# ENERGY STAR Market & Industry Report
## Small (Home) Network Equipment

## 1. Introduction

The US EPA ENERGY STAR program is increasingly focused on products described as miscellaneous energy users – products that are responsible for an ever-growing slice of the home electricity budget. Small Network Equipment (SNE) like modems and routers present an opportunity for reducing national household energy use due to the large installed base of products and their always-on status. Nearly 20 million SNE devices were shipped in 2008[1] as demand for broadband services continues to drive sales. Related products currently covered by the ENERGY STAR program are set-top boxes, digital to analog converter boxes, computers, and a wide range of office equipment; in addition, numerous SNE devices are presently recognized by the ENERGY STAR program indirectly through use of ENERGY STAR external power supplies (EPS). EPA intends to investigate energy saving opportunities across the full spectrum of network equipment, so an effort to develop a specification for Large Network Equipment will be considered separately in the coming year.

This Draft Specification Framework document serves to launch the ENERGY STAR specification development process for SNE. The Framework is intended to outline EPA's initial assessment of the product category and describe ways in which the ENERGY STAR program may be structured. Included in this document are EPA's initial thoughts on definitions, eligible products, possible test protocols, and structures for efficiency requirements. After each section is a set of questions designed to facilitate discussion with stakeholders and further EPA's understanding of this product category.

## 2. Product & Technology Overview

A network device is a device with the primary function is to pass Internet Protocol traffic among various network interfaces/ports. Small Network Equipment is a subset of Network Equipment that meets the following tentative characteristics:

- Is neither rack-mounted nor intended for use in standard equipment racks;
- Designed for stationary operation;
- Primarily powered from the mains through either an internal or external power supply that is not shared with other devices;
- Contains no more than nine ports for wired network.

**Product Types and Other Definitions**

- Switch: Switches are network devices that channel incoming data from one or more input ports to a specific output port. Switches typically consume more energy than

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[1] *Infonetics*: Quarterly Worldwide and Regional Market Share, Size, and Forecasts: 1Q09. 2008 North American combined shipments of ASDL/VSDL modems, gateways, and IADs, and Cable modems and gateways.

routers. Switches are characterized based on speed of data transmission, OSI Layer[2], and form factor.

- Router: Network layer device that uses one or more metrics to determine the optimal path along which network traffic should be forwarded. Routers forward packets from one network to another based on network layer information.

- Access Point: A device that provides IEEE 802.11 (Wi-Fi) connectivity.

- Modem: Device that converts digital and analog signals. At the source, a modem converts digital signals to a form suitable for transmission over analog communication facilities. At the destination, the analog signals are returned to their digital form.

- SOHO: small office/home office.

- CPE: Customer Premises Equipment.

- Gateway/Integrated Home Access Device: Defined by the Wi-Fi Alliance as a device "combining the functionality of a broadband modem with the ability to distribute a Wi-Fi signal." IHAD's are often distributed by broadband providers.

- Speed: Includes Fast Ethernet (100 Mbps), Gigabit Ethernet (1 Gbps), 10-Gigabit Ethernet (10 Gbps) and Fibre Channel (10 Gbps).

- OSI Layer: Layer 2 (L2) switches forward packets based on media access control (MAC) address information, Layer 3 (L3) based on Internet Protocol (IP) and Layers 4-7 (L4-L7) based on application specific address information

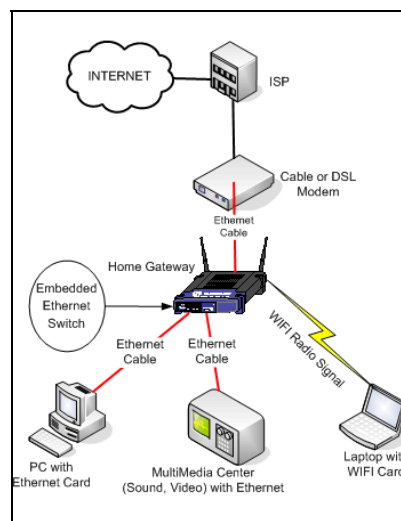## 3. Application and Technology Overview

**Network Topology Examples**



**Figure 1: Home Network[3]**

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[2] OSI is a conceptual framework that describes information flow through a network. For more information, see: http://www.cisco.com/en/US/docs/internetworking/technology/handbook/Intro-to-Internet.html#wp1020580.
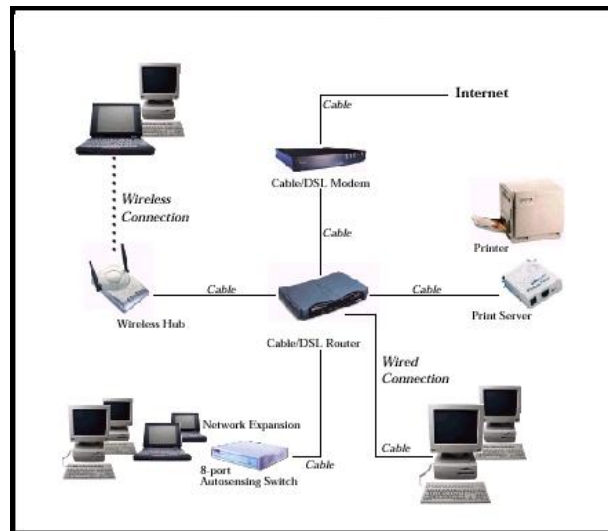
**Figure 2: Small Office Network[4]**

## 4. Market Assessment

**Growth Trends**

- *In Stat*: Worldwide CPE unit shipments grew 15 percent in 2007, to 149 million.
- *Infonetics*: "Worldwide digital home gateway sales **grew 12% in 4Q08**, with most of the revenue hailing from North America and EMEA (Europe, Middle East, Africa), where operators like Verizon, AT&T, Orange, and Free provide fully integrated gateways that can prioritize voice, data, and video packets and provide in-home networking features and services such as whole home DVR…"
- *ABI Research*: **global access point shipments are forecast to exceed 70 million by 2010**, of which an overwhelming 90% will be generated by the SOHO and consumer markets (*Wi-Fi Equipment Market Data, 3/16/09*)
    - Not consensus: "Growth in the market for core home networking products has been slowing in recent years, due to market saturation and price erosion. The decline is certainly not helped by the current global economic slump: forecasts for core home networking device revenues indicate a declining market through 2014." (ABI Research, *Home Networking and Digital Home Network Market Analysis, April 2009*)

## 5. Energy Efficiency Assessment

**Available Test Procedures**

- Ministry of Economy, Trade and Industry (METI): In Top Runner documentation, METI presents a detailed test methodology for small routers and L2 switches that evaluates transmission efficiency. Energy consumption efficiency is evaluated in units of Watts/bit.

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[3] http://www.networkingreviews.com/2008/03/01/the-need-for-setting-up-a-home-network/
[4] http://www.jrnetworksolutions.com/images/office%20networking/networks-overall.jpg

- Juniper/IXIA/LBNL (http://www.ecrinitiative.org/pdfs/ECR_1_0_2.pdf): Test methodology is proposed as applicable to high end equipment, where high throughput is assumed. Proposes an Energy Consumption Rating in Watts/Gbps.

- European Union: Appendix B of the CoC Low Power and On-State conditions for the products covered by the regulations; actual test procedures are limited.

- In-Stat Green Networking Equipment Study: In their 2007 report, *Green Networking Equipment: Who Leads and Who Lags,* In-Stat conducted an energy efficiency review of the market.[5] A "server-like energy efficiency" metric, fabric capacity (Gbps/watt) was used.  A selection of 24-Port, Gigabit Ethernet, Fixed, Managed, and L2–3 switches were rated at 0.4 and 3.3 Gbps/watt. Another group of switches had the same features, except they featured 48 ports instead of 24; results for these products ranged approximately 0.5 to 2.0 Gbps/watt.

## 6. Energy Efficiency Considerations and Opportunities

Small Network Equipment generally has limited power scaling functionality in current products. The following lists existing or nascent best practices for different network technology.

**Wired network**
- Automatic unused port shutdown
- Adaptive powering based on cable length
- Ability to enable/disable Power Over Ethernet
- Ethernet: 802.3az (Energy Efficient Ethernet)

**Wireless network**
- *802.11v*: The next version of the 802.11x standard is scheduled for completion in July 2010. The standard will cut power to the Wi-Fi chip when it's not being used. Key elements of the standard include Wake On WLAN and Wireless Network Management Sleep Mode, both of which should cut the amount of power 802.11v-equipped devices consume. A number of other usability improvements are planned to improve multimedia streaming and wireless positioning. A source cited Linksys noting that some 802.11v improvements could be available via firmware updates to current devices. http://grouper.ieee.org/groups/802/11/Reports/tgv_update.htm.

**Operation**
- *Power management/Auto Power Down*: prevent products from running all day while network is inactive. Options include:
  - Firmware scheduling capability to power down based on user preferences (local or web interface)
  - Variable speed fans (as applicable)
- *Hard Off or Sleep Switches*: Allow users the option to easily switch off devices or place devices in a sleep mode without unplugging.

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[5] http://www.3com.com/gogreen/assets/GreenNetworkingEquipment.pdf

- *Firmware that tracks energy consumption, bandwidth consumed*: The former may not be possible, but would be an interesting feature. The latter is not strictly an energy-related feature, but there may be consumer interest in tracking download activity as Comcast (and others in the US) begin to cap downloads. This might help sell devices.

**Power Supply**

- External Power Supplies sold with ENERGY STAR computers must be ENERGY STAR qualified or meet the no-load and active mode efficiency levels provided in the ENERGY STAR Program Requirements for Single Voltage External Ac-Ac and Ac-Dc Power Supplies, Version 2.0. The ENERGY STAR specification and qualified product list can be found at [www.energystar.gov/powersupplies](www.energystar.gov/powersupplies).

## 7. Key Market Players

| Manufacturers | |
|---|---|
| 2Wire | Actiontec |
| Ambit | ARRIS |
| AVM | Cisco |
| Dataflex | D-Link |
| Foxconn | Gigaset |
| Huawei | Motorola |
| NETGEAR | Netopia |
| Sagem | Scientific Atlanta |
| Siemens | SMC Networks |
| Sumitomo | Telsey |
| Terayon | Thomson |
| U.S. Robotics | Ubee Interactive |
| Westell | Xavi Technologies |
| Zhone | ZTE |
| ZyXEL | |

## 8. Other Policy Initiatives

- *EU Code of Conduct (CoC)*: Divides devices between Consumer Premises Equipment (CPE) and network provider equipment. The division between the two is defined as the access line:
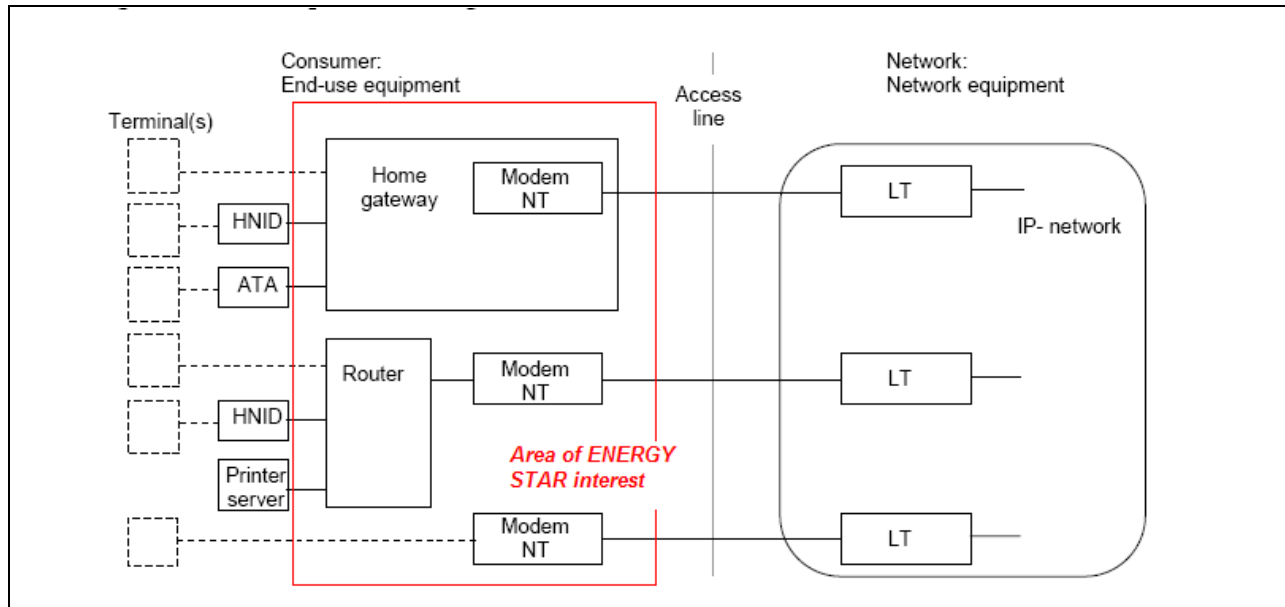
- *EuP Ecodesign*: The EU is tentatively planning to cover "Network, Data Processing, and Data Storage" equipment between 2009-11. In particular, "Network Communication Equipment" is called out for coverage.
  http://ec.europa.eu/energy/demand/legislation/doc/working_plan/2008_10_21_working_plan_en.pdf.

- *Top Runner/METI:* While no standard appears to be developed (target date is fiscal year 2010), METI funded creation of a report studying the energy efficiency of network equipment. Network switches (L2) and small routers are covered. A full version of this report is available on the ECCJ website (http://www.eccj.or.jp/top_runner/pdf/tr_small_routers-apr_2008.pdf).

- Industry/voluntary standards
  - o Wi-Fi Alliance
    - *Wi-Fi Certification* - Wi-Fi Certification assures tested and proven interoperability among wireless computer equipment. This scope of certification includes Wi-Fi base stations like access points and gateways. Wi-Fi CERTIFIED™ products support a maximum data rate of either 11 Mbps (802.11b) or 54 Mbps (802.11a and 802.11g).
  - o HomePlug Alliance
    - *HomePlug 1.0* –First specification for a technology that connects devices to each other through the power lines in a home; released in 2001. HomePlug-certified products connect PCs and other devices that use Ethernet, USB and 802.11 "Wi-Fi" technologies to the power line via a HomePlug "bridge" or "adapter."
  - o HPNA (HomePNA)
    - HomePNA develops MAC and Physical layer protocol specifications for networking over existing wires, as well as specifications for certification testing for components required to implement a HomePNA-compatible device. *HomePNA 3.1* is the latest home networking specification released in December 2006. Data rates over existing home wiring of up to

320 Mbps. Intended to help service providers simultaneously deliver triple-play IPTV, voice and Internet data services as well as other networked entertainment data throughout the home.

- G.hn
  - Unified home networking standard under development by the International Telecommunication Union (ITU).