



ENERGY STAR® Product Specification for Small Network Equipment

Eligibility Criteria Draft 3 Version 1.0

1 Following is the ENERGY STAR product specification for Small Network Equipment. A product shall meet
2 all of the identified criteria if it is to earn the ENERGY STAR.

3 **1 DEFINITIONS**

4 A) Product Classifications:

- 5 1) Network Equipment: A device whose primary function is to pass Internet Protocol (IP) traffic
6 among various network interfaces / ports.
- 7 2) Small Network Equipment (SNE): Network Equipment that is intended to serve users in either
8 small networks or a subset of a large network. SNE includes a) all Network Equipment with
9 integral wireless capability and b) other Network Equipment meeting **all** of the following
10 criteria:
 - 11 a) Designed for stationary operation;
 - 12 b) Contains no more than eleven (11) wired Physical Network Ports;
 - 13 c) Primary configuration for operation outside of standard equipment racks;
 - 14 d) Meets the definition of one or more of the Product Types defined below.
- 15 3) Large Network Equipment: Network Equipment that is rack-mounted, intended for use in
16 standard equipment racks, or contains more than eleven (11) ports for wired network.

17 B) Small Network Equipment Types:

18 1) Broadband Access Equipment

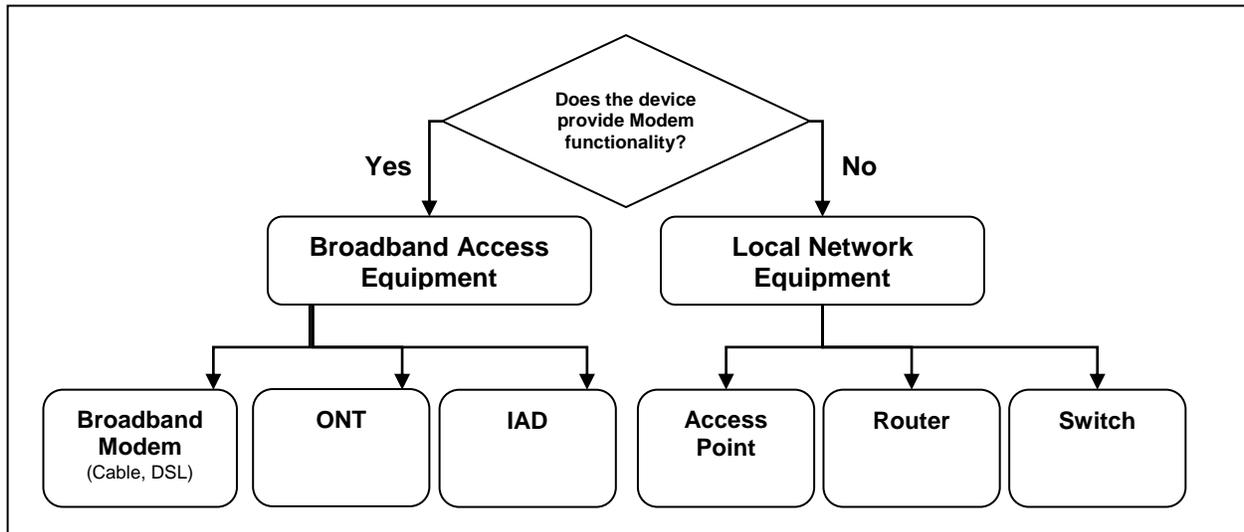
- 19 a) Broadband Modem: A device that transmits and receives digitally-modulated analog
20 signals over a wired or optical network as its primary function. The Broadband Modem
21 category does not include devices with integrated Router, Switch, or Access Point
22 functionality.
- 23 b) Integrated Access Device (IAD): A network device with a modem and one or more of the
24 following functions: wired network routing, multi-port Ethernet switching and/or access
25 point functionality.
- 26 c) Optical Network Termination Device (ONT): A type of device that converts signals
27 between copper (wired) or wireless connections and an optical fiber connection. ONTs
28 are available in either desktop or building-mounted versions with different connectivity
29 options.

30 **Note:** EPA has relocated and revised the Optical Network Termination Device (ONT) definition to clarify
31 that it will not be treated as a type of modem or IAD, but rather a separate distinct product type which may
32 have variable connectivity options. This change is consistent with the analysis of ONT data in both Draft 2
33 and Draft 3 of the specification.

34 2) Local Network Equipment

- 35 a) Access Point: A device that provides wireless network connectivity to multiple clients as
36 its primary function. For the purposes of this specification, Access Points include devices
37 providing only IEEE 802.11 (Wi-Fi) connectivity.

- 38 b) Router: A network device that determines the optimal path along which network traffic
 39 should be forwarded as its primary function. Routers forward packets from one network to
 40 another based on network layer information. Devices fitting this definition may provide
 41 both Router functionality and wireless network capability.
- 42 c) Switch: A network device that filters, forwards, and floods frames based on the
 43 destination address of each frame as its primary function. The switch operates at the data
 44 link layer of the OSI model.
- 45



46
47
48 **Figure 1: Product Type Assignment**

49 C) Operational Modes and States:

- 50 1) On Mode: The product is connected to a power source, is ready to use, and is providing one
 51 or more primary functions.
- 52 a) Idle State: The product is in On Mode and the data rate is 0 kb/s.
- 53 b) Low Data Rate: The product is in On Mode and traffic is passed across ports at 1.0 kb/s
 54 (0.5 kb/s in each direction) as defined in the test procedure.
- 55 c) High Data Rate: The product is in On Mode and traffic is passed across ports at a
 56 selected reference rate as defined in the test procedure.

57 D) Components:

- 58 1) External Power Supply (EPS): A component contained in a separate physical enclosure from
 59 the SNE product designed to convert line voltage ac input into lower voltage ac or dc
 60 output(s) for the purpose of powering the SNE product. An EPS must connect to the SNE
 61 product via a removable or hard-wired male/female electrical connection, cable, cord or other
 62 wiring.

63 E) Marketing or Shipment Terminology:

- 64 1) Cable, Satellite, and Telecom Service Provider ("Service Provider"): An entity that provides
 65 Internet connectivity to subscribers with whom it has an ongoing contractual relationship.
- 66 2) Manufacturing Partner: An entity that manufactures, or markets OEM-manufactured SNE for
 67 sale to either end customers or Service Providers.

68
69

Note: EPA has removed the Small Office/Home Office, SOHO, definition as it is no longer used in the specification or test method language.

70

F) Additional Terms:

71
72
73
74

1) End Point Device: A device that functions as either an originator or destination for network traffic passed through Network Equipment. Examples of end point devices include computers, servers, set-top boxes, IP-capable televisions, IP phones, etc. For the purposes of this specification, an end point device is not considered network equipment.

75
76

2) Energy Efficient Ethernet (EEE): A technology which enables reduced power consumption of Ethernet interfaces during times of low data throughput. Specified by IEEE 802.3az.

77
78
79

3) Link Rate: The maximum PHY bit rate possible on a particular link (e.g., 1000BASE-T Ethernet supports 1 Gb/s in each direction [2 Gb/s total]; IEEE 802.11g supports 54 Mb/s total).

80
81
82

4) Physical Data Port: An integrated physical connection point primarily intended to accept non-IP data. For the purposes of this specification, a port must support one of the following media types to fit this definition:

83

a) Universal Serial Bus (USB);

84

b) Firewire;

85

c) Thunderbolt;

86

d) SATA;

87

e) SCSI; or

88

f) RS-232.

89
90
91

5) Physical Network Port: An integrated physical connection point primarily intended to accept IP or similar traffic via a cable. For the purposes of this specification, a port must support one of the following media types to fit this definition:

92

a) Ethernet;

93

b) Coaxial Cable;

94

c) Twisted Pair Copper; or

95

d) Fiber Optic.

96
97
98

6) Power over Ethernet (PoE): A technology which enables transfer of electrical power, along with data, to network end point devices through an Ethernet cable. Currently specified by IEEE 802.3af and IEEE 802.3at.

99
100
101
102

7) Standard Equipment Rack: An equipment enclosure commonly seen in data centers or managed facilities and intended to house a variety of information technology equipment. Front panel width is typically 19 inches (482.6 mm) in width. Standard Equipment Racks are defined by EIA-310, IEC 60297, or DIN 41494.

103

8) Unit Under Test (UUT): The network equipment device being tested.

104
105

9) Wireless Local Area Network (WLAN) Test Client: A device that is capable of establishing an 802.11x link with an Access Point (AP) and transmitting data to and receiving from the AP.

106
107
108
109
110
111

10) Full Network Connectivity: The ability of an End Point Device to maintain network presence while in Sleep Mode or another low power mode (LPM) of equal or lower power consumption and intelligently wake when further processing is required (including occasional processing required to maintain network presence). Presence of the End Point Device, its network services and applications is maintained even though the End Point Device is in a LPM. From the vantage point of the network, an End Point Device with full network connectivity that is in

112 LPM is functionally equivalent to an idle End Point Device with respect to common
113 applications and usage models. Full network connectivity in LPM is not limited to a specific
114 set of protocols but can cover applications installed after initial installation. Also referred to as
115 “network proxy” functionality and as described in the Ecma-393 standard.

116 a) Network Proxy - Base Capability: To maintain addresses and presence on the network
117 while in LPM, the system handles IPv4 ARP and IPv6 NS/ND.

118 b) Network Proxy - Full Capability: While in LPM, the system supports Base Capability,
119 Remote Wake, and Service Discovery/Name Services.

120 c) Network Proxy - Remote Wake: While in LPM, the system is capable of remotely waking
121 upon request from outside the local network. Includes Base Capability.

122 d) Network Proxy - Service Discovery/Name Services: While in LPM, the system allows for
123 advertising host services and network name. Includes Base Capability.

124 11) External Proxy Capability: The ability of an SNE device to maintain Full Network Connectivity
125 on behalf of an End Point Device. Must include an implementation of a standard protocol for
126 communicating between the End Point Device and the SNE device. Note: A known such
127 protocol is mDNS. Waking the sleeping End Point Device is typically accomplished by Wake-
128 On-LAN, a wireless equivalent, or some other directed traffic.

129 G) Product Family: A group of product models that are (1) made by the same manufacturer, (2)
130 subject to the same ENERGY STAR qualification criteria, and (3) of a common basic design.
131 Product models within a family differ from each other according to one or more characteristics or
132 features that either (1) have no impact on product performance with regard to ENERGY STAR
133 qualification criteria, or (2) are specified herein as acceptable variations within a product family.
134 For Small Network Equipment, acceptable variations within a product family include:

135 1) Color,

136 2) Housing, or

137 3) Any of the functional adders specified in Table 2.

138 2 SCOPE

139 2.1 Included Products

140 2.1.1 Products that meet the definition for Small Network Equipment as specified herein are eligible for
141 ENERGY STAR qualification, with the exception of products listed in Section 2.2. In addition,
142 SNE shall meet one of the following equipment type definitions:

143 i. Broadband Modems (Cable, DSL);

144 ii. Optical Network Termination Device (ONT);

145 iii. Integrated Access Device (IAD);

146 iv. Router;

147 v. Switch; or

148 vi. Access Point.

149 2.2 Excluded Products

150 2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for
151 qualification under this specification. The list of specifications currently in effect can be found at
152 www.energystar.gov/products.

153 2.2.2 The following products are not eligible for qualification under this specification:

- 154 i. Network Equipment with one or more Small Form-factor Pluggable (SFP) network ports;
- 155 ii. Large Network Equipment; and
- 156 iii. Network Equipment that is marketed and sold as enterprise Network Equipment and
- 157 meets one or more of the following additional criteria:
- 158
 - is shipped without a power supply;
 - 159 • requires a separate external access point controller for operation.

160 **Note:** EPA received stakeholder feedback on the need to exclude “enterprise” level access points from
 161 consideration in Version 1.0, as they provide many features not found in the other access point products
 162 in the dataset, and consume significantly more power. Due to limited data on this type of access point,
 163 EPA has added the exclusion above which removes products marketed as enterprise network equipment
 164 and are; (1) shipped without a power supply and/or (2) cannot operate without a separate external access
 165 point controller. EPA welcomes stakeholder feedback on this exclusion. EPA intends to cover enterprise
 166 access point products in the future when more data on their power consumption is available.

167 **3 QUALIFICATION CRITERIA**

168 **3.1 Significant Digits and Rounding**

- 169 3.1.1 All calculations shall be carried out with directly measured (unrounded) values.
- 170 3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using directly
- 171 measured or calculated values without any benefit from rounding.
- 172 3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR
- 173 website shall be rounded to the nearest significant digit as expressed in the corresponding
- 174 specification limit.

175 **3.2 Power Supply Requirements**

- 176 3.2.1 External Power Supplies (EPSs): EPSs (single- and multiple-voltage) shall meet the level V
- 177 performance requirements under the International Efficiency Marking Protocol and include the
- 178 level V marking. Additional information on the Marking Protocol is available
- 179 at www.energystar.gov/powersupplies.
- 180 i. External Power Supplies shall meet level V requirements when tested using the *Test*
- 181 *Method for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac*
- 182 *Power Supplies, Aug. 11, 2004.*

183 **3.3 Efficiency Criteria**

- 184 3.3.1 Average Power Consumption (P_{AVG}): Calculated Average Power Consumption (P_{AVG}) per
- 185 Equation 1 shall be less than or equal to the maximum requirement for Average Power
- 186 Consumption (P_{AVG_MAX}), as calculated per Equation 2.

187 **Equation 1: Average Power Calculation (P_{AVG}) for Small Network Equipment**

188
$$P_{AVG} = Average[P_{WAN_TEST}, P_{LAN_TEST}, P_{WIRELESS_TEST}]$$

189 *Where:*

- 190
 - *Average[x_i] = Average of terms (x_i) applicable to the UUT;*
 - 191 *▪ P_{WAN_TEST} = Measured power consumption in Wired Network –*
 - 192 *WAN test, at 1.0 kb/s (W);*

193
194
195
196
197

- P_{LAN_TEST} = Measured power consumption in Wired Network – LAN test, half of available wired LAN ports populated, at 1.0 kb/s (W);
- $P_{WIRELESS_TEST}$ = Measured power consumption in Wireless Network – LAN test, at 1.0 kb/s (W).

198

Equation 2: Maximum Average Power (P_{AVG_MAX}) Calculation for Small Network Equipment

199

$$P_{AVG_MAX} = P_{BASE} + \sum_{i=1}^n P_{ADD_i}$$

200
201
202
203

Where:

- P_{BASE} = Base power allowance (W) from Table 1;
- P_{ADD_i} = The power allowance as specified in Table 2 for each feature present in the device, for a total of n such allowances.

204

Table 1: Base Power Allowances

Product Type	P_{BASE} (watts) Version 1.0
Broadband Modem – Cable	5.7
Broadband Modem – ADSL	4.0
ONT	4.4
IAD - Cable	6.1
IAD - ADSL	5.5
IAD - VDSL	7.5
Router	3.1
Switch	0.6
Access Point	2.0

205

206
207
208

Note: EPA has proposed the changes to the base power allowances in Table 1 based on stakeholder input and new product data received during the March 2013 SNE final data assembly effort. These changes are discussed in greater detail below:

209
210
211
212
213
214
215
216
217
218
219
220

- EPA removed the Broadband Modem – VDSL product category after closer examination of products in this ENERGY STAR category revealed that their features called for them to be placed in the IAD – VDSL category. As a result, these products have been moved to the IAD – VDSL category in the updated SNE dataset. The result is a lower base value in the IAD – VDSL category and the dropping of the Broadband Modem – VDSL category.
- EPA has added a telephony adder, which was necessary to support 911 capabilities in cable modem and cable IAD products. In light of this adder, EPA adjusted the base power of ONT products to ensure top performing ONTs are recognized as ENERGY STAR as most ONT products contain one or two telephony ports and are eligible for this new adder. See the note box related to Table 2 for more detail on the telephony adder.
- The Broadband Modem – Cable, IAD – Cable and Routers base levels were adjusted by 0.1 or 0.2 watts based on new data introduced during the recent data assembly effort.

Table 2: Additional Functional Adders

Feature	Power Allowance (P _{ADD}) in watts	Notes
Fast Ethernet (100Base-T)	0.1	Allowance applied once per port present in the UUT.
Gigabit Ethernet (1000Base-T)	0.3	Allowance applied once per port present in the UUT.
Wi-Fi (802.11a/b/g/n)	0.7	Allowance applied once for the UUT for availability of Wi-Fi connectivity.
802.11n per Receive Chain	0.2	Allowance applied to total number of 2.4 GHz and 5.0 GHz 802.11n receive chains. Only applicable for products that ship with simultaneous dual band Wi-Fi enabled.
802.11ac per Receive Chain	1.3	Allowance applied to 5.0 GHz 802.11ac receive chains only. Only applicable for products that ship with simultaneous dual band Wi-Fi enabled.
Plain Old Telephone Service (RJ11/RJ14)	0.5	Allowance applied once per port, up to a maximum of two ports.

222 **Note:** EPA has proposed changes to the functional adder values in Table 2 above based on stakeholder
 223 input and new product data received during the March 2013 SNE final data assembly effort. These
 224 changes are discussed in greater detail below:

- 225 • EPA received a number of recommendations to revise the Wi-Fi adders to account for newer
 226 products with multiple Wi-Fi bands and chains. EPA conducted an analysis which included existing
 227 product data from Draft 2, as well as new product data received as part of the SNE final data
 228 assembly effort, and developed an adder structure which results in pass rates at or above 25% for
 229 single and dual band simultaneous Wi-Fi products. Please note that the new Wi-Fi adders are in
 230 addition to the existing base Wi-Fi adder, and that all products with Wi-Fi functionality may still claim
 231 the base adder.
- 232 • EPA received feedback from stakeholders that an adder was needed for Plain Old Telephone Service
 233 (POTS) ports, as the base hardware required to support these ports cannot be shut off due to 911
 234 availability regulations. EPA's analysis of the dataset supported the above adder. EPA did observe an
 235 increase in power consumption between 1 POTS port and 2 POTS ports, but did not see any
 236 additional consumption when analyzing products with 4 POTS ports. For this reason, the telephony
 237 adder is capped at 2 ports.

238 3.3.2 Energy Efficiency Ethernet (EEE) Incentive: Small Network Equipment products that ship with
 239 IEEE 802.3az compliant Gigabit Ethernet ports may claim a 0.2 watt additional adder for each
 240 Gigabit port when calculating P_{ADD}.

241 3.3.3 External Proxy Incentive: Small Network Equipment products that ship with External Proxy
 242 Capability may claim **one** of the following adders in Table 3 when calculating P_{ADD} based on the
 243 level of Proxy functionality in the product, as defined in Section 1)F)10.

244

Table 3: External Proxy Incentives

Capability	Incentive Value in watts
Base Capability	0.2
Remote Wake	0.5
Service Discovery/ Name Services	0.8
Full Capability	1.0

245

246 **4 TESTING**

247 **4.1 Test Methods**

248 4.1.1 When testing SNE, the test methods identified in Table 4 shall be used to determine qualification
249 for ENERGY STAR.

250

Table 4: Test Methods for ENERGY STAR Qualification

Product Type	Test Method
All	ENERGY STAR Test Method for Small Network Equipment, Rev. November 2012

251 4.1.2 Products that have both ADSL and VDSL functionality shall be tested using their VDSL
252 functionality.

<p>253 Note: Based on stakeholder feedback received in response to Draft 2, EPA is proposing that products 254 with both ADSL and VDSL functionality be tested using VDSL connections. In Draft 2, these products 255 were required to be tested using their ADSL functionality, but because many of these products have 256 additional features commonly found in VDSL-only products, EPA will now require these products to be 257 tested with their VDSL functionality, and meet the VDSL base power allowance.</p>

258 **4.2 Number of Units Required for Testing**

259 4.2.1 Representative Models shall be selected for testing per the following requirements:

- 260 i. For qualification of an individual product model, a product configuration equivalent to that
261 which is intended to be marketed and labeled as ENERGY STAR is considered the
262 Representative Model;
- 263 ii. For qualification of a product family, the configuration that consumes the most energy
264 within the family shall be considered the Representative Model. If models in a product
265 family span multiple categories, product configurations that represent the worst-case
266 power consumption for each product category within the family are considered
267 Representative Models. When submitting product families, manufacturers continue to be
268 held accountable for any efficiency claims made about their products, including those not
269 tested or for which data was not reported.

270 4.2.2 A single unit of each Representative Model shall be selected for testing.

271 **4.3 International Market Qualification**

272 4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for
273 each market in which they will be sold and promoted as ENERGY STAR.

274 **4.4 Optional Performance Reporting**

275 4.4.1 At the Partner's option, data on the following performance considerations may be reported along
276 with product evaluation data:

- 277 i. Ethernet Throughput – The maximum data rate supported by the UUT for which there is
278 no packet loss.
- 279 ii. Maximum Number of Wireless Clients - The maximum number of clients supported by the
280 UUT.
- 281 iii. Maximum Number of NAT Clients
- 282 iv. Maximum number of IEEE Gigabit Ethernet ports – The maximum number of IEEE
283 802.3az compliant Gigabit Ethernet ports supported by the UUT. This reporting
284 requirement shall be mandatory for any products that claim the IEEE Incentive in Section
285 3.3.2.
- 286 v. Maximum External Proxy Capability – The highest level of External Proxy Capability
287 provided by the UUT as listed in Table 3. This reporting requirement shall be mandatory
288 for any products that claim the External Proxy Incentive in Section 3.3.3.

289 **5 USER INTERFACE**

290 5.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard
291 IEEE P1621: Standard for User Interface Elements in Power Control of Electronic Devices
292 Employed in Office/Consumer Environments. For details, see <http://eetd.LBL.gov/Controls>.

293 **6 EFFECTIVE DATE**

294 6.1.1 Effective Date: The Version 1.0 ENERGY STAR Small Network Equipment specification shall
295 take effect on **TBD**. To qualify for ENERGY STAR, a product model shall meet the ENERGY
296 STAR specification in effect on its date of manufacture. The date of manufacture is specific to
297 each unit and is the date on which a unit is considered to be completely assembled.

298 **Note:** EPA will issue a Final Draft after this Draft 3 and expects to complete the specification development
299 process in the coming few months. Partners will be invited to certify products to Version 1.0 as soon as it
300 is published. EPA's dataset demonstrates that there are already products on the market that meet the
301 Draft 3 levels, making a near term effective date appropriate.

302
303 6.1.2 Future Specification Revisions: EPA reserves the right to change this specification should
304 technological and/or market changes affect its usefulness to consumers, industry, or the
305 environment. In keeping with current policy, revisions to the specification are arrived at through
306 stakeholder discussions. In the event of a specification revision, please note that the ENERGY
307 STAR qualification is not automatically granted for the life of a product model.

308 **7 CONSIDERATIONS FOR FUTURE REVISIONS**

309 **7.1 Product Scope**

310 TBD

311 **7.2 Energy Efficiency Criteria**

312 TBD

313 **7.3 Energy Efficient Ethernet**

314 7.3.1 All ports for PHYs addressed by IEEE 802.3az shall be compliant with IEEE 802.3az.

315 **7.4 Network Proxy**

316 7.4.1 EPA will continue to monitor the implementation of proxying capability in Small Network
317 Equipment hardware and consider the development of a test method to determine the
318 functionality of a network proxy (e.g. one compliant with ECMA-393 ProxZzy for Sleeping
319 Hosts).