CS6504

Mobile Computing

Dr. Ayman Abdel-Hamid

Computer Science Department

Virginia Tech

Challenges of Mobile Computing

Outline

Discuss the following paper

FZ94   G. Forman and J. Zahorjan, " The Challenges of Mobile Computing," IEEE Computer, vol. 27, no. 44, pp. 38-47, April 1994.

FZ94 Challenges of Mobile Computing

Presents software design pressures particular to mobile computing, which arise from the following requirements

- •Use of wireless networking
- •Ability to change locations
- •Need for portability

FZ94 Challenges of Mobile Computing

Wireless connections implications

- •Lower quality than wired
- •Lower bandwidth
- •Greater variation in available bandwidth
- •Higher error rates
- •More frequent disconnections

FZ94 Challenges of Mobile Computing

Wireless connections - Disconnection operation

•Run locally on mobile unit (operate as stand alone computer)

•Operate asynchronously (pre-fetching and lazy write-back)

•Coda file system

➢Keep best selection of files in an on-board cache

➢Cache whole files (not blocks of files?)

➢When reconnect, cache is merged with master repository

➢Allow files to be modified while in disconnection (less than 1% of all writes are followed by a write by a different user)

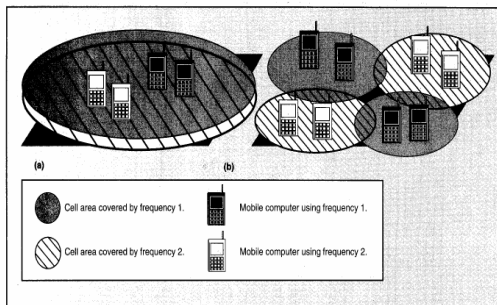## FZ94 Challenges of Mobile Computing

Wireless connections – low bandwidth

•Network bandwidth divided among users sharing a cell

Measure bandwidth per cubic meter, instead of bandwidth delivered per user (*Why*? depends on size and distribution of a user population)

•Solution: Install more wireless cells

➢Overlap cells on different wavelengths

➢Reduce transmission ranges so more cells fit in a given area (*reduce cell size* – hardware tradeoff between bandwidth and coverage area)

➢Use compression and/or buffering (group into larger requests)

➢Use of pre-fetching and lazy write-back

FZ94 Challenges of Mobile Computing

(a)   (b)

Cell area covered by frequency 1.   Mobile computer using frequency 1.

Cell area covered by frequency 2.   Mobile computer using frequency 2.

More Wireless Cells

FZ94 Challenges of Mobile Computing

Wireless connections – High bandwidth variability

•Operate only while plugged in (assume high bandwidth)

•Do not take advantage of higher bandwidth when available (assume low bandwidth)

•Adapt to current available resources

Wireless connections – Heterogeneous networks

•Switching from a wireless LAN within building to cellular network on the road

•Switching from cellular networks in a city to a satellite coverage in the country

2

FZ94 Challenges of Mobile Computing

Wireless connections – Security risks

•Wireless communication much easier to compromise than wired counterpart

  http://www.wififreenet.com/

  The previous URL offers a directory of 802.11 free hotspots!!

  http://www.vnunet.com/News/1142920

  Hackers own all Wi-Fi hotspot data !!

•Use of encryption (software or hardware), depends on the knowledge of a secret encryption key by involved parties

FZ94 Challenges of Mobile Computing

Effect of Mobility

•Network address of a mobile computer changes dynamically

•Current location affects configuration parameters as well as answers to user queries

•Communication path between a mobile computer and a server can increase

FZ94 Challenges of Mobile Computing

Effect of Mobility – Address Migration

•Selective broadcast

  an out-of date cell address may suffice if adjacent cells are known

•Central services

  current address of MH maintained in a logically centralized database. The MH has the responsibility of updating its address

•Home Bases

  special case of distributing the central services

•Forwarding pointers

  a copy of new address is deposited at old location

FZ94 Challenges of Mobile Computing

Effect of Mobility – Location dependent Information

•Factor out information and provide mechanisms to obtain configuration data appropriate to present location (local name server, available printers, time zone)

•Need access to location sensitive information

  •"Where is the nearest taxi?/ nearest ATM?"

  •"Where is the nearest open gas station heading north on Hwy 69?"

Effect of Mobility – Migrating locality

  •Network distance versus physical distance

  •Might be necessary to transfer connections to servers that are closer (load-balancing issues)

FZ94 Challenges of Mobile Computing

Portability (design pressures)

•Low power

•Heightened risk of data loss

• small user-interfaces

•Limited on-board storage

Handhelds from Palm One

Casio Handhelds

Toshiba portables

FZ94 Challenges of Mobile Computing

Portability – low power

•Power management software (power consumption profiles)

Portability – risk of data loss

•External copies

•replicated file systems

Portability – small user interface

•Handwritten recognition

•Voice recognition

•Pointing devices

FZ94 Challenges of Mobile Computing

Portability – small storage capacity

•Hard drives are a liability, since they consume more power

•Solutions

➢Compressing file systems

➢Accessing remote storage over the network (contradictory to network unavailability due to disconnection)