Outline

1. **The Anatomy of a Context-Aware Application –** Andy Harter, Andy Hopper, Pete Steggles, Andy Ward and Paul Webster. AT&T Labs, Cambridge, UK (cont)

Bat Unit

- Radio transceiver, ultrasonic transducer and control logic
- Each bat has a GUID
- Use the radio, ultrasonic transducer and the speed of sound in air (estimated from ambient temperature) to estimate location
- Use multiple receivers to get 3D location using multilateration
- Reflections of ultrasonic waves – statistical outlier elimination

Bat Unit (cont.)

- It takes 20 ms between bat readings = 50 timeslots per base station per second
- Location can be used to measure orientation
  - Attach many bats to the same object. Use the measurements to infer the orientation
- Base station can provide Location Quality-of-service to allocate time slots to bats based on the expected update frequency
  - Bats carried by people – few times a second
  - Bats attached to workstation – once every few minutes

Bat Unit (cont.)

- Bats perform handover when moving from one base station to another (similar to the cellular networks)
- Hand off decisions can also be made based on the Bat location

- Battery consumption is low, power consumed depends on the update frequency and power state

- Bat is good enough to be used as a 3D mouse

Modeling the environment

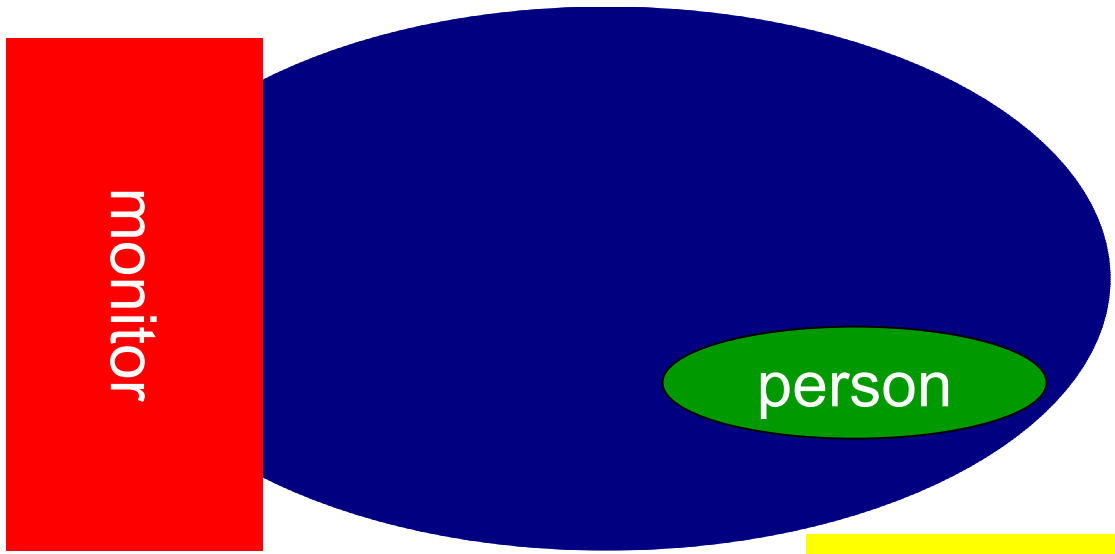
- Detailed model describing entities in the real world and their possible interactions
- Use CORBA and databases to implement persistent distributed objects
- Three classes of resource monitors:
  - Machine activity e.g. keyboard activity
  - Machine resource e.g. CPU usage, memory usage
  - Network point-to-point bandwidth and latency

Client level event filters

- Update Frequency
  - The frequency at which items are monitored is based on how quickly the item tends to change
- Relevancy
  - If a value has not changed significantly, it is not sent. This value depends on the data being monitored
- Caching
  - Caching improves performance at the cost of consistency

API

- Absolute and relative spatial facts
  - "Person is at (x,y,z) facing in direction δ" .vs. "Person is standing in front of the monitor"
  - Geometric containment is used for relative spatial facts



Contained(person, screenspace)

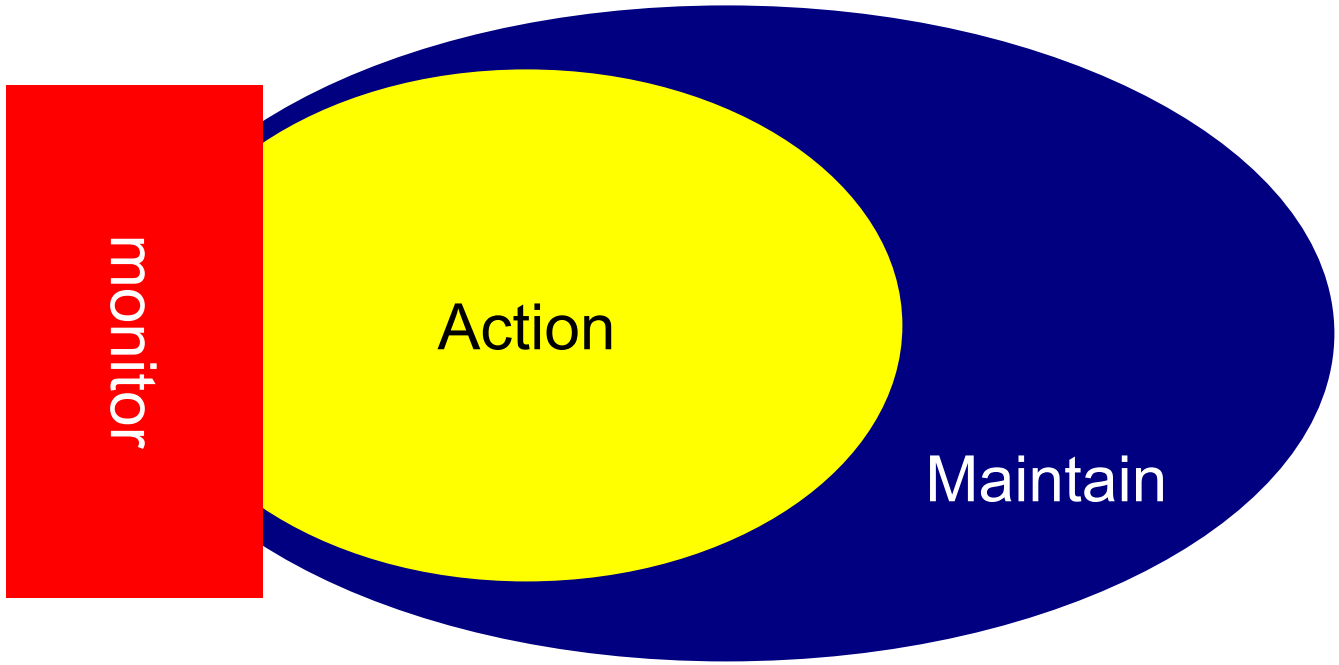
Scalability

- With many devices, containment is complex
- They use containment tree indexing system (a quad-tree based approach)

Implementation

- BAT teleportation system
  - With their earlier active badge based teleportation system, they only knew that a user was in the room and so they had to cycle between multiple displays in a room
  - If a particular display was being use, they would still cycle that display because they did not monitor machines
  - If a machine is dead, their system would still wait because they did not monitor machines
  - With the BAT system, they have more accurate location information
  - Event driven programming style

Zones and Buttons



- Action zone triggers teleportation
- Within maintain zone, teleported desktops are maintained