Networked Devices: Industry Perspectives on Global EE Policy Framework

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Agenda

- Networked Device: Overview/Current environment
  - IoT and Intelligent Efficiency (Benefits and Savings Potential)
- Industry perspective on energy efficiency, current barriers, and government's role
  - Consumer electronics/IT
  - Product standards/protocols
- Summary/Discussion
  - Policy Issues/Options
  - Wrap-up/future considerations

Background/Introduction - I

- Historically governments/public focused on negative environmental impact and energy impacts of ICT.
- Recent energy and environmental impact studies of the ICT Industry demonstrate the positive effects of these technologies. (macro-story)
- IEA highlights significant role of energy efficiency (4^{th} fuel!) towards a sustainable global economy.
- ICT applications create positive impact by enabling significant number of end-use energy efficiency improvements reducing electricity demand.
- Improvements found in many technologies deployed across the Industrial sectors.

Background/Introduction - II

- 50 Billion internet connected devices by 2020, the so called IoT effect.
- Many of these devices will be sensors or similar with very low power and low duty cycle and often battery powered.
- Increasing number of domestic and office equipment will be internet connected. IoT in effect extends and multiplies the reach and impact of the positive effects of the ICT network.
- The ACEEE* labelled IoT enabled energy efficiency phenomenon as "intelligent efficiency" (IE). IE is a systems-based holistic approach to energy savings, enabled by ICT and user access to real-time information.

**ACEEE = American Council of Energy Efficient Economy*

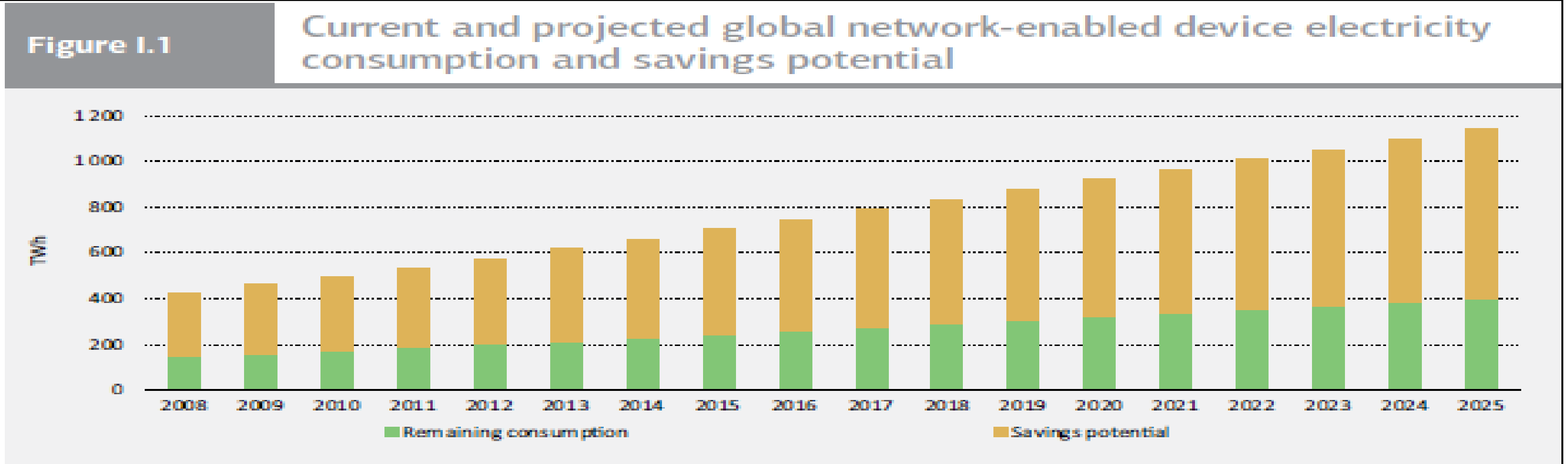
Networking impact approach

Device centric approach

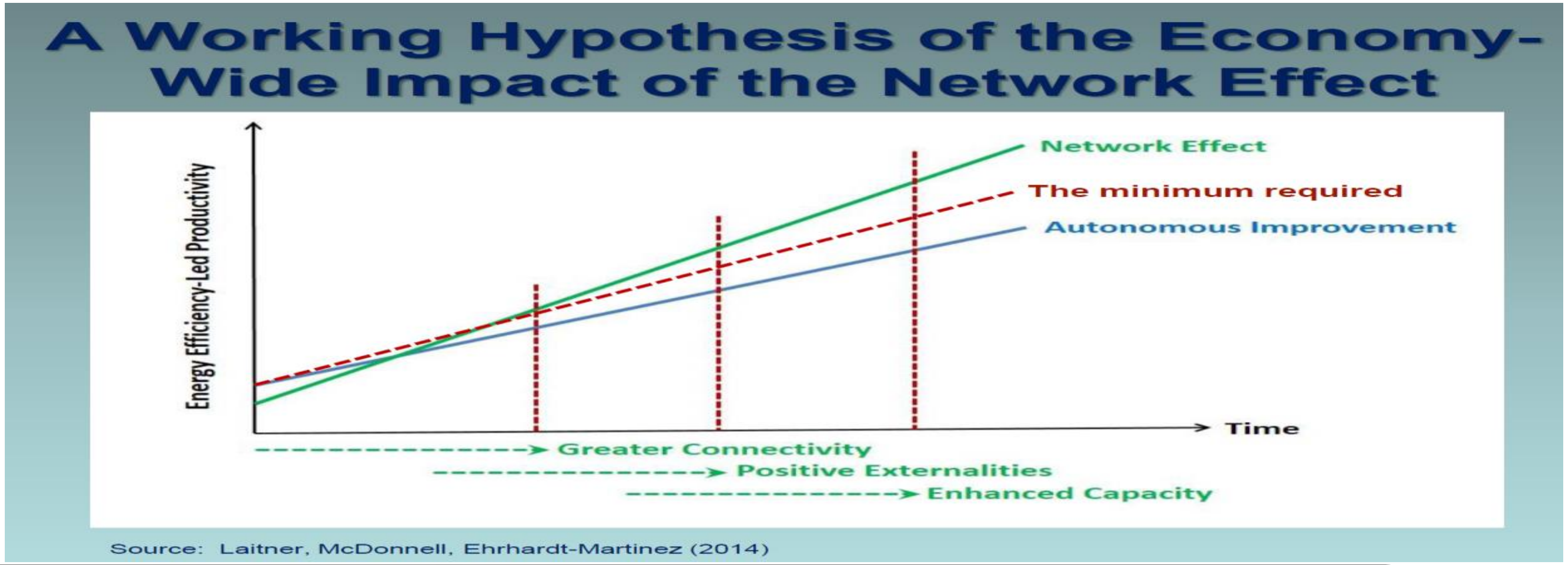
- Focus on networked device power and savings potential

System centric approach

- Focus on intelligent system efficiency that includes smart devices
- Economy wide benefits and energy savings potential



Notes: Domestically and professionally used network-enabled devices, connected to external or internal networks. Savings potential is estimated on the difference between the best available technology and the average device on the market. Projections start with 2012.
Source: Bio Intelligence Service, 2013, Inputs provided.



Source: Laitner, McDonnell, Ehrhardt-Martinez (2014), The Energy Efficiency and Productivity Benefits of Smart Appliances and ICT-Enabled Networks: An Initial Assessment at:
http://www.aceee.org/blog/2014/11/internet-everything-could-be-huge-boo

Networking impact analysis requires holistic systems approach

How Intelligent Efficiency (IE) Saves

- System optimization
  - Parts working better as a whole
  - The whole working towards the goal
- Eliminating the degradation of savings
  - Early fault detection
  - Continual optimization
- Substitution of technology
  - Technological evolution

Source: R. Neal Elliott, ACEEE
EPA-ITI Workshop on Enabling Energy Efficient Systems
June 26, 2014

The Technology behind *Intelligent Efficiency*

Evolution of Components

- Dumb & inefficient
- Dumb & efficient
- Informative & efficient
- Interactive & efficient

Evolution of Controls

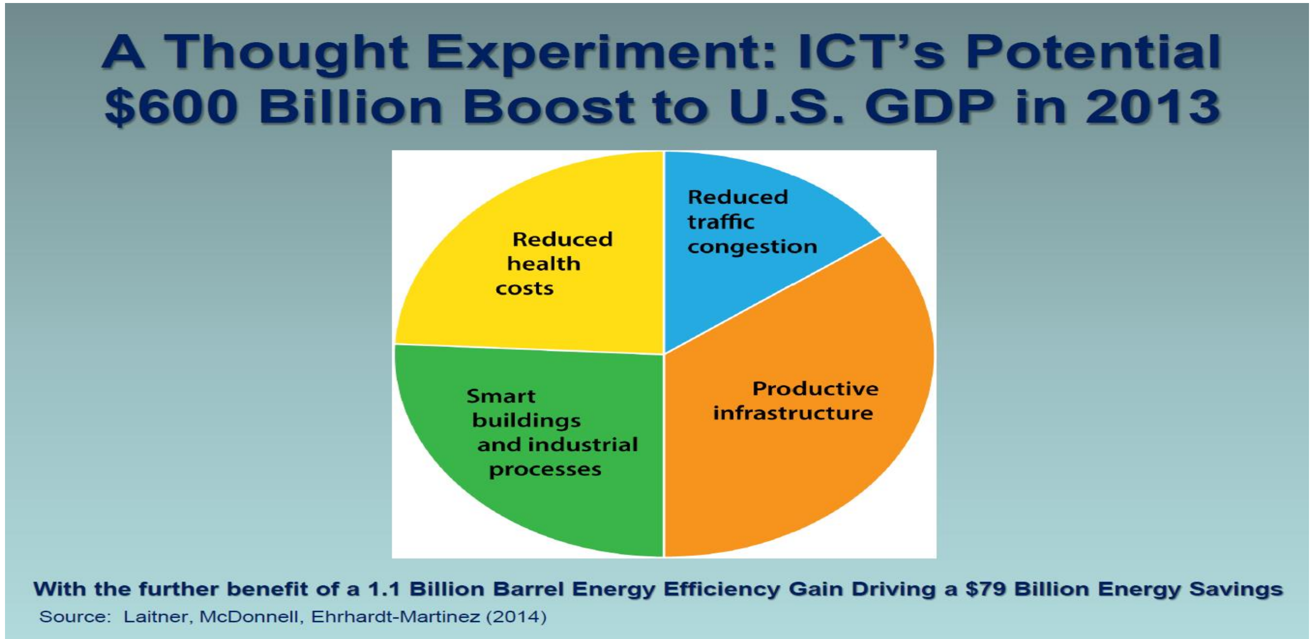
- Simple (on/off)
- Reactive
- Programmable
- Adaptive & predictive

intelligent efficiency

Source: R. Neal Elliott, ACEEE
EPA-ITI Workshop on Enabling Energy Efficient Systems
June 26, 2014

Potential for Intelligent Efficiency

- Energy savings from “enabling” technologies
  - 12-22% (GeSI)
- Savings from systems effects
  - 40-60% (ACEEE)
  - $50 billion/year energy cost savings
- Efficiency & productivity creates jobs
  - Internet job creation rate 2.6:1 (McKinsey)



Source: R. Neal Elliott, ACEEE
EPA-ITI Workshop on Enabling Energy Efficient Systems , June 26, 2014

Source: Laitner et al.
ACEEE, Intelligent Efficiency Conference, San Francisco, CA, November 18, 2014

IE Energy Savings are transformational, and essential for sustainability

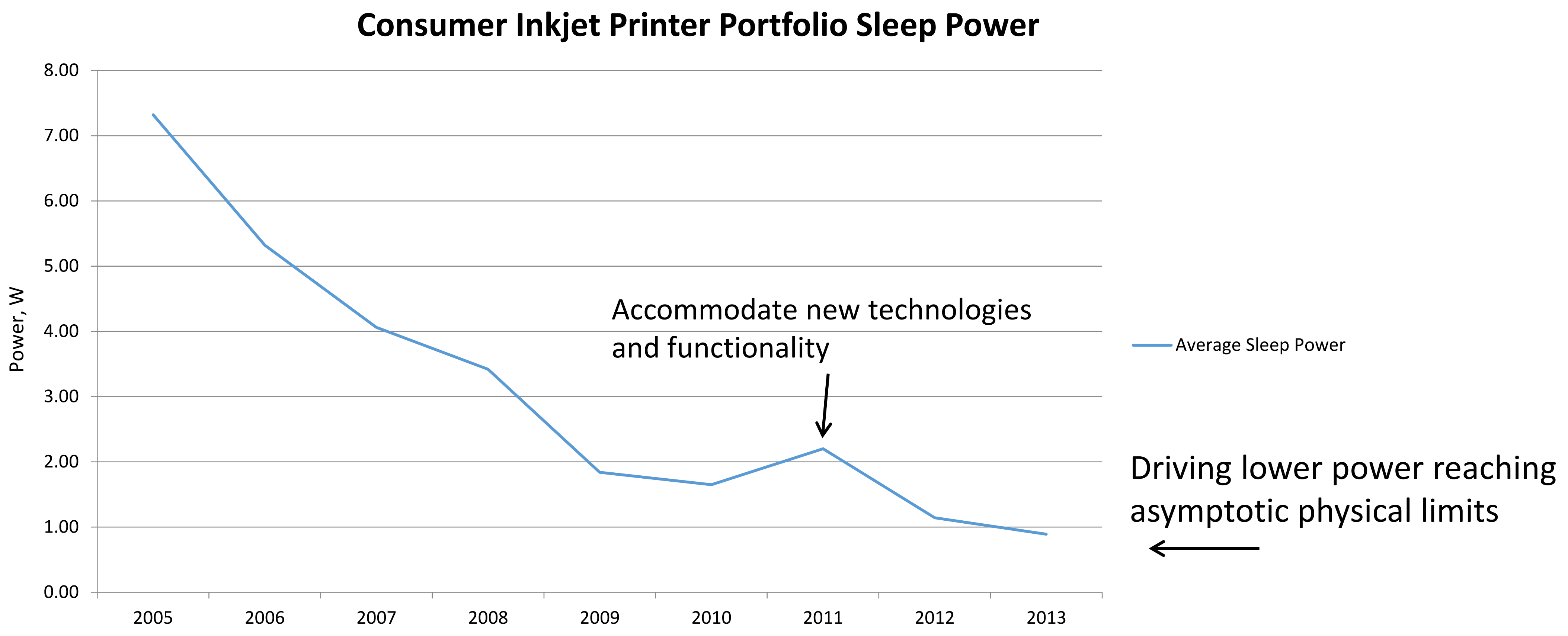
Industry perspective on energy efficiency, current barriers, and governments role

Consumer Electronics/IT

Consumer Electronics/IT

- What is currently being done to address energy efficiency in this area?
  - There are many eco-label, regulatory and non-regulatory drivers for energy efficient designs, with ENERGY STAR program and private sector voluntary agreements being most notable and progressive. Multiple specification revisions demonstrate the progress achieved to date.
  - Power management to low power modes, products default to a low power state after a period of inactivity, has been implemented for many edge device product categories- imaging equipment, PC’s, displays, TV’s.
  - Low power modes that maintain network connectivity are very low for these product categories.

Consumer Inkjet Printer Portfolio Sleep Mode Power Reduction (Example*)



Industry continues to drive energy efficiency recognizing both technology requirements and physics limitations

** This is an example of Consumer Inkjet printer portfolio only, and does not represent the power levels of other edge or networking devices within the network.*

Consumer Electronics/IT

- EU Regulation 1275/2008 (ERP Directive Lot6/26)
  - Power management approach is appropriate for many categories of edge devices and NOT appropriate for networking equipment and network infrastructure equipment.
  - Horizontal approach to scope is not appropriate; vertical product scope when appropriate is more effective and can lead to greater savings potential.

Consumer Electronics/IT

- What are the existing barriers that inhibit progress?
  - Edge devices- many product categories are already reaching the power limits, beyond which it impacts functionality and may impede future innovation. (Beware of annoyance modes- forcing users to disable power management)
  - Too much focus on individual device power levels and not enough emphasis on net energy savings of networked systems, and resulting economic benefits
  - Conflicting initiatives/requirements/programs leading to consumer confusion
  - Initiatives that address the network ecosystem beyond edge devices get very complicated very quickly and require a holistic/systems view of the entire network- interdependencies, communication protocols, rapidly developing technologies, interoperability and unintended consequences. (need for international standards)
  - Customer demand for more features, faster delivery and processing of data causes changes in energy efficiency approaches.

Consumer Electronics/IT

- What can governments do to overcome these barriers ?
  - Balanced, coordinated, and holistic regulatory policy approach to not inhibit technology innovation
  - Conduct comprehensive market studies and data collection (networked system benefits and savings potential vs. energy consumption), building on existing research such as:
    - ACEEE reports;
    - Skip Laitner reports;
    - C2ES reports;
    - ITS of America reports
  - Advocate global harmonization
    - International standards(including interoperability standards)
    - Common product framework and test methodologies
    - Transportable conformity assessment data for global acceptance

Consumer Electronics/IT

- What can governments do to overcome these barriers ?
  - In partnership with stakeholders, encourage networked systems innovation for energy efficiency and future sustainability.   US examples:
    - EPA/ITI Workshops and activities;
    - EPA ENERGY STAR standards development, rewarding system efficiency;
    - Green Button and DOE's Energy Data Initiative;
    - DOE's Building to Grid Integration work;
    - President's Climate Data Initiative and Climate Resilience Toolkit
    - Voluntary Agreements (when appropriate)

  - Consider Beyond Network Standby- A Policy Framework and Action Plan for Low Energy Networks (Harrington, Nordman 2014)

Industry perspective on energy efficiency, current barriers, and governments role

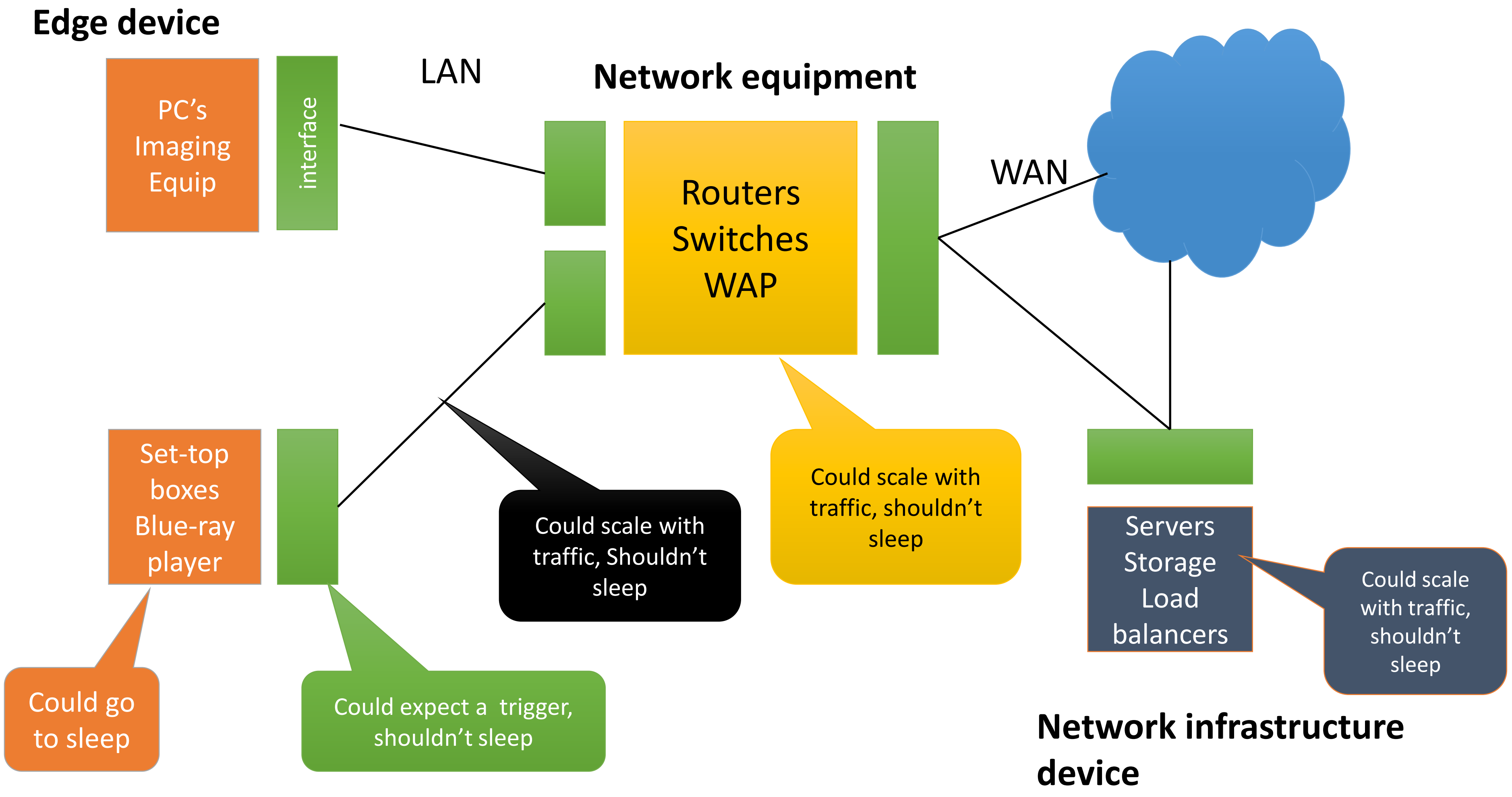
Product standards and protocols

3 types of standards

- Technology standards/protocols ➡ ensures interoperability
  - **Communication protocols**
    - Ethernet 802,3az
    - Ethernet WoL
    - HDMI CEC
    - Docsis 1x1 mode…
    - …
  - **Power management protocols**
    - IETF EMAN
    - ETSI GAL
    - …
- Energy efficiency measurement standards ➡ ensures consistent feasible measurements
  - ETSI/ATIS/ITU-T for routers and switches
  - CENELEC/ETSI for lot 26
  - IEC62301 Ed 2
  - …
- Standards which set targets/ energy requirements ➡ policy instruments
  - BB CoC
  - Lot 26
  - ENERGY STAR
  - …

Standards must be compatible and consistent with each other. Policy instruments must comprehend the technical boundaries of interoperability and measurement standards

The Big Picture



Scope for network standby policy

- Edge device primarily interacts with end user
  - Some devices are not expected to be activated by the network – no need for NW Standby, use normal standby mode
  - Some devices activated by the network – opportunity for reduced power while maintaining network connection
- Networking devices provide connectivity to edge devices
  - Benefit from mechanisms that scale energy consumption with traffic intensity
  - Linkage to edge device becoming less dependent, so less opportunity to benefit from low traffic conditions
- Networked infrastructure devices manage and manipulate the data within the network and service application requests from edge devices
  - Efficiency addressed through management utilities and/or virtualization features to coordinate a power and performance policy
- Energy Efficiency of the network should be assessed in traffic conditions that match normal usage - *scale, should not sleep*
  - assessment not just based on edge device but the overall effect on the network
  - Relevant efficiency dependent on device performance under worst case load vs. typical load – will depend on use profile of each device

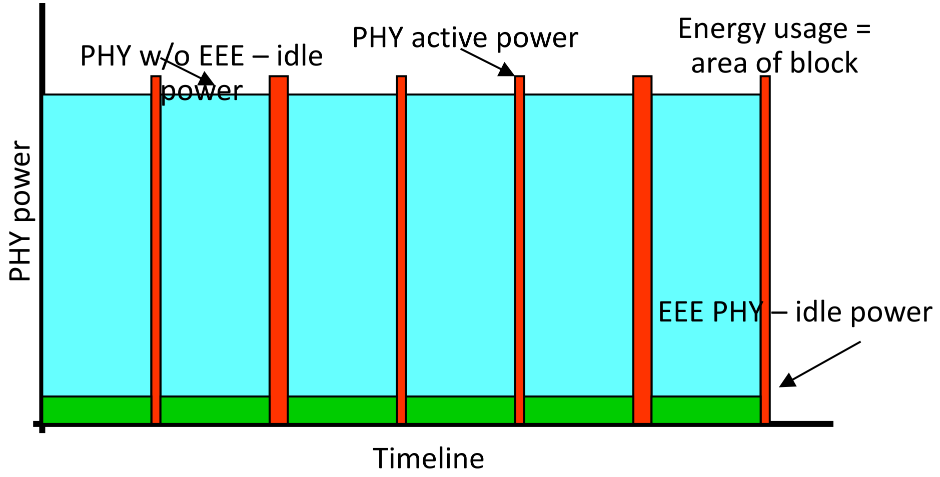
4 types of protocols/solutions

	Sleep Network Standby	Power Scales with work
Edge device	✔	✔
Networking Equipment	✗	✔
Network	✗	✔

Network and networking equipment should NEVER go to sleep. Edge devices may opportunistically sleep and wake pursuant to compliance to interoperability standards.

Network power scaling

- Interoperability standards supporting lower power conditions
  - Energy Efficient Ethernet (802.3az)
  - Docsis Energy Management 1x1
  - ADSL 2+ L2 Low power
- Lowers link power levels
- Allows device to consider reducing power



- Works autonomously and under interoperability standards
- Maintains the link, re-establish the link within ms
- Need both ends to support the technology
- ***This is not network standby***

Networks Should NOT go to Sleep

- Ethernet interfaces: detect link status, ports power down when no cable connected
- Lot 26 promotes deactivation of the network ports when not in use **(problem-unintended consequences)**
- De-activated (sleeping) networks require resynchronization (or boot).
  - All transmission requests are lost (dropped packets) and
  - Equipment along that network connection is considered non-existent until reboot and discovery.

- Disconnects the link – no remote reactivation possible
- Reduces power of the interface and opportunity to reduce energy
- May increase energy consumption (other devices) across the network
- Network and network hosts should NOT power down
- ***This is not network standby***

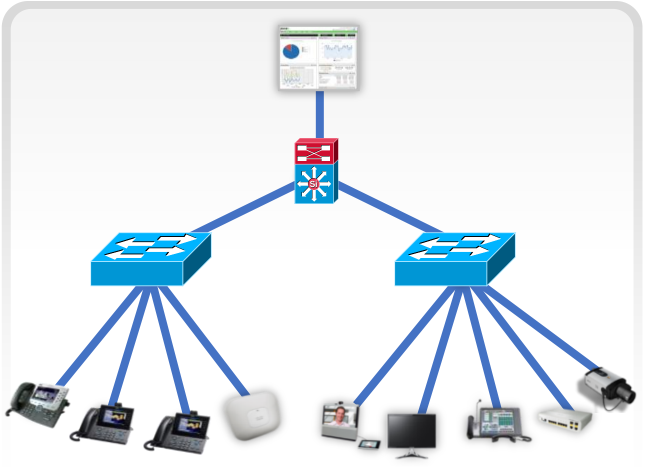
Equipment with power scaling

- Networking Equipment
  - ETSI ES 203 136, ATIS-0600015.03.2013, ITU L.1310
- Types of power reduction: # fans, # PSU’s, #RAM, frequency
- Coordination across power islands

- Maintains the link to the network
- ***This is not network standby***

Edge device opportunity to sleep

- Network Protocols to support edge device's opportunity to sleep and maintain network presence:
  - Ethernet WoL
  - UPnP Low Power
  - HDMI CEC
  - IETF EMAN rfc7326 - Cisco Energywise
  - ETSI ES 203 237 (Green Abstraction Layer)



- Opportunity to sleep:
  - Timer expires OR event happens
  - Network interface remains awake
  - May be Centralized (network initiated) or Decentralised (edge device se
  - Lack of uniformity/implementation
  - NOT applicable for monitoring, security, and other systems whose main function is dependent on persistent connectivity.
  - ***This IS network standby***

Conclusion

	Sleep Network Standby	Scale with work
Edge device	✔	✔
Networking equipment	✗	✔
Network	✗	✔

Network standby

- Network Standby is only opportunistically applicable to edge devices.
  - Not applicable for devices whose main function relies on persistent connection
- Network Standby is NOT applicable for energy savings on the network itself or networking equipment.
- Deactivated networks require reboot and/or resynchronization. Data loss and unavailable functions are expected until reboot occurs.
  - Forced network deactivation may cause unintended consequences

Summary/Discussion

Key principles on global energy efficiency convergence approach

IEA/Industry Alignment

- Ensure energy efficiency programs for ICT products help promote, and not impede, energy efficient economic growth and innovation.
- Ensure energy efficiency programs for ICT products are based on accurate data and sound analysis.
- Adopt international standards and metrics in energy efficiency programs for ICT products.
- Ensure transparency and stakeholder participation in the regulatory process for energy efficient ICT products

Additional Industry Principles

- Use <u>proven</u> successful voluntary and mandatory energy efficiency programs for ICT products as a framework for product energy efficiency convergence
- Avoid using voluntary energy efficiency program metrics as minimum energy performance standards (MEPS) for market access of ICT products
- Adopt minimally trade-restrictive conformity assessment requirements in energy efficiency programs for ICT products
- Align to ENERGY STAR® framework (voluntary) supported by international standards

Industry advocates voluntary programs to drive energy efficiency and innovation

Scope for network standby policy

- Consider the network elements (networking devices, networked infrastructure devices, edge devices) in their entirety before considering efficiency requirements for each device class separately
- Horizontal approach not workable, the power and energy profiles and energy efficiency opportunities vary considerably between device classes- Horizontal approach leads to significant inefficiencies
- Vertical approach preferred and should identify product scope ensuring comprehensive studies (incl. effect on network):
  - Identify product category specific requirements that may include separate limits, adjustments (allowances) etc.
  - Minimises need for exemptions and avoids limits that are set too high, and maximises efficiency savings

Moving Forward – Key Policy Considerations From an Industry Perspective

- Intelligent Efficiency
  - Partnership and Innovation
  - Governments should use their purchasing power
- Network Standby
  - Focus on energy, not power
  - Holistic data collection approach (including intelligent efficiency gains)
  - Vertical product focus (when appropriate)
  - Voluntary (market forces driven)
  - Global perspective (harmonization)
  - Lot 26 (Horizontal approach) should not be a precedent
    - Power management (defaulting to low power mode) is appropriate approach for many edge devices, and NOT appropriate for networking equipment and network infrastructure equipment
    - Power management has been effectively implemented for many edge product categories

Industry is ready to work with the G20 policy makers

Back-up

Policy Issues and Options

- Key learning from Lot 26 experience made available for other policy makers
- Regulatory requirements must be balanced reflecting market incentives to avoid stifling innovation
- Data driven, prioritized vertical segment approach with greatest energy savings gains taking into consideration, dependencies, costs, and potential “unintended consequences”. Where similarities exist – leveraging regional device level data could be shared
- Policy makers must evaluate current policy tools (Voluntary, MEPs, COC, labeling) and work with Industry to agree on the approach
    - Even the voluntary labeling programs (ENERGY STAR) work, since the market forces continue to drive technology innovation, competitive cost, and consumer choice
- Address justifiable exemptions , trade-off between creating extra niche product categories and exempt such products with no material impact to CFF goals
- Conflicting policies and requirements
- Long term approach (Defining end-state; MEPs to voluntary; end of regulation). This is key – as there comes a point of diminishing return for any incremental effort.
    - Multi-tiered regulatory approach with an intention to spur future innovation, could be counter productive and in fact stifle innovation (since the future target setting is largely arbitrary)

IE – Examples of U.S. Partnerships

White House.
- Climate Data Initiative and Commitments
- Climate Resiliency Toolkit
- Smart cities discussions and projects

DOE.
- Green Button and Energy Data Initiative
- Building to Grid Integration work
- Federal Smart Grid Task Force
- Better Bldgs. Challenge, and Better Data Centers Challenge

EPA.
- ITI/EPA Workshops on furthering Intelligent Efficiency
- ENERGY STAR standards development rewarding systems efficiency and network connectivity

DOT.
- Connected Vehicles program
- Intelligent Transportation Systems program
- Smart Roadside program

DOC.
- NIST's Global City Teams Challenge

IE – Examples of Existing Research

Center for Climate And Energy Solutions (C2ES).

- "*Leading by Example: Using Information and Communications Technology to Achieve Federal Sustainability Goal*," presenting eight case studies of US federal agencies using smarter technologies to use less energy and reduce greenhouse gas emissions while cutting costs and enhancing productivity. Available at: http://www.c2es.org/docUploads/federal-sustainability-ict.pdf.
- "*Leading by Example 2.0: How Information and Communication Technologies Help Achieve Federal Sustainability Goals*," highlights federal agencies' initial progress in adopting these technologies and outlines steps to overcome barriers. Available at: http://www.c2es.org/docUploads/how-ict-help-achieve-federal-sustainability-goals.pdf.

American Council for an Energy-Efficient Economy (ACEEE).

- "*A Defining Framework for Intelligent Efficiency*," estimating if US homeowners and businesses were to take advantage of currently available information and communications technologies that enable system efficiencies, the US could reduce its energy use by 12-22% and realize tens or hundreds of billions of dollars in energy savings and productivity gains. Available at: http://www.aceee.org/sites/default/files/publications/researchreports/e125.pdf.
- "*Intelligent Efficiency: Opportunities, Barriers, and Solutions*." A follow-on report, providing ideas for policy solutions. Available at: http://www.aceee.org/research-report/e13j.
- "*Smart Freight: Applications of Information and Communications Technologies to Freight System Efficiency*." A further follow-on report focusing on freight. Available at: http://www.aceee.org/white-paper/smart-freight-ict.
- "*Energy Savings Potential of Smart Manufacturing*." A further follow-on report, focusing on manufacturing. Available at: http://www.aceee.org/research-report/ie1403.
- "*The Energy Efficiency and Productivity Benefits of Smart Appliances and ICT-enabled Networks: An Initial Assessment*." A further follow-on report, focusing on appliances. Available at: http://www.aceee.org/research-report/f1402.

Laitner Study.

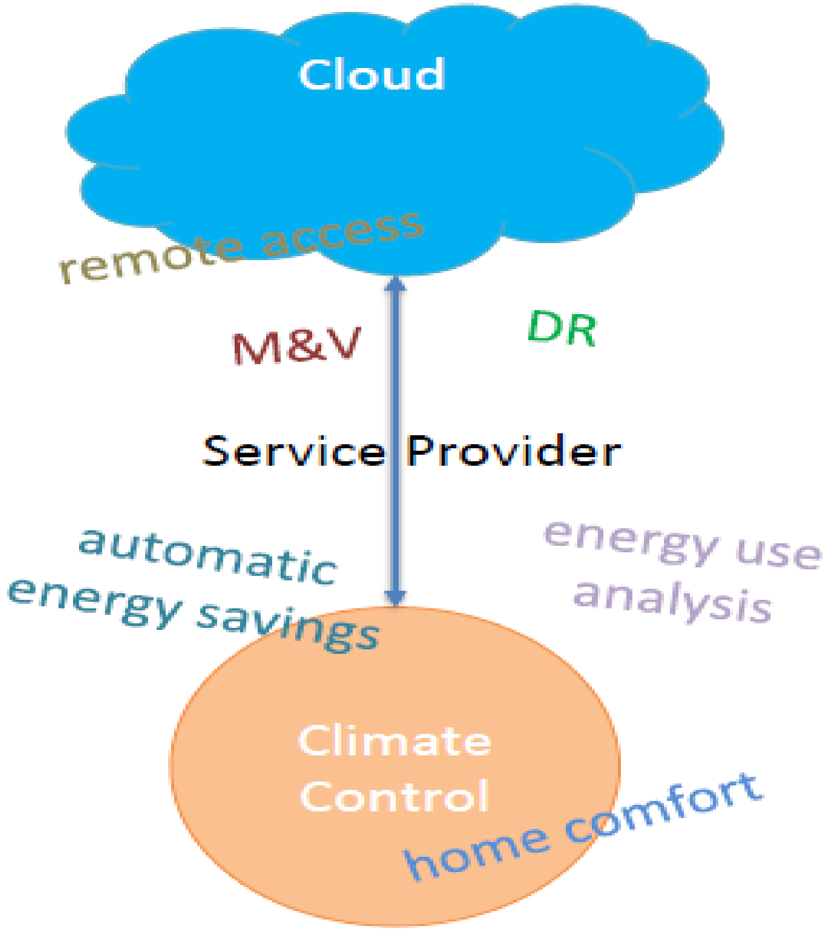
- "*The Energy Efficiency and Productivity Benefits of Smart Appliances and ICT-Enabled Networks: An Initial Assessment.*" The easy read is his ACEEE Conference presentation: (http://aceee.org/files/pdf/conferences/IE/2014/5c-laitner.pdf)

ITS America.

- "Accelerating Sustainability: Demonstrating the Benefits of Transportation Technology," highlighting certain tools currently available such as connected car and smart cities technologies that could substantially reduce carbon emissions. Available at: http://www.digitalenergysolutions.org/dotAsset/933052fc-0c81-43cf-a061-6f76a44459d6.pdf.

Connected climate controls: new opportunity

- Presence of a programmable thermostat in home not sufficient for energy savings
- New connected products include service, help realize the promise of HVAC control
- With connection, EPA can **base recognition on data from installed units**
- **Partner would be service provider**
- If approach works, could provide a model for other connected controls



ENERGY STAR Climate Controls next steps

- Metrics are key:
  - Rich data from units: equipment start/stop times, temperature settings, indoor temperature, location, etc.
  - Combine with public data, e.g. weather
- Considering possible metrics at stakeholder workshop SF 11/19
- In 2015, test candidate metrics, correlate to meter savings
- Service provider partners periodically submit summary data as proxy for average energy savings for clients
- Consumers have access to average savings developed with common method

→ WIN for service providers, consumers and the environment

Annex - informative list of European energy related standards - I

Annex - informative list of European energy related standards - II

Annex - informative list of European energy related standards - III

Annex - informative list of European energy related standards - IV