

**VOLUNTARY AGREEMENT
FOR ONGOING IMPROVEMENT TO THE ENERGY EFFICIENCY OF
SMALL NETWORK EQUIPMENT**

As Amended July 27, 2016

This document sets out a Voluntary Agreement between the undersigned Signatories to continue improvements in the energy efficiency of Small Network Equipment (SNE) used by consumers of residential broadband Internet access services in the United States.

1. Purpose

- 1.1 The purpose of this Voluntary Agreement is to continue improvements in the energy efficiency of SNE, thereby further reducing potential environmental impact and increasing benefits to consumers. Fostering device and service functionality while encouraging innovation and competition by Service Providers and SNE manufacturers are equally important objectives of this Voluntary Agreement.
- 1.2 Energy efficiency improvements will be pursued provided that such improvements do not jeopardize the intended uses and functionalities of SNE; that they preserve or enhance the customer experience; and that they are sufficiently flexible to adapt to technological options and market competition, to improve functionality, to offer service enhancements, and to foster rapid innovation.
- 1.3 The Voluntary Agreement is intended to be a complete and adequate substitute for all Federal and State legislative and regulatory solutions. The Signatories agree that this agreement is the preferred means for addressing the energy consumption of complex and rapidly changing networked devices that consumers purchase for home use for Internet access.
- 1.4 The Signatories agree that energy efficiency measures should not create undue burdens or competitive disadvantages for service providers or manufacturers.
- 1.5 Nothing in this Voluntary Agreement shall preclude any party from implementing energy efficiency measures that exceed the requirements of this Agreement.

2. Equipment Covered

- 2.1 This Voluntary Agreement covers the following types of SNE for residential use in the United States: Broadband Modems, Integrated Access Devices (IADs), and Local Network Equipment, as defined in Annex 1.
- 2.2 This Voluntary Agreement has no retroactive effect on equipment that is Sold, Purchased, deployed, or in inventory prior to January 1, 2015. In addition, the commitments of Section 3 have no retroactive effect on equipment that is Sold, Purchased, deployed, or in inventory prior to January 1, 2016. There is no requirement to retire or change existing equipment or to change existing equipment that is returned to a Service Provider and refurbished, repaired, and/or upgraded, and then redeployed. SNE that is returned from a retail channel to a Vendor and refurbished, repaired, and/or Sold shall be deemed to have been manufactured and Sold on its original date of manufacture and Sale.

3. Signatory Commitments for Small Network Equipment

- 3.1 Ninety percent (90%) of all SNE that Service Providers Purchase after December 31, 2015 shall meet the efficiency levels set forth in Annex 2 of this Voluntary Agreement.
- 3.2 Ninety percent (90%) of all SNE that Vendors Sell after December 31, 2015 shall meet the efficiency levels set forth in Annex 2 of this Voluntary Agreement.

4. Signatories to the Voluntary Agreement

- 4.1 Service Providers, Vendors, and Energy Advocates may become initial Signatories by executing this Agreement prior to its Effective Date.
- 4.2 After the Effective Date, qualified additional parties may become Signatories upon the approval of the Steering Committee, which shall not be unreasonably withheld.
- 4.3 Each Signatory endorses the purposes of the Voluntary Agreement and agrees to its commitments set out herein.
- 4.4 Each Signatory commits only to the areas which are under its individual control and responsibility.

5. Test Method

- 5.1 Compliance with the Voluntary Agreement efficiency levels shall be demonstrated using tests defined by Consumer Technology Association standard ANSI/CTA-2049, Determination of Small Network Equipment Average Energy Consumption, or such successor standard as is approved by the Steering Committee. Test results must be retained for a period of at least two years.
- 5.2 Self-testing is permitted, but is subject to audit pursuant to Section 7.

6. Reporting

- 6.1 Service Providers and Vendors shall provide their subscribers and potential customers with reasonable access to energy efficiency information about the SNE subject to the Voluntary Agreement no later than July 1, 2015 (or six months after signature, if later). The energy efficiency information to be made available under this section shall include test results in idle mode applicable to each model under the Test Method, with a list of features sufficient to calculate applicable allowances for each model of SNE Purchased or Sold after January 1, 2015. Different configurations of a model should be reported separately if energy use varies by configuration. This information shall be made publicly available by Service Providers for each model Purchased by that Service Provider as such models are made available to the Service Provider's subscribers, and shall be made available by Vendors for each model Sold (through retail channels) as such models are Sold by such Vendor. The information need not include confidential or commercially sensitive information, such as features that have not been publicly announced.
- 6.2 Commencing in 2016, each Service Provider and Vendor that Purchased or Sold SNE during the prior Reporting Period shall prepare a confidential annual report containing the data for the prior Reporting Period during which it was a Signatory and submit the report by April 1 of each year to the Independent Administrator or to an aggregating entity as set forth in Section 6.4 below. The information in the annual report shall include:

6.2.1 For Service Providers:

- 6.2.1.1 Total number of SNE units Purchased by the Service Provider during the Reporting Period, by device category.
- 6.2.1.2 Total number of SNE units Purchased by the Service Provider during the Reporting Period that meet the efficiency levels set forth in Annex 2, by device category.
- 6.2.1.3 Test results in idle mode applicable to each Purchased model under the Test Method, with a list of features sufficient to calculate applicable allowances.
- 6.2.1.4 Number of residential wireline broadband Internet access subscribers served during the Reporting Period.

6.2.2 For Vendors:

- 6.2.2.1 Total number of SNE units Sold during the Reporting Period, by device category.
- 6.2.2.2 Total number of SNE units Sold during the Reporting Period that meet the efficiency levels set forth in Annex 2, by device category. In order to avoid duplicate reporting, Vendor annual reports shall report Sales through retail channels and shall not report units provided at wholesale to Service Providers. If the total number of SNE units Sold by a Vendor during the Reporting Period is less than 5% of its total SNE units distributed for use in the United States during such period, in lieu of reporting only its devices Sold at retail, it may also separately report devices provided to Service Providers during the Reporting Period for purposes of demonstrating compliance with the 90% Sales commitment set forth in Section 3.2. The Independent Administrator shall use such data to determine whether the Vendor is in substantial compliance with the Sales commitment, but shall not otherwise include the Vendor's wholesale units in the Annual Report.
- 6.2.2.3 Test results in idle mode applicable to each Sold model under the Test Method, with a list of features sufficient to calculate applicable allowances. In order to avoid duplicate reporting, Vendor annual reports shall not report test results for models provided at wholesale to Service Providers. If such models are also Sold (through retail channels), test reports should also indicate that performance may vary when connected to Service Providers' networks.

6.2.3 Recommended reporting templates for Service Providers and Vendors are shown in Annex 3A and 3B.

- 6.3 A Reporting Period covers a single calendar year. When a Service Provider is making its first report, it may provide data either for the entire prior calendar year (effectively backdating its commitment to the January 1 preceding its signature) or provide a report covering only the period beginning with its signature.
- 6.4 By April 1 of each year commencing in 2016, the National Cable & Telecommunications Association (NCTA) and the Consumer Technology Association (CTA) shall provide the Independent Administrator with the estimated total number of U.S. residential wireline broadband Internet access subscribers served by all Service Providers (including those outside of the Voluntary Agreement) during the reporting period.

- 6.5 Annual reports shall be provided for the 2017 Reporting Period by April 1, 2018, notwithstanding any expiration of the initial Term of the Voluntary Agreement.
- 6.6 Service Providers may elect to submit reports to a recognized industry consortium or industry association for aggregation and anonymization prior to forwarding to the Independent Administrator for final aggregation and reporting, provided that individual records are retained for purposes of audit. In the case of Service Providers, the aggregating entity shall provide the Independent Administrator with: (1) the total number of compliant SNE devices Purchased by company; (2) the total number of SNE devices Purchased by company; (3) test results in idle mode applicable to each model under the Test Method, with a list of features sufficient to calculate applicable allowances; and (4) the total number by category of SNE (e.g., Broadband Modems, Integrated Access Devices (IADs), and Local Network Equipment) aggregated and anonymized so as not to reveal the mix of products by company. In the case of Vendors, the aggregating entity shall provide the Independent Administrator with the same information with respect to SNE Sold.
- 6.7 All reporting arrangements shall protect the confidentiality of commercially sensitive information. The Independent Administrator must sign a confidentiality agreement in relation to any confidential information supplied by the Signatories.
- 6.8 The Independent Administrator will review submissions for completeness and compliance, and will raise concerns within 30 days of submission.
- 6.9 The Independent Administrator and Steering Committee will publish a public annual report that will:
 - 6.9.1 Identify participating members during the reporting period.
 - 6.9.2 Identify the aggregate percentage of SNE devices Purchased and Sold that meet the efficiency levels set forth in Annex 2 of this Voluntary Agreement.
 - 6.9.3 Identify the aggregate number of wireline broadband customers served by Service Provider Signatories compared with the number of U.S. residential wireline broadband subscribers served by all Service Providers (including those outside of the Voluntary Agreement) during the Reporting Period.
 - 6.9.4 Include an Appendix of models of SNE devices Purchased by Service Provider Signatories and Sold by Vendor Signatories during the Reporting Period including their test results and a list of features sufficient to calculate applicable allowances. The information shall not include confidential or commercially sensitive information, such as shipping and volume reports and features that have not been publicly announced.

7. Audit and Verification

- 7.1 Either the Independent Administrator or an independent auditor approved by the Steering Committee will arrange for one model from each Commercial Signatory's annual report to be selected at random for verification testing at the Signatory's expense. Verification testing shall be conducted in third party labs approved by the Steering Committee or under a supervised Vendor or Service Provider testing program with an accredited observer approved by the Steering Committee. Cable Television Laboratories, Inc. (CableLabs) and the Cable Operators' test facilities operating under CableLabs' guidance are specifically approved as test facilities for these purposes.

- 7.2 Either the Independent Administrator or an independent auditor approved by the Steering Committee will conduct an audit of procurement or sale figures reported by one Commercial Signatory selected at random each year. The same Signatory shall not be randomly selected two years in a row.
- 7.3 In addition, on request of the Steering Committee, the Independent Administrator or independent auditor approved by the Steering Committee shall conduct an audit of the information and test results supplied by any Commercial Signatory's annual report.
- 7.4 Commercially sensitive information with respect to an individual Signatory, as designated by that Signatory, shall remain confidential both during and after the audit. Signatories agree to provide reasonable assistance to the auditor. The independent auditor must sign a confidentiality agreement in a form reasonably satisfactory to the Signatory. The Steering Committee shall bear the cost of such audit.

8. Steering Committee

- 8.1 A Steering Committee is established as the coordinating and governing body of this Voluntary Agreement.
- 8.2 Each Service Provider which is a signatory to the Set-Top Box Voluntary Agreement may nominate one person to represent it as a Member on the Steering Committee. Initial Service Provider Signatories shall maintain their Member seats on the Steering Committee notwithstanding any merger or consolidation of particular Service Provider Members. Additional Service Provider Signatories may be admitted on terms to be approved by the Steering Committee.
- 8.3 The Vendor Signatories may together nominate no more than three persons to serve as Members of the Steering Committee. A representative of the Consumer Technology Association shall serve as one such Member.
- 8.4 A representative of the National Cable & Telecommunications Association shall serve as a Member.
- 8.5 The Energy Advocates together may nominate no more than two persons to serve as voting Members of the Steering Committee.
- 8.6 Signatories entitled to nominate a Member may appoint an alternate representative that may attend meetings and vote in the absence of that Member. Signatories may replace a Member or alternative representative on notice.
- 8.7 The Steering Committee will elect a Chair from among its Members.
- 8.8 The Chair will be responsible for convening the Steering Committee meetings at least once each calendar year, and for running meetings of the Steering Committee.
- 8.9 At the request of any Signatory, the Chair may authorize any person to attend meetings of the Steering Committee as a non-voting observer.
- 8.10 Attendees at Steering Committee meetings shall sign a confidentiality agreement as a condition of attendance.
- 8.11 The Steering Committee may adopt rules of procedure and administration.

- 8.12 The Steering Committee may delegate any of its powers under the Voluntary Agreement to specific individuals or to sub-committees established by the Steering Committee.
- 8.13 The Steering Committee shall designate an Independent Administrator to be responsible for the collection and processing of information supplied directly or indirectly by Signatories and determining a Signatory's compliance with the Voluntary Agreement.
- 8.14 The costs of attending Steering Committee meetings will be borne by each attendee.
- 8.15 The costs of operating the Steering Committee shall be allocated in cost-recovery only annual dues set by the Steering Committee and assessed equally on each Signatory, except that the Steering Committee may approve lower dues for non-profit Energy Advocates. The initial dues shall not exceed \$10,000 per Signatory annually.
- 8.16 The Steering Committee will seek regular consultation and engagement with representatives of appropriate regulatory authorities and other stakeholders to provide updates regarding the implementation of this Agreement.

9. Amendment of the Voluntary Agreement

- 9.1 The Voluntary Agreement may be amended in accordance with the procedure set out in this Section 9. The Steering Committee will consult on proposed amendments to the Voluntary Agreement prior to any vote on an amendment.
- 9.2 The Members of the Steering Committee will negotiate in good faith when considering amendments to the Voluntary Agreement.
- 9.3 The Chair of the Steering Committee will call for a vote to be made by a subsequent meeting of the Steering Committee.
- 9.4 At the next meeting of the Steering Committee, each proposed amendment will be adopted if (1) there is at least agreement of two-thirds of the voting Members representing Commercial Signatories; (2) the two-thirds includes at least one Service Provider from each industry group (cable, satellite, and telephone) that Purchases a substantial volume of SNE equipment affected by the proposed amendment and at least one Vendor that Sells a substantial volume of SNE equipment affected by the proposed amendment; and (3) there is agreement by a majority of all voting Members.
- 9.5 Once an amendment to the Voluntary Agreement has been adopted, the Voluntary Agreement will be amended with the newly adopted amendment taking effect on the next anniversary of the Effective Date or such other date as may be adopted with the amendment.

10. Non-Compliance and Dispute Resolution

- 10.1 Substantial compliance with the Voluntary Agreement shall be assessed by the Independent Administrator, provided that the Signatory may appeal to the Steering Committee. The Steering Committee will establish dispute and compliance resolution procedures that provide notice of a claim to the Signatory, consultation, and an opportunity to provide a satisfactory remedial plan to the Steering Committee. The Steering Committee shall endeavor in good faith to resolve the issue within three (3) months.
- 10.2 Energy usage incident to patches released to SNE to address security and cybersecurity issues shall not be deemed a violation of Voluntary Agreement energy allowances or commitments.

- 10.3 In mitigation of any claims or concerns raised with respect to any Reporting Period and in evaluating substantial compliance with the Voluntary Agreement, a Signatory shall be credited for alternative energy efficiency steps which the Signatory demonstrates will provide net energy efficiency gains in the delivery of services that are superior to those required by the Voluntary Agreement. The Steering Committee shall adopt procedures for evaluating such alternative energy efficiency steps.
- 10.4 The Steering Committee may raise a claim against a Signatory concerning compliance with the Voluntary Agreement.
- 10.5 A Signatory that fails to fulfill its remedial plan may have its Signatory status terminated by the Steering Committee and its termination reported to such persons as the Chair may deem appropriate.
- 10.6 Involuntary termination constitutes the sole and complete remedy available to the Steering Committee, Signatories, Independent Administrator, auditor or any third party or other individuals or entities with respect to any alleged noncompliance with any term, provision or obligation of the Voluntary Agreement by a Signatory. Remedies under this SNE Voluntary Agreement are independent of remedies under the Set-Top Box Voluntary Agreement. A default under either such agreement is not a default of the other agreement.

11. Term and Termination

- 11.1 The term of this Voluntary Agreement begins on January 1, 2015, and continues through December 31, 2017. The Voluntary Agreement may be renewed by mutual agreement.
- 11.2 Any Commercial Signatory may terminate its Signatory status on twenty-eight days' written notice. Such termination shall immediately terminate all of that Signatory's rights and obligations under the Voluntary Agreement except that all confidentiality obligations arising from this Voluntary Agreement shall survive such termination.
- 11.3 The Energy Advocates may jointly terminate their status as Signatories, if (i) the other Signatories are not performing their obligations hereunder in good faith or changes in the Voluntary Agreement are not faithful to the purposes of the Voluntary Agreement and consistent with the justified expectations of all Signatories, or (ii) coverage of the Voluntary Agreement drops such that Service Providers who are Signatories serve less than 85% of the residential wireline broadband Internet access market. Upon termination of their Signatory status, the Energy Advocates may advocate for energy efficiency regulations for SNE, provided that during the period that the Voluntary Agreement remains in effect, any such advocacy will include their best efforts to assure that Signatories still operating under the Voluntary Agreement may continue to operate under its terms in lieu of new energy efficiency regulations. Examples of such advocacy would include urging regulators to (1) narrowly define the class of any regulated covered products to cover only equipment of Service Providers or Vendors that are not Signatories to the Voluntary Agreement (including those who were Signatories but have terminated their Signatory status); or (2) create a safe harbor for those operating under the Voluntary Agreement. Such termination shall be indicated by giving twenty eight days' written notice, signed by all Energy Advocates, to the Chair of the Steering Committee. Such termination shall immediately terminate all of the Energy Advocates' rights and obligations under the Voluntary Agreement except (i) the foregoing provision regarding post-termination advocacy and (ii) all confidentiality obligations arising from this Voluntary Agreement shall survive such termination.

- 11.4 The Chair of the Steering Committee will notify all Members of the Steering Committee and such other persons as the Chair may deem appropriate of the termination of any Signatory.

12. Termination of Regulatory Approaches

- 12.1 Each Signatory will use its best efforts to have all U.S. Federal and State proceedings considering mandatory test procedures or energy efficiency regulation of SNE used by Service Providers or sold by Vendors terminated and to discourage initiation of any new regulation directed at that equipment.
- 12.2 All commitments of Signatories are contingent on the termination and continued absence of all such proceedings unless otherwise mutually agreed by the Signatories.

13. Miscellaneous

- 13.1 Press. A Signatory may make public statements or issue press releases in relation to the Voluntary Agreement generally and its own compliance and/or engagement with the Voluntary Agreement. Except as expressly provided in this Voluntary Agreement, neither the Steering Committee nor any Signatory may make public statements or issue press releases making reference to another Signatory's compliance and/or engagement with the Voluntary Agreement (directly or by inference), except for: (1) statements made with prior approval of that other Signatory; and (2) comparative product information; provided that no statements may make use of or reveal confidential information. A Signatory may make public statements or issue press releases in relation to the Voluntary Agreement provided that no public statement or press releases: (1) may reveal confidential information; (2) provide information from which the operations of an individual Signatory may be inferred; or (3) be used as a tool for negotiations or advocacy for Federal or State legislative and regulatory solutions, it being agreed that concerns with operations under the Voluntary Agreement or opportunities for change shall be directed to Steering Committee discussions. A Signatory may engage in press activities concerning SNE energy efficiency that do not provide information about or refer to the Voluntary Agreement.
- 13.2 Force Majeure. If a Signatory is prevented or delayed in performance of its commitments hereunder as a result of circumstances beyond such Signatory's reasonable control, including, without limitation, acts of God, war, terrorism, acts of the government, or failure of suppliers, subcontractors, or carriers, such failure or delay will not be deemed to constitute substantial noncompliance with this Voluntary Agreement, but such commitments will remain in full force and effect, and will be performed or satisfied as soon as reasonably practicable after the termination of the relevant circumstances causing such failure or delay.
- 13.3 Counterparts. This Voluntary Agreement may be executed in one or more counterparts, each of which when so executed and delivered shall be an original and all of which together shall constitute one and the same instrument. Signatures to this Voluntary Agreement may be delivered by facsimile, which, upon delivery, shall be deemed to be originals.
- 13.4 Legal Effect. The Voluntary Agreement sets out a course of action for the Signatories to improve the energy efficiency of SNE. The Voluntary Agreement is not a commercial agreement and does not in itself create any contractual relationship, partnership, joint venture or other agency relationship among the Signatories. Nothing in this Voluntary Agreement shall be deemed to create a third-party beneficiary relationship.

13.5 Notice. All communications to Signatories in relation to the Voluntary Agreement should be addressed and sent to the relevant contact point specified in Annex 6. Communications to Members regarding the ordinary business of the Steering Committee may be sent to the email addresses provided by the Member.

SCHEDULE OF ANNEXES

ANNEX 1 – GENERAL DEFINITIONS

ANNEX 2 – ALLOWANCES

ANNEX 3A – REPORTING PRO-FORMA FOR SERVICE PROVIDERS

ANNEX 3B – REPORTING PRO-FORMA FOR VENDORS

ANNEX 4 – NEW FEATURES PROCESS

ANNEX 5, Part A – SERVICE PROVIDER SIGNING FORMS

ANNEX 5, Part B – VENDOR SIGNING FORMS

ANNEX 6 – CONTACT INFORMATION FOR NOTICES

ANNEX 1 – GENERAL DEFINITIONS

1. “Commercial Signatories” means Service Provider Signatories and Vendor Signatories.
2. “Effective Date” means January 1, 2015, except that as applied to a Signatory that signs the Voluntary Agreement after that date, it shall mean the date on which that party signs the Voluntary Agreement.
3. “End User” means a subscriber to Internet access services provided by a Service Provider who uses SNE provided by the Service Provider as part of the subscription.
4. “Energy Advocates” are the non-commercial organizations that participate in this Voluntary Agreement as Energy Advocates.
5. “Federal” includes any part of the government of the United States and any department, agency, or instrument thereof.
6. “Independent Administrator” means the party designated by the Steering Committee that is tasked with, and responsible for, the collection and processing of information supplied directly or indirectly by Signatories, and with determining a Signatory’s compliance with the Voluntary Agreement.
7. “Member” means a member of the Steering Committee.
8. “Purchase” means, with respect to a Service Provider, to accept delivery of SNE for commercial deployment to residential customers in the United States.
9. “Reporting Period” means the period within which the required information is to be submitted by a Signatory (which is generally a calendar year).
10. “Sell,” “Sale” and “Sold” refers to sale by a Vendor of SNE through retail channels for consumer purchase and use in residential broadband Internet access services in the United States. For purposes of Section 3.2, these terms refer only to units manufactured after December 31, 2015.
11. “Service Provider” means an entity that provides broadband Internet access services to residential subscribers with whom it has an ongoing contractual relationship through a cable, satellite, or other managed distribution network provided by that entity, and provides SNE to at least some of those subscribers.
12. “Set-Top Box Voluntary Agreement” refers to the Voluntary Agreement for Ongoing Improvement to the Energy Efficiency of Set-Top Boxes, Amended and Restated January 1, 2014.
13. “Signatory” and “Signatories” mean those companies or organizations that sign this Voluntary Agreement as Service Providers, Vendors or Energy Advocates.
14. “Small Network Equipment” means the following types of devices Purchased and placed into service by a Service Provider or Sold by a Vendor for the first time on or after the Effective Date for use by a consumer for residential access to broadband Internet access services in the United States. SNE excludes enterprise equipment and excludes Set-Top Boxes and Multi-Service Gateway Set-Top

Boxes with video as one of the primary functions (services) (as defined by the Set-Top Box Voluntary Agreement).

- a. "Broadband Modem." A simple network device that enables high speed data service with a WAN (Wide Area Network) interface to a service provider wired or optical network, and typically a single LAN (Local Area Network) interface for the customer premise network. The Broadband Modem category does not include devices with integrated router, or IEEE 802.11 (Wi-Fi) wireless access point functionality.
 - b. "Integrated Access Device" ("IAD"). A network device that enables high speed data service with a WAN interface to a service provider wired or optical network and one or more of the following functions on the LAN interface: multiport routing, IEEE 802.11 (Wi-Fi) wireless access point functionality, and/or VoIP.
 - c. "Local Network Equipment" ("LNE"). The following local network devices that do not have a direct interface to a Service Provider wired or optical network:
 - i. Wireless Access Point: A device that typically includes one or more Ethernet interfaces, and that provides IEEE 802.11 (Wi-Fi) wireless network connectivity to multiple clients as its primary function.
 - ii. Router: A network device that forwards packets from one network interface to another based on network layer information (typically IP destination address). Devices fitting this definition may provide both wired and wireless network connectivity.
 - iii. Switch: A network device that filters and forwards frames based on the Ethernet destination MAC address of each frame as its primary function.
 - iv. Network Extender: A device that bridges or extends a local area network beyond its physical limitations using one or more transmission media such as twisted pair, coax, Wi-Fi, or powerline.
15. "State" includes the governments of the District of Columbia and any State, territory, and insular possession of the United States and their political subdivisions; and any agency or instrument thereof.
16. "Steering Committee" means the coordinating and governing body of this Voluntary Agreement.
17. "Vendor" means an equipment manufacturer or other company that Sells SNE through retail channels for consumer purchase and use with residential broadband Internet access services in the United States; and a company that is responsible for designing, developing and/or manufacturing SNE for Purchase and deployment in the United States by a Service Provider.

ANNEX 2 – ALLOWANCES

VOLUNTARY AGREEMENT FOR ONGOING IMPROVEMENT TO THE ENERGY EFFICIENCY OF SMALL NETWORK EQUIPMENT

1 1. Introduction

2 This document defines maximum base and additional feature energy allowances and allowance
3 rules used to determine compliance with the VOLUNTARY AGREEMENT FOR ONGOING
4 IMPROVEMENT TO THE ENERGY EFFICIENCY OF SMALL NETWORK EQUIPMENT
5 (VA). The allowances are applicable to Small Network Equipment, as defined in the VA. SNE
6 excludes enterprise equipment and excludes Set-Top Boxes and Multi-Service Gateway Set-Top
7 Boxes with video as one of the primary functions (services) (as defined by the Set-Top Box
8 Voluntary Agreement).

9 2. Definitions

- 10 2.1. Small Network Equipment, Broadband Modem, Integrated Access Device, Wireless Access
11 Point, Router, Switch, and Local Network Equipment shall have the meaning set forth in
12 Annex 1.
- 13 2.2. ADSL2plus: an International Telecommunication Union standard for asymmetric digital
14 subscriber line (ADSL) broadband Internet access as defined by ITU G.992.5.
- 15 2.3. VDSL2: an International Telecommunication Union standard for very high speed digital
16 subscriber line (VDSL) broadband Internet access as defined by ITU G.993.2.
- 17 2.4. G.fast: an International Telecommunication Union standard for DSL broadband Internet
18 access as defined by ITU G.9700 and G.9701.
- 19 2.5. DOCSIS 3.0: DOCSIS 3.0 interface as defined by CableLabs® Data Over Cable Service
20 Interface Specification.
- 21 2.6. Advanced LNE: Local Network Equipment (LNE) that incorporates multi-port routing,
22 wireless access point, and/or VoIP functionality.
- 23 2.7. MoCA 1.1 and 2.0: home networking specification as defined by the Multimedia Over
24 Coax Alliance.
- 25 2.8. SFP - small form-factor pluggable (SFP): a compact, hot-pluggable transceiver used to
26 interface a device to a fiber optic or copper networking cable.
- 27 2.9. WAN – Wide Area Network: the interface(s) to the service provider network.
- 28 2.10. LAN – Local Area Network: the interface(s) to the consumer networking devices within the
29 premise.

- 30 2.11. MIMO - Multiple-Input and Multiple-Output: the use of multiple antennas at both the
31 transmitter and receiver in a bidirectional wireless communication device to improve
32 communication.
- 33 2.12. HPNA: HomePNA Alliance, formerly the Home Phoneline Networking Alliance.
- 34 2.13. FXS (Foreign Exchange Station): device interface, such as RJ-11, to connect directly to a
35 standard telephone, fax machine, or similar device and supply ring, voltage, and dial tone.
- 36 2.14. DECT: Digital Enhanced Cordless Telecommunications is the ETSI standard for short-
37 range cordless communications over unlicensed frequency used for voice, data and
38 networking applications with a range up to 500 meters.
- 39 2.15. USB: Universal Serial Bus.
- 40 2.16. SATA – Serial ATA: interface for connecting devices to external storage devices, such as
41 a hard disk drive (HDD).
- 42 2.17. Bluetooth: a wireless technology standard for exchanging data over short distances.
- 43 2.18. Zigbee: a specification for a suite of high-level communication protocols used to create
44 personal area networks built from small, low-power digital radios.
- 45 2.19. Z-wave: a wireless communications protocol designed for home automation.
- 46 2.20. PCIe (Peripheral Component Interconnect Express): a high-speed serial computer
47 expansion bus standard.
- 48 2.21. Application Processor > 5K DMIPS: This allowance provides for more powerful
49 processors in devices to accommodate advanced functionality.

50 **3. Test Method**

51 The test procedure as defined in ANSI/CTA-2049, Determination of Small Network Equipment
52 Average Energy Consumption, published by the Consumer Technology Association, shall be
53 used to measure the power consumption to demonstrate compliance.

54 **4. Idle Operational State**

55 The testing and power allowances are based on the device operating in idle state as defined in
56 ANSI/CTA-2049. This is defined as powered on but not actively passing traffic. It also defines
57 an idle interface as an interface that is configured and active and capable of passing traffic.

58 **5. Efficiency Criteria**

59 5.1. Significant Digits and Rounding – all measured and calculated power values shall be
60 rounded as follows:

61 5.1.1. To the nearest 0.01 W for power values of 10 W or less

62 5.1.2. To the nearest 0.1 W for power measurements of greater than 10 W and less than 100
 63 W

64 5.1.3. To the nearest 1 W for power measurements of greater than 100 W

65 5.2. Measured idle power as measured per the test method described in ANSI/CTA-2049 shall be
 66 less than or equal to the maximum requirement for allowed power in the idle state as
 67 calculated per equation 1.

68 **Equation 1 – Maximum idle power calculation for small network equipment**

$$P_{IDLE_MAX} = P_{Base} + \sum_{i=1}^n P_{ADD_i}$$

69 where

- 70 • P_{Base} = Base power allowance (W) from Table 1;
- 71 • P_{ADD_i} = The power allowance (W) as specified in Tables 2 and 3 for each
 72 feature present in the device, for a total of n such allowances.

73 **Table 1 – Base Power Allowances**

Base Allowance: IAD Devices (by WAN interface) (watts)		
ADSL2plus	3.9	
VDSL2 (8, 12a, 17a, but not 30a)	4.7	
VDSL2 (all above profiles including 30a)	6.2	
DOCSIS 3.0 basic configuration (4x4)	6.2	
MoCA 1.1/2.0	5.7	
Gigabit Ethernet	4.0	
SFP (1000BaseLX/SX)	4.0	
SFP (GPON)	5.0	
Base Allowance: Broadband Modems (by WAN Interface) (watts)		
ADSL2plus	2.4	
VDSL2 (8, 12a, 17a, but not 30a)	3.2	
VDSL2 (all above profiles including 30a)	4.7	
DOCSIS 3.0 basic configuration (4x4)	4.7	
G.fast	4.2	Reverse power feed (if available) should be disabled when testing
Base Allowance: LNE (watts)		
LNE other than Advanced LNE	2.0	
Advanced LNE	3.75	

Table 2 – Additional WAN Power Allowances

Adders for Additional Backup WAN Interface (watts)		
Gigabit Ethernet WAN	0.7	
SFP Not Present	0.7	
SFP Present (1000BaseLX/SX or GPON)	2.0	
Adders for Simultaneous Additional WAN Interface (watts)		
VDSL2 (8, 12a, 17a, but not 30a)	3.2	Use this adder for VDSL bonding
VDSL2 (profile 30a)	4.7	Use this adder for VDSL bonding
DOCSIS 3.0 additional power allowance for each additional 4 downstream channels above 4	1.5	e.g. a 16x4 cable modem has 12 downstream channels above 4, take $1.5 \times 3 = 4.5W$ adder.

Table 3 – Additional LAN Power Allowances

Adders for LAN interfaces and Additional Functionality (watts)		
1 Fast Ethernet port	0.2	For each port
1 Gigabit Ethernet port	0.25	For each port
Wi-Fi IEEE 802.11n radio at 2.4 GHz or at 5.0 GHz with a conducted output power less than 200 mW per chain (up to 2x2, i.e. 400 mW)	1.0	For each radio. A dual-band Wi-Fi router would take $1.0 \times 2 = 2.0W$ adder.
Wi-Fi, IEEE 802.11ac radio at 5 GHz with a conducted output power less than 200 mW per chain (up to 2x2, i.e. 400 mW)	2.1	
Additional allowance per RF chain above a 2x2 MIMO configuration (e.g., for 3x3 and 4x4) with a conducted output power less than 200 mW per chain	0.3	e.g. for a 4x4 radio, take $0.3 \times 2 = 0.6W$ adder.
Wi-Fi IEEE 802.11n radio at 2.4 GHz or at 5.0 GHz with a conducted output power greater than or equal to 200 mW per chain (up to 2x2, i.e. 400 mW)	1.2	For each radio. A dual-band Wi-Fi router would take $1.2 \times 2 = 2.4W$ adder.
Wi-Fi, IEEE 802.11ac radio at 5 GHz with a conducted output power greater than or equal to 200 mW per chain (up to 2x2, i.e. 400 mW)	2.5	

Additional allowance per RF chain above a 2x2 MIMO configuration (e.g., for 3x3 and 4x4) with a conducted output power greater than or equal to 200 mW per chain	0.4	e.g. for a 4x4 radio, take $0.4 \times 2 = 0.8W$ adder.
Wi-Fi IEEE 802.11n at 2.4GHz supporting 256-QAM	0.5	Take this in addition to 802.11n if supporting 256-QAM at 2.4GHz
HPNA	1.5	
G.hn	2.0	
MoCA 1.1/2.0	2.5	
FXS	0.3	For each port (up to two)
DECT	0.5	
USB 2.0 - no load connected	0.1	
USB 3.0 - no load connected	0.2	
SATA - no load connected	0.3	
Built-in back-up battery	0.4	If battery is present during test
Bluetooth	0.1	
ZigBee	0.1	
Z-wave	0.1	
PCIe Interface (Connected)	0.2	
Application Processor > 5K DMIPS	1.0	

76 **6. Usage rules for establishing the maximum allowable values:**

- 77 6.1. One and only one base allowance (P_{Base}) shall be used from either the IAD group, the
78 broadband modem group, or the LNE group in Table 1.
- 79 6.2. For an IAD or a broadband modem, the WAN interface is included in the base allowance.
80 For an LNE device all interfaces should be taken as additional allowances from Table 3:
81 LAN Power Allowances, even if a WAN interface is explicitly defined (because LNE does
82 not have a WAN that connects directly to the service provider network, as is the definition
83 of WAN in this document).
- 84 6.3. For VDSL channel bonding, add an allowance in the Adders for Simultaneous Additional
85 WAN Interface group.
- 86 6.4. For DOCSIS 3.0 channel bonding above 4x4, add an allowance for every four downstream
87 channels greater than 4. For example, a 16x4 cable modem will take an additional
88 $1.5 \times 3 = 4.5W$ allowance.
- 89 6.5. A device can only take either the adder for a backup WAN interface with SFP Not Present
90 (if the device contains an SFP cage that is not populated) or the adder with SFP Present, but
91 not both.

- 92 6.6. A dual-band 802.11 Wi-Fi device that supports both 2.4 GHz and 5.0 GHz concurrently can
93 take allowances for each radio, as described below:
- 94 6.1.1. If a device supports dual-band 802.11n but not 802.11ac, then it would take at most
95 two allowances for the 802.11n category (e.g. for a lower output power 2x2 device,
96 this would be $1.0 + 1.0 = 2.0W$).
- 97 6.1.2. If a device supports 802.11ac at 5.0 GHz, and 802.11n at 2.4 and 5.0 GHz, the
98 device can take at most one allowance in the 802.11ac category and at most one
99 allowance for the 802.11n category (e.g. for a lower output power 2x2 device, this
100 would be $2.1 + 1.0 = 3.1W$).
- 101 6.7. A device that supports more than 2 RF chains (or spatial streams) per radio (i.e. a 2x2) can
102 take one allowance for each RF chain greater than 2 for each radio (e.g. a device that
103 supports 802.11ac at 5.0 GHz, and 802.11n at 2.4 and 5.0 GHz, with a 3x3 MIMO at 2.4
104 GHz and a 4x4 MIMO at 5.0 GHz, would take $2.1 + 1.0 + 0.3 + (2 \times 0.3) = 4.0W$ for a lower
105 output power device.
- 106 6.8. A device can take either the low power Wi-Fi allowances or the high power Wi-Fi
107 allowances but not both.
- 108 6.9. A device that includes 802.11n supporting 256-QAM at 2.4GHz can take a 0.5W allowance
109 in addition to the appropriate (low power or high power) 802.11n allowance.
- 110 6.10. Transitional functionality allowance for external Wi-Fi acceleration processor: A VDSL
111 Gateway designed prior to July 1, 2013 with an external Wi-Fi network acceleration
112 processor and currently in field tests for 2015 and later deployment by a service provider
113 shall have a transitional functionality allowance of 2.8 W for the external Wi-Fi
114 acceleration processor, expiring December 31, 2017. This transitional allowance accounts
115 for a particular design, testing and deployment cycle as service providers meet minimum
116 customer performance requirements while they transition product to integrated chips that
117 include Wi-Fi baseband processing (avoiding need for an external network acceleration
118 processor). It is noted that devices deployed with this transitional allowance also permit
119 service providers to integrate Wi-Fi access point functionality currently performed by older
120 equipment in the home and to remove such older equipment.

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122 **7. Sample Calculations**

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124 7.1. **Product 1:** Integrated Access Device (IAD) with a DOCSIS 3.0 Cable WAN connection
125 and the following LAN connections:

- 126 1. Four Gigabit Ethernet ports
127 2. Dual-band simultaneous wireless access point using three receive streams of
128 5GHz 802.11ac and two receive streams of 2.4GHz 802.11n
129

DOCSIS 3.0 basic configuration (4x4)	6.2W
Four Gigabit Ethernet ports	1.0W (4 x 0.25W)
Wi-Fi IEEE 802.11n radio at 2.4 GHz or at 5.0 GHz with a conducted output power up to 200 mW per chain (up to 2x2, i.e. 400 mW)	1W
Wi-Fi, IEEE 802.11ac radio at 5.0 GHz with a conducted output power up to 200 mW per chain (up to 2x2, i.e. 400 mW)	2.1W
Additional allowance per RF chain above a 2x2 MIMO configuration (e.g., for 3x3 and 4x4) with a conducted output power up to 200 mW per chain	0.3W
Total	10.6W

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7.2. **Product 2:** Advanced Local Network Equipment (LNE) wireless router with a GigE interface to connect to a modem and the following additional features:

1. Four Gigabit Ethernet ports
2. Dual-band simultaneous wireless access point using 3 transmitters at 2.4 GHz and 3 transmitters at 5.0 GHz, supporting 802.11n at 2.4 GHz and 5.0 GHz, and 802.11ac at 5.0 GHz. (higher power radios that operate at > 200 mW conducted output power per chain)
3. USB 2.0
4. USB 3.0

Advanced LNE	3.75W
FIVE Gigabit Ethernet ports	1.25W (5 x 0.25W)
Wi-Fi IEEE 802.11n radio at 2.4 GHz or at 5.0 GHz with a conducted output greater than or equal to 200 mW per chain (up to 2x2, i.e. 400 mW)	1.2 W
Wi-Fi, IEEE 802.11ac radio at 5.0 GHz with a conducted output power greater than or equal to 200 mW per chain (up to 2x2, i.e. 400 mW)	2.5W
Additional allowance per RF chain above a 2x2 MIMO configuration (e.g., for 3x3 and 4x4) with a conducted output power greater than or equal to 200 mW per chain	0.8W (2x0.4W)
USB 2.0	0.1
USB 3.0	0.2
Total	9.8W

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ANNEX 3A – REPORTING PRO-FORMA FOR SERVICE PROVIDERS

Information to be provided by Service Providers

COMPANY REPORT

CONFIDENTIAL, RESTRICTED BY NDA

Service Provider Name:

Category (Cable, DBS, Telco):

Reporting Period:

Number of residential wireline broadband Internet access subscribers served:

as of (indicate date the reported number was recorded):

SNE Category:	Total Purchased	Number of Compliant Units	% of Units Compliant	Weighted Average (Watts)
Broadband Modems				
Integrated Access Devices				
LNE				
Total				

Energy consumption figures for each model, as detailed in Figure 1	
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Figure 1

Brand	Model Name	Model Number	Description	Primary Deployed Function	Base ... (1)	Adders ... (2)	Power Allowance (W)	Reported Power (W)
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Note (1) Include all columns indicated in Annex 2, Table 1. Indicate features with an integer value in the proper column.

Note (2) Include all columns indicated in Annex 2, Tables 2 and 3. Indicate features with an integer value in the proper column.

ANNEX 3B – REPORTING PRO-FORMA FOR VENDORS

Information to be provided by Vendors

COMPANY REPORT

CONFIDENTIAL, RESTRICTED BY NDA

Vendor Name:

Reporting Period:

SNE Category:	Total Sold	Number of Compliant Units	% of Units Compliant	Weighted Average (Watts)
Broadband Modems				
Integrated Access Devices				
LNE				
Total				

Energy consumption figures for each model, as detailed in Figure 1	
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Figure 1

Brand	Model Name	Model Number	Description	Primary Deployed Function	Base ... (1)	Adders ... (2)	Power Allowance (W)	Reported Power (W)
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Note (1) Include all columns indicated in Annex 2, Table 1. Indicate features with an integer value in the proper column.

Note (2) Include all columns indicated in Annex 2, Tables 2 and 3. Indicate features with an integer value in proper column.

Note: Performance may vary when connected to Service Providers’ networks.

ANNEX 4 – NEW FEATURES PROCESS

1. The New Features Process is intended to encourage innovation and competition by Service Provider and Vendor Signatories and also to encourage energy efficiency by design.
2. This process is intended to provide a path for Signatories to innovate and add new features, including features with no assigned allowances and features that are in the early stages of design, without being treated as in violation of Voluntary Agreement energy allowances or commitments.
3. This new feature process is intended to assure that most SNE remains under the procurement commitments of the Voluntary Agreement, with sufficient transparency for appropriate allowances to be established for new features.
4. If a Service Provider Signatory deploys or a Vendor Signatory Sells SNE that includes a new feature with no allowance, and the presence of the feature causes the SNE to exceed the prescribed allowances, the Signatory will set and report an appropriate initial allowance for the power consumption of that feature when it reports the device under the Voluntary Agreement.
5. The initial allowance will be reported within nine months of the initial deployment or Sale of such SNE if the Signatory expects that its percentage of Procurement or Sale of such SNE will be sufficient to be reported in its next annual report.
6. The initial allowance will represent the Signatory's best estimate of the amount of energy consumed by the new feature in that particular unit. All new features, associated initial allowances, and justifications for such allowances will be submitted to the Independent Administrator together with other required testing data. The Independent Administrator shall inform the Steering Committee of the Signatory's created allowance for the new feature, except as otherwise provided in Section 7 of this Annex.
7. If the new feature is confidential and the Signatory seeks an allowance, the Signatory shall confidentially report the initial allowance, the basis for the allowance, and a written justification for its confidentiality to the Independent Administrator. The new feature may remain confidential until the feature is marketed or otherwise made public. The Signatory shall inform the Independent Administrator within thirty days of marketing or otherwise making public a previously confidential new feature. In no case may a new feature remain confidential for purposes of this agreement for longer than eighteen months from initial deployment. Once a new feature is reported as public information or the eighteen month period has elapsed, the Independent Administrator shall inform the Steering Committee of the Signatory created allowance for the new feature. Annual reports should include the total energy use of SNE that includes confidential new features, but need not identify the new feature.
8. When the information is reported to the Steering Committee, the Steering Committee shall propose appropriate allowances and effective dates when the allowances would go into effect under the processes of Voluntary Agreement. Initial allowances set by the Steering Committee will reflect the Steering Committee's best estimates of the energy consumption required for systems incorporating the new feature to meet the Voluntary Agreement levels. Initial

allowances shall be set within six months of submission, and become effective at such time as is prescribed by the Steering Committee.

9. If a Signatory includes in its report to the Independent Administrator a SNE that it has Purchased but has not yet deployed that includes a new feature with no allowance, and the presence of the feature causes the SNE to exceed the prescribed allowances, the Signatory may report a provisional Signatory created allowance until an initial allowance is submitted after deployment.
10. Allowance setting would be designed to not prejudice a variety of implementations. If a new feature is specific to one particular industry group (cable, satellite, and telephone) and its energy consumption when applied to other industry groups is undetermined, it may be adopted for application solely to that particular industry group. The process for adopting a level for that feature will apply to other industry groups when one of its Signatory members submits an allowance for that feature to the Independent Administrator.
11. Allowances established by the Steering Committee for a new feature would be publicly reported as are other such allowances under the Voluntary Agreement.

ANNEX 5, Part A – SERVICE PROVIDER SIGNING FORMS

The undersigned Signatories agree to the Voluntary Agreement.

[COMPANY NAME]

Signature: _____

Name:

Title:

Date:

ANNEX 5, Part B – VENDOR SIGNING FORMS

The undersigned Signatories agree to the Voluntary Agreement.

[COMPANY NAME]

Signature: _____

Name:

Title:

Date: