



*Performance from Experience*

# **Gazillions of Gizmos: What are the (location) challenges?**

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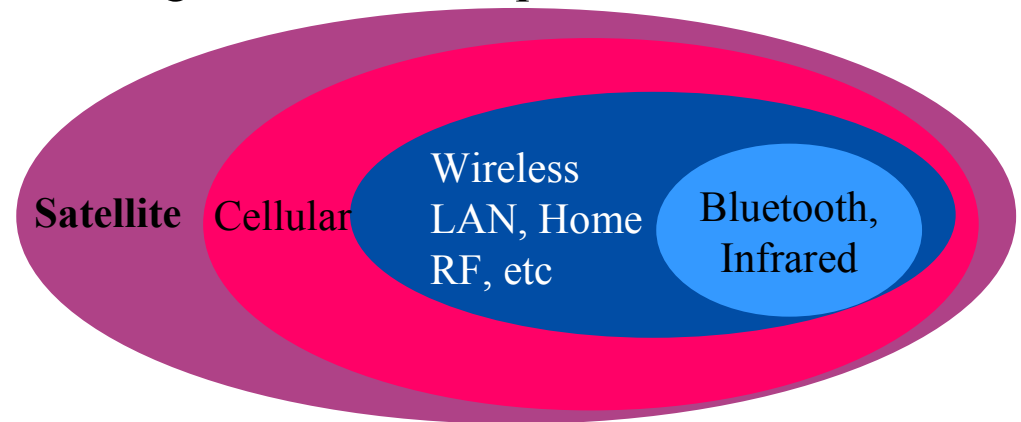
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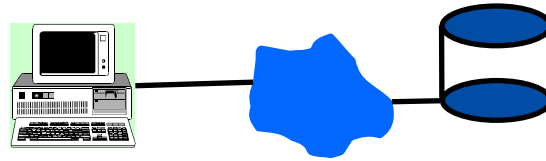
# 1 billion gizmos by 200x (Choose x = 3, 4, 5, ...)

- Gizmos and technology originally developed for one purpose will be used in new and innovative ways for other purposes
  - e.g. Bluetooth was primarily designed as a cable replacement but will be used as a location technology and an ad-hoc networking technology
- Two parallel, contradictory (or complementary) gizmo trends leading to different location needs and capabilities
  - **Integration**: cell phone as pager, organizer, e-wallet, radio, media player ...
  - **Specialization**: different functionality, form factors, power requirements, connectivity, processing and storage, fashion niches
- *Project MultiLoc*: Location management in a comprehensive multi-tier wireless network with seamless gizmo connectivity

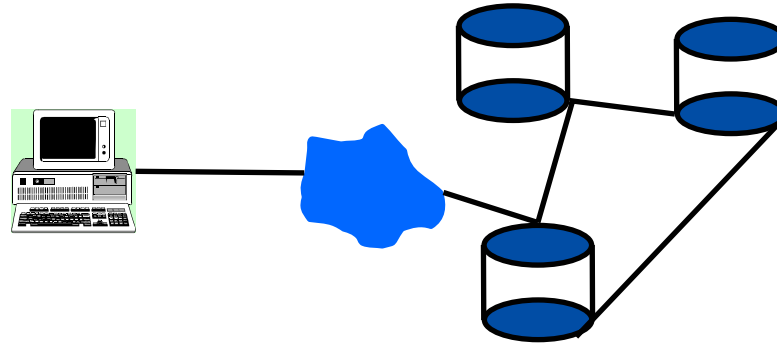


# Database network architectures

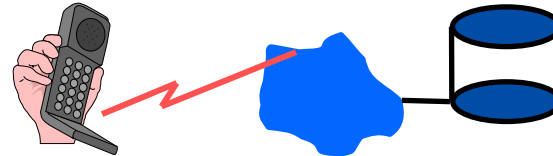
- Centralized



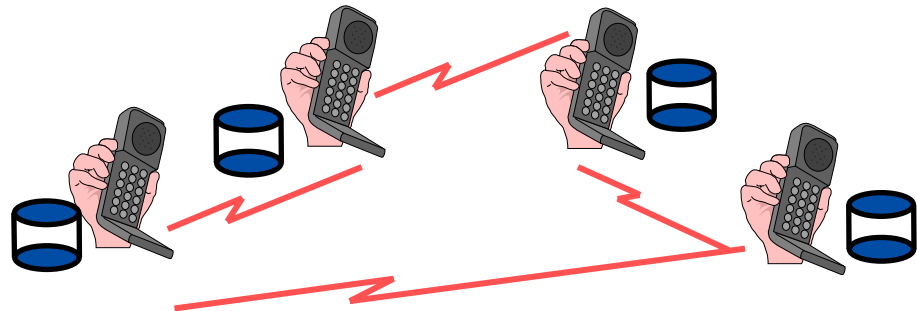
- Distributed



- Mobile wireless database access
  - Database access using a gizmo



- Ad-hoc database networks
  - Database on the gizmo



# Location management: It's not just for gizmos anymore!

- Mobile software will become an increasingly important aspect of next generation networks and applications
  - Mobile agents, active networks, mobile code, programmable networks, etc.
- Mobile software to serve a (mobile) user
  - A user agent for personalized information retrieval, shopping, etc
  - Makes particular sense for information access over a wireless link
  - *Jain and Anjum, IEEE WCNC, 2000*
- Mobile software to serve the network provider
  - Mobile software in the network to decrease the cost of personalized information delivery to (mobile) users
  - *Shah, Jain, Rajagopalan, Anjum, 2001*
- Managing the itineraries and location of mobile software modules will be a major challenge
  - Security, cost, and efficiency implications

# Database needs: gizmos as blessing (and curse ...)

- Where is my gizmo?
  - Databases for managing the location and mobility of distributed communicating devices
- Where is the user (or object) who has my (or this) gizmo?
  - Databases for using devices and connectivity to identify, authenticate, and locate users -- as well as other devices
- What can my gizmo do for me today?
  - Databases for dynamic service discovery, download, and activation
- Why can't my one gizmo do everything?
  - Integrating database facilities with other horizontal & vertical applications
- Why can't I have a special gizmo to do this one thing I need?
  - Application-specific *micro-databases* and database micro-clients
- Why can't my gizmo and your gizmo figure things out together?
  - Database transactions across ad-hoc networks

# Gizmo risks

- The gizmo divide
  - gizmo haves and have-nots
- Security and privacy
  - especially for micro-databases and mobile databases
  - especially for location and transaction information
- Environment
  - Compare: ~800 million black phones in the world today
  - The half-life of a gizmo will continue to drop
  - Profile databases and location-aware databases of software radio modules
- Serenity and tranquility
- Health and safety

OK, the database folks can't solve everything, but still ...

# Backup slides

# Gazillions of gizmos: Database challenges

- Scaling up
  - Gazillions of gizmos, transactions, etc., in real time, across very large distances
- Scaling down
  - Micro-databases and special optimized databases
    - Micro-databases  $\neq$  Embedded databases
    - Zero administration but also dynamic, incremental functionality update
    - Essential to utilize scarce resources efficiently and use across multiple applications
- Query and Update Optimization
  - to conserve wireless bandwidth and power
  - taking into account special network topologies and technologies
    - asymmetry
    - line-of-sight restrictions
    - availability of cheap broadcast facilities