Wireless Graffiti: data, data everywhere

Tomasz Imielinski, Badri Nath
Dept of Computer Science
Rutgers University
Phones then and now

600 grams  200 grams
Wireless Infrastructure

- PSTN
- Internet
- MSC
- IWF
- BS
- BS
- BS
Issues in Wireless data management

- Location management
  - Massive number of users. 0.5 billion cell-phone users, Average 5 to 10 million subscribers per carrier, 40 to 100 base stations
    - Tracking mobile users
      - Search vs update tradeoff
  - Energy management
    - Typical power consumption (0.25 to 0.3 watts for Tx) and (0.08 to 0.01 watts for Rx/standby mode) – Talk time 1.5 to 5 hours, 80 to 150 hours standby time (A factor of 1:30)
      - Indexing to help devices switch off (standby)
      - Controlling doze mode
  - Bandwidth management
    - (9.2 Kbps [2G] to 54 Kbps [GPRS] to 1 Mbps [3G] -- Fixed 10 to 100 Mbps already available)
      - Broadcasting data
      - “Tune” to data without uplink requests
Location management using areas/zones

- Track only at a zone/area granularity instead of a cell
  - Zones are determined adaptively on a per user basis (msg/mobility ratio)
- Use other techniques to locate within a zone
  - Page, follow pointers, or an ordered search (most likely location first)
Location-dependent querying

- Querying with location uncertainty
  - Give me doctors who are within 1 mile of the accident site
- Search only if needed (constraints may eliminate zones)
- Acquire data during query processing
- Location constraints used to minimize cost
Now, bragging time!

- Data on Air: Wireless Data Streaming
- Energy efficient querying and dissemination
- Client-proxy-server architecture
- Disconnection
- Geocast
- CACM 94, SIGMOD 94, EDBT 94…
- Mobidata workshop Mobicom, mobile databases, Mobide
Now...

What’s new now?

Miniaturization: Sensors, low power radios, MEMS technology

Location awareness

- Finer granularity possible
- Outdoor: GPS (within 20 meters accuracy, with correction from DGPS, 5 meters accuracy possible)
- Indoor: triangulation using radio signal, acoustic, visual cues (a few feet but error management needed)

Broadband

- Bandwidth has improved (9 Kbps to 20 Kbps in wide area, 1 to 10 Mbps in local area)
- Free spectrum usage (802.11, bluetooth, UWB etc, offers 1 to 100 Mbps)
Blackboxes in every object

- Blackbox records diagnostic data, performance data, history of the object
  - Planes .... Already there
  - Vehicles
  - Bridges and intersections
  - Cameras
  - Computers
  - Physical spaces (pollution, noise level, bandwidth availability, signal conditions)
  - Humans
What are the new applications?

- Grassroots consumer reports
- Intelligent Transportation: estimated travel time from A to B, road conditions, accidents
- Space Capsules: correlate say medical data with location; how does the blood pressure of a patient change with location. Pollution history at specific location.
- Location History Channel with replay
Querying/monitoring blackboxes

- Provide average travel time for canal road within the last 10 minutes
- Find average longevity of a battery in Lattitude X200 laptops
- Available Bits/s on Wi-Fi along Spring Street in Soho
- Notify me when the traffic jam near my house clears
Scenario:

- Data is with producers
- Many consumers
- Query and subscribe mechanisms
- Mobility: Location of consumers and producers is changing
- Databases as opposed to data spaces

Peer to peer interaction
Why dataspaces?

- Scalability
- Information decentralization (minimal infrastructure)
- Trust
What happens in dataspaces

- Access to every object is over the network
- Access methods have to use network primitives
- Access plan and its cost may vary from object to object
- Failure / disconnection is the norm rather than exception
- Retry, reschedule primitive
Challenges of Dataspaces

- Yellow pages or road signs? Database or Network as Query Engine?
- Network indexes – multicast and group communication primitives used in query evaluation
- Location Management for micro to macro scale
Conclusions

- **DataSpace – new challenge**
  - It is geographic web – this time we can do it “right”
  - Merger of (spatial) databases and networking - who does what? Querying, caching, recovery and disconnection, quality of service
  - Databases “on the road”? 