Electronics:
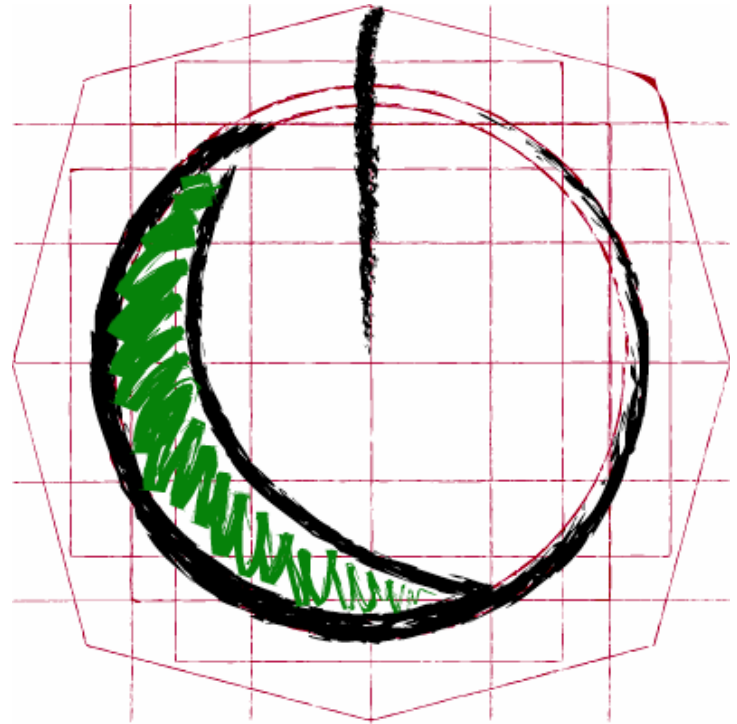## The New Major Electricity End Use

ACEEE NATIONAL SYMPOSIUM ON MARKET TRANSFORMATION
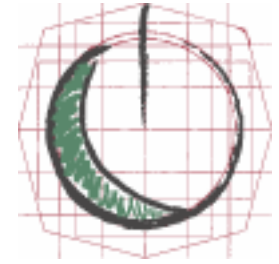*March 14, 2005*
Bruce Nordman
Lawrence Berkeley National Laboratory
BNordman@LBL.gov — 510-486-7089

Overview

- Terms

- Electronics are Different

- Networks

- Displays

- User Interfaces

- Predictions

- Needs for Energy Efficiency — Institutional Issues

Problems/ Opportunities In Blue
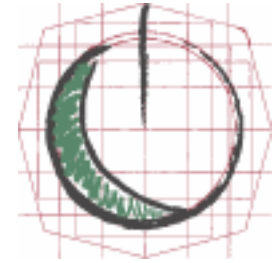
Examples/ Anecdotes in Red

Technologies are happening…What to do about them?

Power Management Controls

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Terms

Information Technology <==> Consumer Electronics

⇒ **Electronics** (or IT):

Devices whose primary function is Information (obtain, store, manage, present)
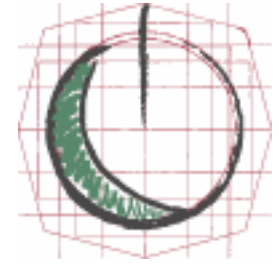
Cameras: IT or CE? Still vs. Video   Displays

- Electronics in non-electronic products
  - Controls (incl. remote), displays, network connections
- Product boundary: AC-powered only -- *or* also low-voltage distribution?   USB Fridge

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Power Management Controls

Electronics are Different (1)

- Less constrained by physics
  - Both maximum and minimum consumption
- Energy cost usually small fraction of purchase price
- Service-provider selection of products
  - Set-top boxes, Broadband modems/routers, Mobile phones
- Inherently global models / technologies
- Key role of Power Supplies / DC Power
- Number of discrete devices per home

Power Management Controls

Electronics are Different (2)
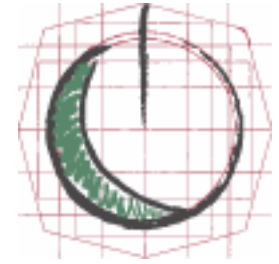
- Rate of Change: Technology, Models, Product Types, Combination, Division, …

- **Digital** Network Connections

- Capability and power consumption can change with software / updates; easier hardware changes

- Energy consumption often usage dominated
  - Easy for device activity to deliver no useful service
 - Configuration can be critical   => User Interface

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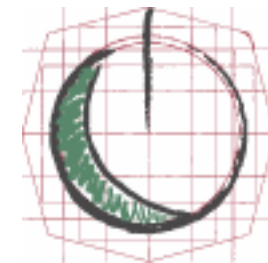
Networks (1)

- **Direct** Consumption of Network Interfaces, Network Products

  - Network Link Speeds / Modulations
    PC: 10 - 100 Mbps
    100 Mbps   +0.2 W
    1 Gbps   +2 W
    10 Gbps   **+20 W**

  - Distributed DC power over network links (w/ or w/o control)
    USB, USBPowerPlus, Ethernet

Product
Network Int.

Network Products

Power Management Controls
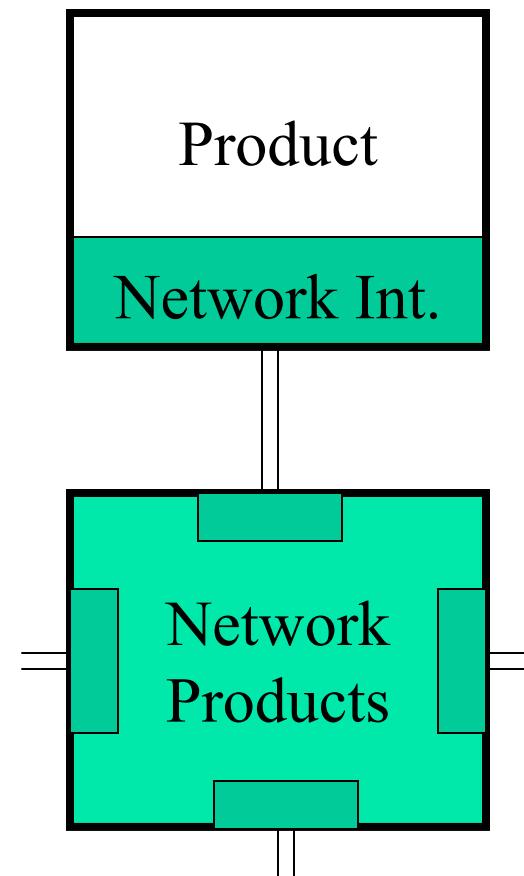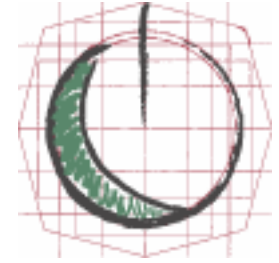
Networks (2)

- **Induced** Consumption
  - Lack of support for low power modes in network protocols: Network Insomnia, Network Chatter, Falling off Network
  - Feedback failures
- Today's Networks: PC-dominated. Tomorrow: mostly **not** PCs
- Security, Content Protection: Increase power and on-times
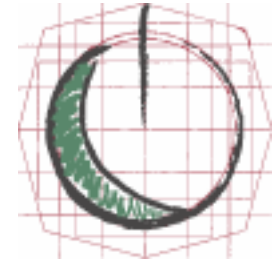 - Satellite set-top boxes; IEEE 1394/Firewire links

Principles
- Routine activity not keep machine awake
- Maintain network presence in sleep
- Clear state communication to user, other network devices

Example: 1 Desktop + 1 Notebook,
+ 1 Network Device => 100 W!

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Power Management Controls

Displays

- Displays: Images, Sounds, **?????**
- Flat Panels & Wireless => Remote

  Wireless speakers: No PM;   Some subwoofers have PM

- Larger, tiled, more, new applications   VOIP
  => Much more display area/person

  Future: 100s of W of connected displays/home

- Many emerging Display Technologies
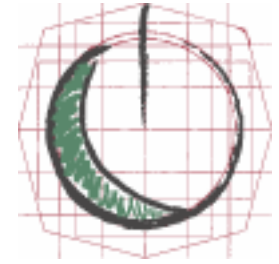- Intersection with Lighting (solid state)

User Interfaces

- Displays
  - Multiple sources
  - More input options
    - Speech, gestures, presence, touch, wired network (Ethernet), IR, WiFi, Bluetooth, RFID, switches, …

    => Need for User Interface Standards

- Demise of CE 2-state power model

  => Need for Remote Control standards (internal & external)

- IEEE 1621: "Power Control User Interface Standard" — terms, symbols, colors, dynamics
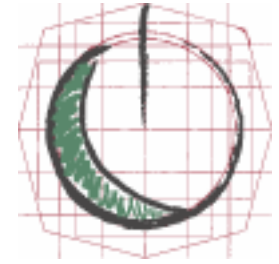
Predictions

- Displays
    - More quantity, area, usage
- Networks
    - Large increases in energy use and significant savings
- Key Problems
    - Legacy Products, Security, Content Protection
- Farther Out
    - Wireless Power Distribution
- Residential Electronics Consumption
    - Initially more energy use; longer term modest savings

Needs —
Research and Policy

$\Rightarrow$ Strategy: Anticipate problems before appear rather than fix after the fact => Anticipatory research

- Clear & Ambitious Agenda
  - Clear and strong focus of funding and responsibility
- Overall approach: Different from traditional end uses
  - Work with industry cooperatively and through standards organizations (heavy hand only when necessary)
- Institutional Needs
  - Federal responsibility — Active engagement with industry, esp. standards, protocols
  - MT agenda
- At this time, Action more important than Baseline

Questions/Comments