language (NCL), and RD-LAP 19.2. Mobile Data users do not have to deal at all with the latter protocol. This protocol communicates between the wireless modem terminal and the Mobile Data base station. Figure 2(Motorola, 1995) depicts the locations of the above mentioned protocols.

**1.3 Applications Over Wireless Data Networks**

The combination of networking and mobility will engender new types of information systems. These systems can support collaborative environments, electronic bulletin boards whose contents adapt to the current viewers, lighting and heating that adjust to the needs of those present, Internet browsing, hotel and flight reservation, navigation software to guide users in unfamiliar places and tours, remote E-mail, and law-enforcement agencies, to name just a few applications.

. For example, bushfire control is different from flood control. For illustration, we take the example of bushfire control. Firstly, the wired network setup is almost impossible although the wired network can be set up in the command centre. The terminals needed would be the ones found in the field service applications, terminals installed in the fire fighting vehicles. Secondly, the data access is two way communication as both access and updates of the distributed databases are necessary. Thirdly, the system performance requirements are

strict: instant response and high volume of data per time unit as maps are accessed and updated frequently. Fourthly, the cost of using the network is not of priority. Fifthly, the transmission medium in this case has to be satellite(s) because other media do not cover less populated areas unless a backbone network is also wireless, eg, a wireless ATM. Sixthly, the network setup should be fast as time is critical. Finally, the GPS functionality is also required for this situation as the positions of all vehicles are reported to the commander centre, which can be used to reflect the global picture of the burning forests.
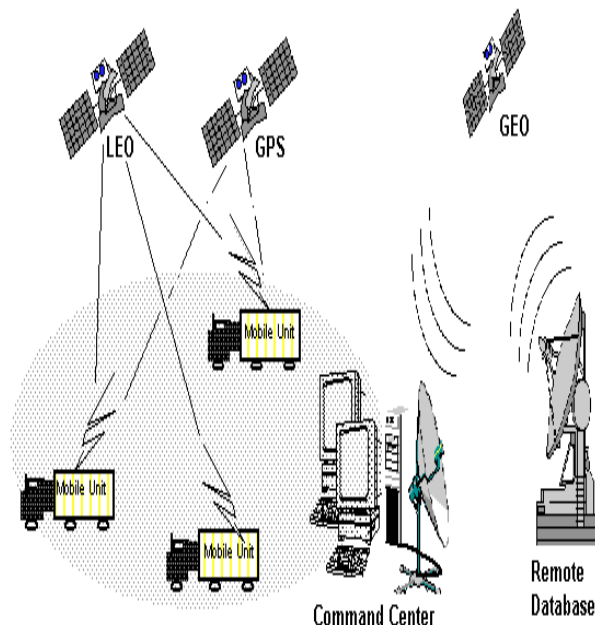


**Fig.3. Internetworking for Bushfire Control Application**

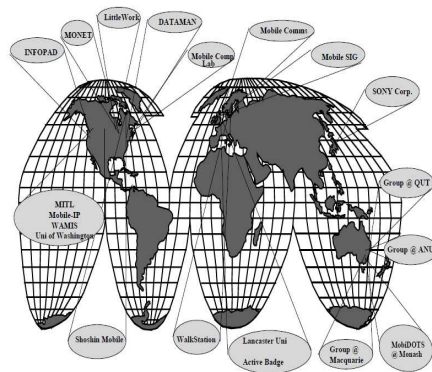## 2. Current Status of Mobile Computing Research

Mobile computing is a rapidly emerging research and development area. Examples of applications which are in a great need of mobile access to computing resources include agriculture, bushfire control, mass disasters, wildlife monitoring, non-stop business activity and many others. There has been a considerable research effort going on around

the world with respect to mobility. A number of research groups have been set up all around the world to deal with the various aspects of mobility. Table 1 gives a condensed summary of research groups world-wide, which are looking into various aspects of mobile computing. Figure 4 depicts the geographical distribution of research efforts in mobile computing world-wid

**Table 1. Summary of Ongoing Research Projects in Mobile Computing**

| GROUP NAME | WHO | WHERE | WHAT |
|---|---|---|---|
| DATAMAN (http://paul.rutgers.edu/~acharya/dataman.html ) | T. Imielinski, B.R. Badrinath | Rutgers Uni, NJ, U.S.A. | Mobile Computing Issues with respect to data management Distributed algorithms and services Data Broadcasting Indirect Protocols Data Replication Issues |
| INFOPAD (http://infopad.eecs.berkeley.edu/ ) | EECS Dept. | Uni of California, Berkeley,USA | Developing a platform and prototype for providing wireless access to multimedia data. |
| LITTLE WORK (http://www.citi.umich.edu/mobile.html ) | CITI( Centre for Information Technology Integration ) | Uni of Michigan, Ann Arbor, USA. | Investigating O.S. requirements for mobile computers. |
| Mobile Communications Research Group (http://www.ee.surrey.ac.uk/EE/CSER/csertext.html ) | EE Dept CSER (centre for satellite engineering ) | University of Surrey U.K. | Satellite and personal communications system, Universal mobile telecom systems (UMTS ) |
| Mobile Computing Lab (http://www.cs.columbia.edu/mil ) | Dan Duchamp | Columbia University, U.S.A. | All aspects of mobile computing |
| Mobile SIG (http://www.cl.cam.ac.uk/Research/SRG/msig.html ) | University of Cambridge, Computer Laboratory | Cambridge University, UK. | From Media access layer to O.S. support for mobile computing, Distributed file systems |
| MONET ( Mobile Internet ) ( http://fury.nosc.mil/) | Military | Navy, U.S.A. | Networks, Demonstrate the technologies required to develop a department of defence network that is interoperable with the future public-carrier. |
| Wireless/ Mobile Networks , Mobile IP ( http://netlab.itd.nrl.navy.mil/wireless.html ) | Navy | Naval Research Lab , Washington D.C., USA | Networks, Distributed computing, Super Computing, Optical Computing. |
| Pathfinder, BBN ( http://malachite.bbn.com/Departments/DistributedSystems/mobile.html ) | Bolt Beranek and Newman INC | U.S.A. | Communication Systems |
| Walkstation II Project (http://www.it.kth.se/Tslab/ws/ws.html ) | KTH, Teleinformatik | Stockholm, Sweden | Mobile Multimedia communication via a global system approach. |
| WAMIS (http://esto.sysplan.com/ESTO/WAMIS/ ) | Wireless Adaptive and Mobile Information System | U.S.A. | Information Technology support to mobile systems. Achieving revolutionary improvements in mobile communicaions technology. |
| Mobile Computing at the Uni of Washington (http://www.cs.washington.edu/reserach/mobicomp/mobile.html ) | CSE dept | U.S.A | Mobisaic - An information system for a mobile and wireless computing environment (http://www.cs.washington.edu/homes/voelken/mobisaic/mobisaic.html ) Wit - A system infrastructure for mobile handheld computing (http://snapple.cs.washington.edu:600/wit/wit.html ) |
| MITL (ftp://mitl.research.panasonic.com/pub/tr ) | Matsushita Information technology lab | U.S.A. | Mobile issues |
| SONY CSL (http://www.csl.sony.co.jp ) | Sony Corp | Japan, Tokyo | Protocols |
| Lancaster Univ (ftp://ftp.comp.lancs.ac.uk/pub/mpg/README ) | Distributed Multimedia Research Group | U.K. | Multimedia Research Group |
| Active Badge ( http://www.cam-orl.co.uk/ab.html ) | Olivetti | U.K. | Locating Persons |

**Fig.4. Geographical distribution of research in mobile computing**

Mobile computing is enjoying rapidly growing interest and popularity. This is indicated by the fact that almost any international conference in the areas of networking, distributed systems and databases includes now at least one session to discuss mobility issues and impacts.

## III. CONCLUSIONS

This paper provides an overview of concepts, achievements, research issues and challenges in mobile computing. Mobile computing, as it stands today, offers many exciting opportunities. However, the challenges that the research community faces are quite significant. These challenges include mobility aspects, power, frequent connections/disconnections, bandwidth limitations, cost factors, resource scheduling and management, advanced concurrency, replication and synchronization algorithms. Stronger support and attention from Australian government, academia and business would also be helpful in addressing these challenges by Australian universities and IT industry.

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