RollCall™: 
Active RFID for Continuous Asset Tracking

WINLAB

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Despite Wal-Mart's Edict, Radio Tags Will Take Time

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A year and a half ago, Wal-Mart served notice that it expected its top 100 suppliers to be shipping goods to it with new radio tagging technology by Jan. 1, 2005.

While it may still be true, as the saying goes, that the best way to predict the future is to create it, Wal-Mart's experience so far has served as a reminder that creating the future is not all that easy.

With Jan. 1 just days away, the technology is not yet ready to meet the needs of either Wal-Mart or its suppliers. The tags, which are typically about the size of a credit card and contain an antenna and microchip encased in plastic, receive query signals from scanning devices called readers. Using the energy captured from those signals, they broadcast a snippet of code identifying the goods to which they are attached.
Limitations with Existing RFID

Passive RFID Tags
+ Potentially Inexpensive
+ Long Lifetime
- Poor Range
- Unreliable
- Complex Protocol
- High Power Basestation

Active RFID Tags
+ Good Range
+ Reliable Link
+ Low Radiation Emission
- More Expensive
- Short Lifetime
- Larger

I’m still here!

Anyone there?

Passive Tag Reader

Active Tag Receiver

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What’s Hard About RFID?

- Interference
  - Radio is easy only where there are no users.

- Propagation
  - Attenuation $\sim 1/r^3$ (or worse) EACH WAY
    - Passive RFID $1/r^6$ or worse
  - Shadowing and multipath degrade link

- Energy
  - Short transmissions are energy efficient
  - Listening is VERY expensive in energy
  - Batteries are going nowhere (*unless they go nuclear.*)
Micro Radio Tag (MRT™)

- USB Basestation (Front Side)
- Tag (Back Side)
Healthcare Workflow for an Emergency Department

- **Goal:** Improve patient throughput
  - Less waiting time for patients
  - Increased revenue for the ED
    - Go from 120 patients/day \(\rightarrow\) 150/day

- **Approach:**
  - Automatically deduce clinical events from spatial-temporal primitives of patients, staff, equipment
    - Assume everything has a wireless device
  - Translate clinical events into workflow actions that improve throughput
Workflow improvement:

- Treatment is a pipelined process
- Bubbles in the pipeline cause delays
- Dynamically reorganize activity to keep a smooth pipeline:
  - Pull nursing staff from treatment to triage during surge
  - Move physicians between units
  - Have staff push on process delays taking too long
    - Lab, radiology, transport
  - Introduce accountability to change behavior
Roll-Call

- Goal: High density, low cost active RFID tags + readers

- 1,500 tags/reader possible with 1 second beacon rate (simulated)
  - 100 + actual, (not enough tags!)
Example events

1. Trauma care
2. Pediatrics
3. Minor care
4. Waiting
5. Triage
6. Radiology
7. Behavior
8. Exam rooms
9. Staff/Admin
Integration with Workflow

- Build events into existing workflow system (YAWL)
- Assign new tasks
  - Change areas/roles (treatment->triage)
  - Call/inquire about length of time:
    - Labs, radiology, transport
- Reorder tasks
  - Prioritize patients waiting the longest
- Re-organize space?