MOBIBLE COMPUTING

Three themes of the current investigative efforts on mobility
(according to Ghezzi and Roman):

1. the delivery of connectivity to mobile nodes,
2. languages that provide facilities for code migration, and
3. computational models that include the notion of locality.

Research efforts in the first category have their roots in the networking
tradition and are concerned with
- communication protocols,
- application support software,
- the unique characteristics of the wireless communication medium,
- security,
- location aware applications,
- algorithms for implementing basic system services.

Language-based research is preoccupied with
- the kinds of constructs,
- abstractions and software architectures
that facilitate the movement of code mostly across existing wired networks.

New models of concurrency and proof logics are emerging in an attempt
to better understand the fundamental differences between distributed
computing across a fixed graph structure and new paradigms in which
components have a location attribute and may travel across a logical
or physical space.

The Challenges of Mobile Computing
George H. Forman and John Zahorjan

Mobile computing -- use of a portable computer capable of wireless
networkking.

Advance in technology to support portable computers with wireless
communication.

Three essential properties of mobile computing
- communication
- mobility
- portability

I. Wireless communication
- mobile computers need wireless network access

Facts
- wireless networks communicate by modulating radio waves or pulsing infrared
light
- linked to the wired network infrastructure by stationary tranceivers
- Cell: an area covered by an individual transceiver’s signal
  + infared transceiver (a few meters)
  + cellular telephone receiver (a few miles)
  + satellite beam (more than 400 miles in diameter)

Characterization of wireless communication

- high interference by the surrounding environment such as blocking signal paths, introducing noises and echoes

--> lower bandwithds, higher error rates, more spurious disconnections

--> increase communication latency from retransmissions, retransmission time-out delays, error-control protocol processing, short disconnection

Design challenges
- disconnection
- low bandwidth
- high bandwidth variability
- heterogeneous network
- security risks

Disconnection
- network failures
- operate as a stand-along computer (with frequent disconnections)
- in some cases, both round-trip latency and short disconnections can be hidden by asynchronous ipc.
- ...

Low Bandwidth
- 1 Mbps for infared communication, 2 Mbps for radio communication, 9-14 Kbps for cellular telephony (compared to 10 Mbps for Ethernet, 100 Mbps for fast Ethernet and FDDI, 155 Mbps for ATM)
- Network bandwidth is divided among all the users sharing a cell, so the effective bandwidth per user is smaller.
- Two ways to improve network capacity: 1) Overlap cells on different wavelenghts or 2) reduce transmission ranges so that more cells fit in a given area (Fig 2)
- 2) is more scalable.
- software techniques such as delayed write-back
- scheduling the use of bandwidth

High Bandwidth Variability
- bandwidth can vary one to four orders of magnitude whether it is connected by wired or wireless
- should adapt to variability

Heterogeneous Network
- As mobile computers leave the range of one network transceiver and switch to another, they may need to change transmission speed and protocol.
- Mobile computers may need to switch interface; e.g., when moved from indoor to outdoor

Security Risks
- Easy to eavesdrop
- Security complicated if users are allowed to cross security domains.
- Encryption and authentication

II. Mobility
- ability to change locations while connected to the network

Address migration
- in the Internet IP, a host IP name is bound with its network address (moving to a new location means acquiring a new IP name)
- Four basic ways to determine a mobile computer’s currrent address: broadcast, central services, home base, forwarding pointers
- mobile IP

Location-dependent information

Migrating locality

III. Portability

Low power
- Batteries are the largest source of weight
- Power consumption is proportional to CV^2F
where C is the capacitance of the circuit, V is the volage swing,
and F is the clock frequency.

Risks to data
- more you carry, more you can loose
- portable terminal (vs. computer) is less prone ot data loss

Small user interface
- bottons versus analog input: no keyboad
- pointing devices: mouse vs penn

Small storage capacity
- PDA products have no disks due to physical size and power requirements.
- To reduce the size of code, use interpretative script language

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Fundamental Challenges in Mobile Computing
M. Satyanarayanan

Four Characteristic Contraints due to Mobility
1) Mobile elements are resource-poor relative to static elements.
2) Mobility is inherently harzardous.
3) Mobile connectivity is highly vaiable in performance and reliability.
4) Mobile elements rely on a finite energy source.
Concern for power consumption must span many levels of hardware and software
to be effective.

The Need for Adaptation
- tradeoff (tension) between autonomy and interdependence
- reliance to static server vs self-reliance
- need to be adaptive

Texanomy of Adaptation Strategies

The Extended Client-Server Model

Summary of Coda and Odyssey Results
- disconnected operation
- optimistic application
- support for weak connectivity
- isolation-only transactions
- server replication

Fetile Topics for Exploration
1. Caching metrics
2. Semantics of callbacks and validators
3. Algorithms for resource revocation
4. Analysis of adaptation
5. Global estimation from local observations