Emerging Display Technologies

- Slides initially presented in 2008 stakeholder meeting – today have 2011 annotations
- Some technologies have since entered the market

Key points
- Need to adapt test procedures, specifications
- Need new user interaction conventions
Future Networking of Displays

Proposition

• Many future changes to display functionality will be related to **networks** (and users)
• These changes may (will) increase and decrease display energy use
• Need **standards** to guide many of these developments
• **ENERGY STAR** could play a lagging or leading role
Future Networking of Displays

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- These changes may (will) increase and decrease display energy use
- Need standards to guide many of these developments
- ENERGY STAR could play a lagging or leading role

Some technologies have begun to enter the market

Standards development is lacking
Displays today

- Connected to a single source device
  - With a data, not network link
- Source only determinant of power state
  - (aside from power switch)
- No user input capability
- No environmental sensors

This simplifies
- Test procedures
- Specifications
- Product design
- Use
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- Product design
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Still true for most models, but not all
Future - Usage models

- Convergence of TVs and other display
  - Continuum from phones to monitors to large screen TVs ✔
- Content available from many sources
  - Multiple PCs and Set-top Boxes (of various sorts)
  - Webcams in homes or offices (or anywhere)
  - User interfaces for other devices
    - Appliances, utility meter, etc. ❌
    - User interfaces for building controls / elements
      - Lights, HVAC, security system, etc. ❌
  - Multiple sources (windows) per display
    - Multiple displays per display ❌
- Adding User Interface capability ✔
Multiple sources of information
– Network and data connections (not windows within one source)

• How does a display select data source(s)?
• When should it “listen” (or not) to a source?
• What are power requirements for sources in different states?
Future - Power State

Power State: On, Sleep, Off
(Sleep has network connectivity)

Many determinants of display power state
- Multiple data sources
- Context within a source
- Environmental sensors
  - Ambient light, ambient sound, …
- Occupancy sensors
- User interfaces
  - Touch, cameras, remotes, …

- How to test shifting between power states?
- How to measure power for particular states?
- What are the implications for usage patterns (TEC)?
Future - Inputs and Sensors

Possible User Interfaces
- Touch
- Remotes
- Keyboards / Mice
- Audio / Speech
- Cameras / Gestures

Possible Sensors
- Ambient light
- Ambient sound
- Occupancy (direct and inferred)
Future - Inputs and Sensors

• How does the user know what inputs / sensors exist?
  – Symbols
• What inputs / sensors are active during sleep?
  – Indicators
• What (display or other) does an input or sensor wake up?
• What (display or other) do sensors influence?
• What are power requirements for inputs / sensors?
  – How active could / should they be?
  – How to test?
Impacts on ENERGY STAR

Test Procedure
- Data / network context for testing
- Functions to enable / disable / exercise
- Key functions for particular power states
- What to report

Specifications
- Features to reward with additional power
- Features to
  - encourage / discourage
  - require / prohibit
Standards needs

User expectations / User interface
• Dynamic operation
• Symbols / terms / colors
  – Power state, sources, inputs/sensors

Data / network interfaces
• Mediation of power control
• Role of user inputs / sensors

What venues to address these?
How does ENERGY STAR engage?

Audio / Video
Inter-Device
Power Control
eetd.lbl.gov/ea/nordman/avcontrol
Ideal Result

Use ENERGY STAR to help:

- Develop and bring into market new energy-saving features
- Discourage or reduce consumption of energy-intensive features
- Create a universal set of user expectations for how to use displays
  - Enhances user experience
  - Saves energy