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 halves every 18 months
  – 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

- MSP 430: Sleep power dominates lifetime.
- C8051: 

![Graph showing expected lifetime model with beacon period in seconds (Sec) on the x-axis and years on the y-axis. Two lines represent MSP 430 and C8051, with MSP 430 showing a significant increase in years with beacon period, while C8051 remains relatively flat.]
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