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THE STATE UNIVERSITY
OF NEW JERSEY

Increasing the Re-Use of IT equipment through RFID and tracking

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IT Equipment Recycling and Reclamation

- Much IT equipment is not re-used/reclaimed
  - Laptops, servers, monitors, switches, NAS storage
  - Recycled for materials (e.g. gold, copper), not reclaimed

- Example equipment still usable
    - Old laptops
    - 10/100 switches
    - Tube Monitors
    - Desktops (for ages 1-3)
    - Specialized Servers (print)
    - Firewalls
    - Wireless APs

Example of non-reclamation

Incentivizing used IT equipment recovery

- Goal: Give the owner a $ incentive to put used equipment in a secondary market
  - Analogy: bottle deposits -> recycled plastics -> composite decks
- Approach: Make the reclamation cost < residual value
- Challenges:
  - Residual value is low
  - Hard to place on secondary market
  - Reclamation cost is high

Low Residual Value

- Moore's Law: processor speed doubles every 18 months
- Corollary: value of IT equipment haves every 18 months
  - Simple model: $2000 laptop -> $125 after 4 years.
  - Real data: This $2500 powerbook G4 , 2003, today is $400.
- Rule of thumb: halves every year
- Can't do much about this …

Secondary Markets for used IT equipment

- Current examples and limitations:
  - E-bay
    - Shipping, reputation, auctions
  - Rutgers surplus store
    - Pricing, inventory, payment
  - LCSR “junkyard”
    - Accessibility (only CS dept)

- Easy to use, secondary market for used IT equipment?
  - Not part of this talk
  - Examples:
    - Want 4 100-Mb/s switches, might pay $20
    - Want a large pizza, get rid of some old server

Reducing Reclamation costs

- Search costs higher than residual value
  - How long to find a piece of 5 year old equipment?
  - Takes several hours: not worth it.
  - Result: Buying new is much less time than finding the old!
- Track real-time position of all IT equipment
  - Instantaneous physical inventory
  - Remove search cost
- Many Mobile equipment scenarios
  - Laptops
  - Humans moving offices, leaving the organization

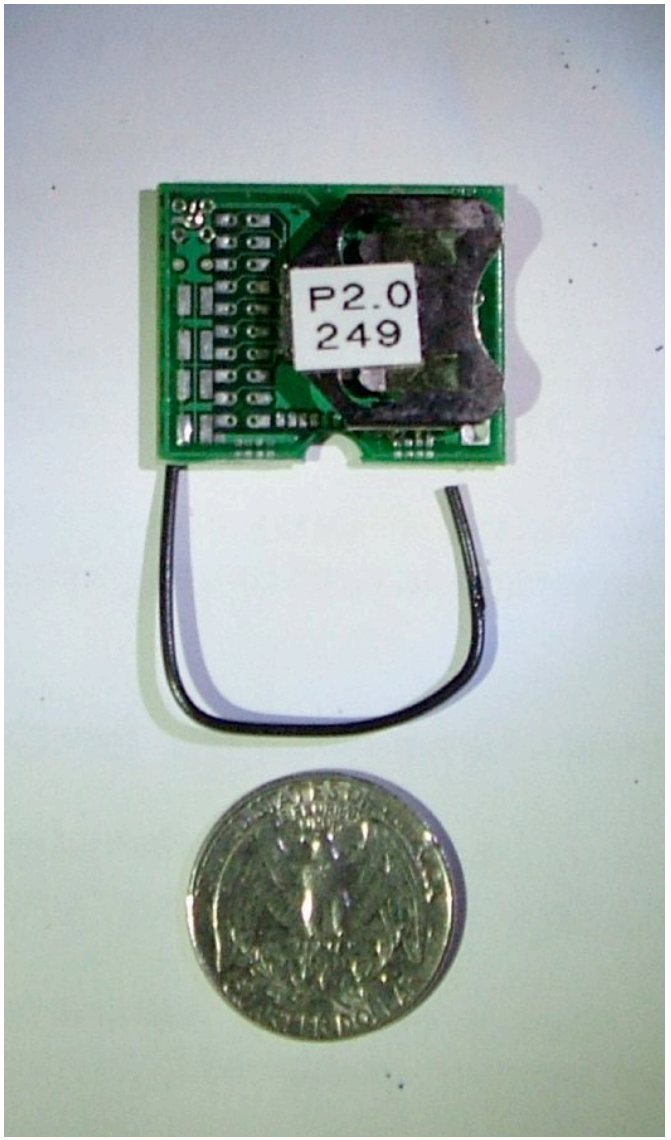
RFID + tracking to reduce location costs

- Low cost active RFID tags
  - Active beaconing
  - 6-year battery lifetime
  - < $10 @ small volumes, including the battery
- Room-level tracking
  - Can realize today
- Good enough for small IT equipment?
  - Hard drives, power supplies, cases.
  - $1-$2 tag?
  - Shelf-level accuracy?

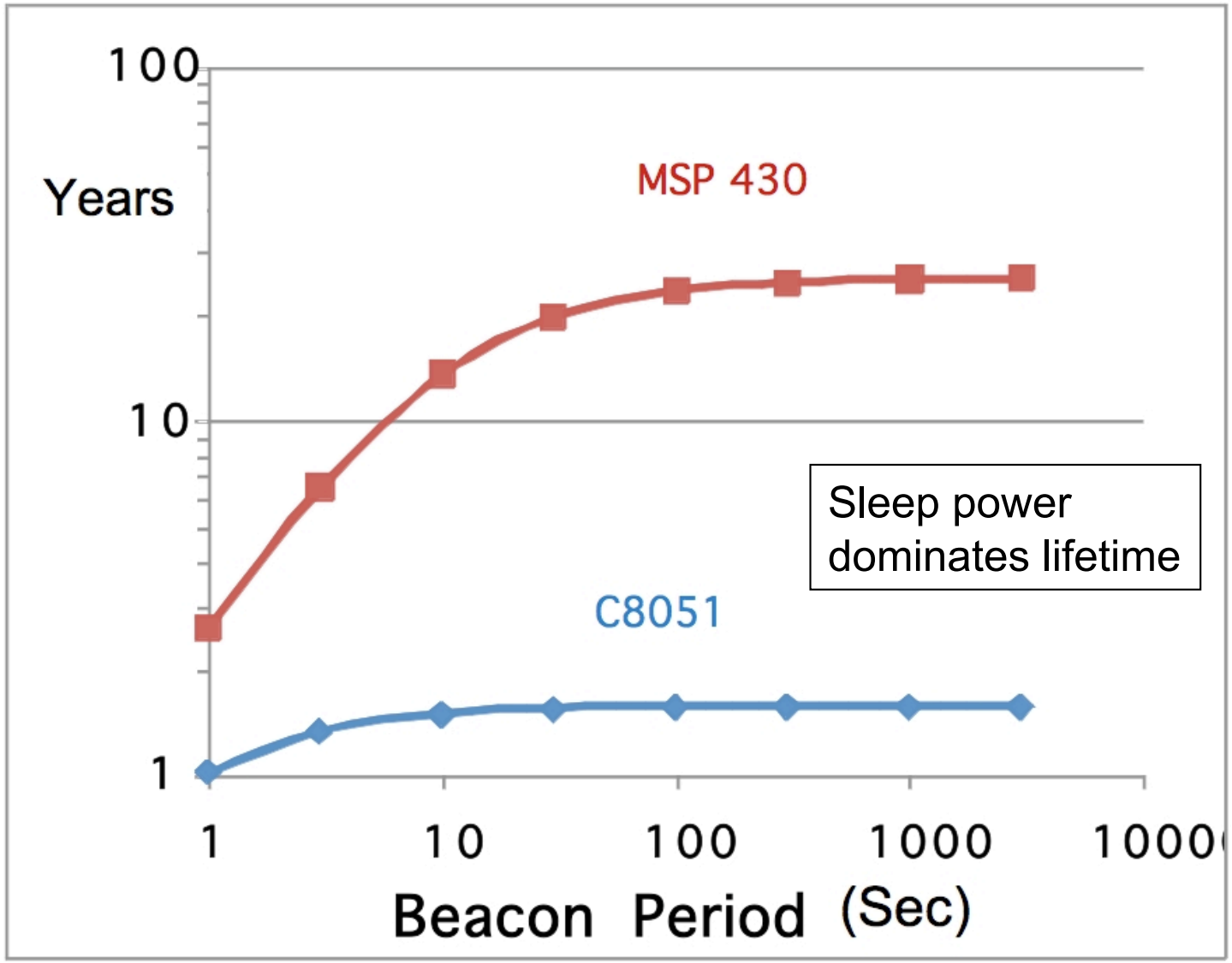
Current Work: Next Generation Pipsqueak tag

- Rich Howard @ WINLAB

- Change the CPU
  - Lower power
- Roll-call protocol
  - No receive, TX only
- Single X-tal
  - Better sleep management
  - 1 Hz cycle time
- Reduce size 2X
  - Size of battery clip

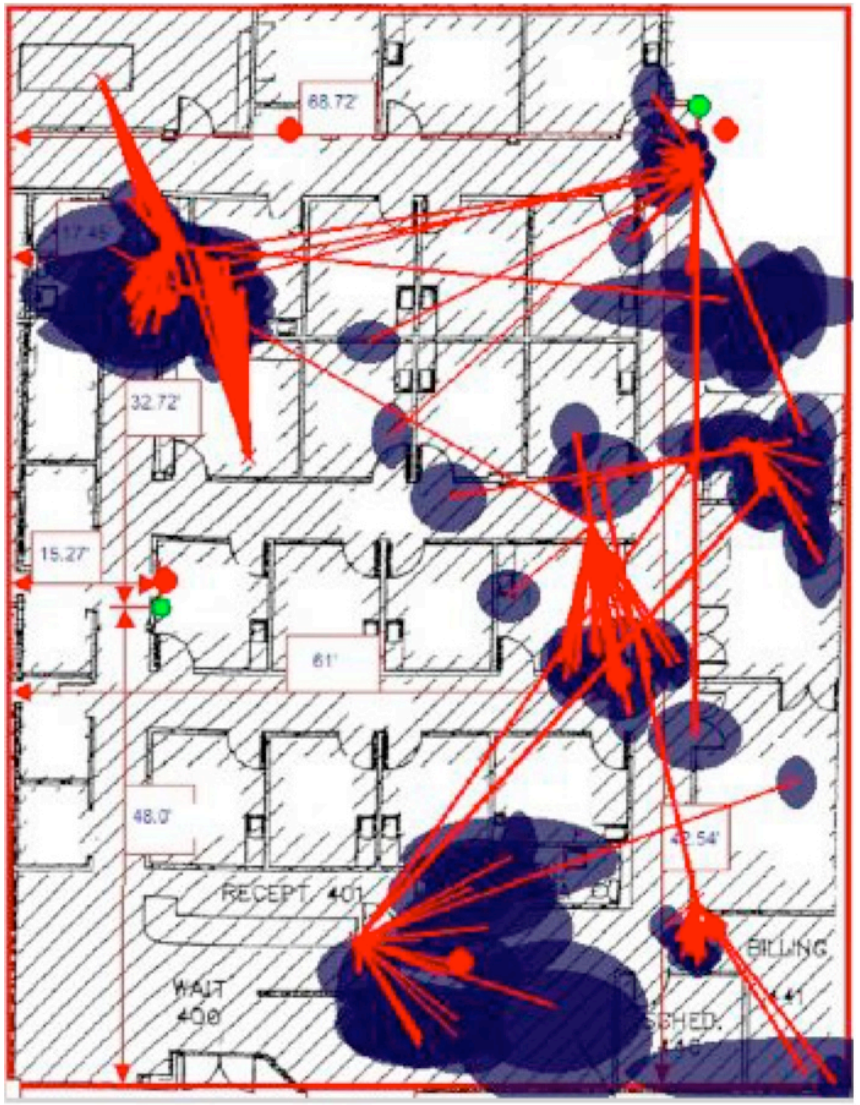


Expected lifetime model



Tracking Result

- Cancer Clinic @ Penn State
  - 80x100 ft
- Paper chart
  - Pipsqueak 2 tag
  - 1 second beacon interval
- Median accuracy 12 ft.
- Fixed costs of $2.50 sq/ft.



Conclusions and Future Work

- Improving Re-Use of IT equipment important part of Green Computing
  - Reducing the IT waste stream
- Efficient mechanisms to finding equipment
  - Can realize vision of instantaneous inventory snapshot in few years
- Actual residual values and reclamation potential of CS Dept.
- Matching current and future owners
  - Social, economic, market efficiency issues