

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

As Amended Effective January 1, 2018

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 This Voluntary Agreement is intended to be a complete and adequate substitute for all Federal and State legislative and regulatory solutions related to the energy efficiency of SNE. 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.
- 3.3 Annex 2 includes more rigorous Tier 2 levels that apply to both Service Provider Purchases and Vendor Sales commitments after December 31, 2019.

4. Signatories to the Voluntary Agreement

- 4.1 The current Signatories are set forth in Annex 4.
- 4.2 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 Satisfaction of the Voluntary Agreement efficiency levels shall be demonstrated using tests conducted in accordance with the Test Method as defined in Annex 1 (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) and the procedures set forth in Annex 2 (Program Requirements) and Annex 3 (New Features Process). 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.
- 5.3 The Signatories agree that consumers and stakeholders are best served by the consistent use of the same test method to measure the energy use of SNE, and will use best efforts to discourage any Federal or State authority from initiating any proceeding to consider the adoption of any mandatory test method for SNE.

6. Reporting

- 6.1 Service Providers and Vendors that Sell SNE at retail shall provide their subscribers and potential customers with reasonable access to energy efficiency information about the SNE subject to the Voluntary Agreement. For any new Commercial Signatories, this commitment will become effective six months after signature. 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 the Effective Date. Different configurations of a model should be reported separately if energy use materially 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 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 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 applicable 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 applicable 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.

6.2.2.4 Vendor Signatories are encouraged to transition early to manufacturing SNE that will meet new Tier energy levels prior to the effective date of such levels. At the same time, it would be counterproductive to the objectives of energy and resource efficiency to require the disposal of Vendor SNE that is manufactured prior to the date on which new Tier allowances become effective but that remain in inventory and have not been Sold prior to such date. Accordingly, a Vendor may choose to report such SNE in the year of its manufacture rather than its Sale, or it may report such SNE separately in the year of its Sale but request application of the Tier allowances that applied at the time of its manufacture.

6.2.3 Recommended reporting templates shall be approved by the Steering Committee.

- 6.3 A Reporting Period covers a single calendar year. When any new Signatory 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, NCTA - The Internet & Television 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 2021 Reporting Period by April 1, 2022, and the Independent Administrator shall provide a report to the Steering Committee in 2022 for the 2021 Reporting Period, notwithstanding any expiration of the Voluntary Agreement.
- 6.6 The Independent Administrator shall at least annually verify that the information required by Section 6.1 is posted and is readily accessible to consumers. If the Independent Administrator is not able to verify that the Signatory is in substantial compliance with its commitment, it shall request a report from the Signatory demonstrating substantial compliance. If the Independent Administrator finds that there has been insufficient improvement within 60 days of its request, it shall report that finding to the Steering Committee.
- 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 applicable 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 Independent Administrator's report 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 The Independent Administrator will randomly select one model from each Commercial Signatory's annual report that meets the energy efficiency levels of the applicable Tier for verification testing. The Independent Administrator may in its discretion exclude from selection any model that was successfully tested pursuant to this section in the prior year. Verification testing shall be conducted using the Test Method 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. The cost of verification testing shall be borne by the Commercial Signatory.

- 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. Upon request, 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 that has at least two million residential broadband Internet access subscribers at or after the date of execution of the 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 NCTA shall serve as a Member.
- 8.5 The Energy Advocates together may nominate no more than two persons to serve as 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. A Signatory may replace its 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.
- 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 A 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.
- 9.4 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 based upon data for the most recently completed Reporting Period and the information provided by each Signatory and data collected under the verification testing program. The Steering Committee will establish dispute and compliance resolution procedures that provide notice of a claim to the Signatory, consultation, and an opportunity to appeal to the Steering Committee or 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 initial term of this Voluntary Agreement began on January 1, 2015. Effective January 1, 2018, the Voluntary Agreement was extended for four (4) years, through December 31, 2021. 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 to the Chair of the Steering Committee. 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. 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 that 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. Commitment to the Voluntary Agreement as an Alternative to Regulatory Approaches

- 12.1 Each Signatory will use its best efforts to promote the Voluntary Agreement as an effective alternative to any U.S. Federal and State proceedings considering mandatory test procedures or energy regulation of SNE used by Service Providers or sold by Vendors terminated and to discourage initiation of any new regulations or legislation covering SNE energy use by any Federal or State authority.
- 12.2 All commitments of Signatories are contingent on the termination and continued absence of all U.S. Federal and State proceedings considering the adoption of such regulations or legislation 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 include confidential information.
- 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 legal notices to Signatories in relation to the Voluntary Agreement should be addressed and sent to the relevant contact point specified in Annex 5. Communications to Signatories regarding the ordinary business of the Steering Committee may be sent to the email addresses provided by the Signatory.

SCHEDULE OF ANNEXES

ANNEX 1 – GENERAL DEFINITIONS

ANNEX 2 – PROGRAM REQUIREMENTS

ANNEX 3 – NEW FEATURES PROCESS

ANNEX 4, Part A – SERVICE PROVIDER SIGNING FORMS

ANNEX 4, Part B – VENDOR SIGNING FORMS

ANNEX 5 – 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 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.
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.
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, 2018.
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, Service Provider network equipment, and 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. “Test Method” means the test procedure as defined in ANSI/CTA-2049, Determination of Small Network Equipment Average Energy Consumption, published by the Consumer Technology Association, or such successor standard as is approved by the Steering Committee.
18. “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 – PROGRAM REQUIREMENTS

1. Introduction

This document defines maximum base and additional feature energy allowances and allowance rules used to determine compliance with the Voluntary Agreement (VA). The allowances are applicable to Small Network Equipment, as defined in the VA. 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).

2. Definitions

- 2.1. Small Network Equipment, Broadband Modem, Integrated Access Device, Wireless Access Point, Router, Switch, and Local Network Equipment shall have the meaning set forth in Annex 1.
- 2.2. ADSL2plus: an International Telecommunication Union standard for asymmetric digital subscriber line (ADSL) broadband Internet access as defined by ITU G.992.5.
- 2.3. VDSL2: an International Telecommunication Union standard for very high speed digital subscriber line (VDSL) broadband Internet access as defined by ITU G.993.2.
- 2.4. G.fast: an International Telecommunication Union standard for DSL broadband Internet access as defined by ITU G.9700 and G.9701. References to G.fast herein and the associated allowances are only for single twisted pair implementations using a +4 dBm, 106 MHz profile, or coax implementations using a +2 dBm, 106 MHz or 212 MHz profile.
- 2.5. DOCSIS 3.0: DOCSIS® 3.0 interface as defined by CableLabs Data Over Cable Service Interface Specifications 3.0.
- 2.6. Advanced LNE: Local Network Equipment (LNE) that incorporates multi-port routing, wireless access point, and/or VoIP functionality.
- 2.7. MoCA 1.1 and 2.0 (single channel): home networking specification as defined by the Multimedia Over Coax Alliance.
- 2.8. SFP: small form-factor pluggable a compact, hot-pluggable transceiver used to interface a device to a fiber optic or copper networking cable.
- 2.9. WAN: Wide Area Network: the interface(s) to the service provider network.
- 2.10. LAN: Local Area Network: the interface(s) to the consumer networking devices within the premise.
- 2.11. MIMO: Multiple-Input and Multiple-Output: the use of multiple antennas at both the transmitter and receiver in a bidirectional wireless communication device to improve communication.
- 2.12. HPNA: HomePNA Alliance, formerly the Home Phoneline Networking Alliance.

- 2.13. FXS (Foreign Exchange Station): device interface, such as RJ-11, to connect directly to a standard telephone, fax machine, or similar device and supply ring, voltage, and dial tone.
- 2.14. DECT: Digital Enhanced Cordless Telecommunications is the ETSI standard for short-range cordless communications over unlicensed frequency used for voice, data and networking applications with a range up to 500 meters.
- 2.15. USB: Universal Serial Bus.
- 2.16. SATA – Serial ATA: interface for connecting devices to external storage devices, such as a hard disk drive (HDD).
- 2.17. Bluetooth: a wireless technology standard for exchanging data over short distances.
- 2.18. ZigBee: a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios.
- 2.19. Z-wave: a wireless communications protocol designed for home automation.
- 2.20. PCIe (Peripheral Component Interconnect Express): a high-speed serial computer expansion bus standard.
- 2.21. DOCSIS 3.1: DOCSIS® 3.1 interface as defined by CableLabs Data Over Cable Service Interface Specifications 3.1. References to DOCSIS 3.1 herein and the associated allowances do not include support for symmetrical full duplex (FDX) DOCSIS 3.1 as initially defined in Annex F of the CableLabs Specification CM-SP-PHYv3.1-I12-17026 or later versions.
- 2.22. G.hn: a home networking specification as defined by ITU-T G.9960 for data transmission over telephone wiring, coaxial cables, power lines, and Plastic Optical Fiber (POF).

3. Test Method

Satisfaction of the Voluntary Agreement efficiency levels shall be demonstrated using tests conducted in accordance with the Test Method and the Voluntary Agreement.

4. Idle Operational State

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

5. Efficiency Criteria

- 5.1. Significant Digits and Rounding – all measured and calculated power values shall be rounded as follows:
 - 5.1.1. To the nearest 0.01 W for power values of 10 W or less
 - 5.1.2. To the nearest 0.1 W for power measurements of greater than 10 W and less than 100 W
 - 5.1.3. To the nearest 1 W for power measurements of greater than 100 W

5.2. Idle power as measured per the Test Method shall be less than or equal to the maximum requirement for allowed power in the idle state as calculated per equation 1.

Equation 1 – Maximum idle power calculation for small network equipment

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

where

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

Table 1 – Base Power Allowances

Base Allowance: IAD Devices (by WAN interface)	Tier 1 (watts)	Tier 2 (watts)	Notes
ADSL2plus	3.9	3.7	
VDSL2 (8, 12a, 17a, but not 30a)	4.7	4.5	
VDSL2 (all above profiles including 30a)	6.2	6.0	
DOCSIS 3.0 basic configuration (4x4)	6.2	6.0	
DOCSIS 3.1 (no FDX)	16.7	15.1	
MoCA 1.1/2.0	5.7	5.7	
Gigabit Ethernet	4.0	4.0	
SFP (1000BaseLX/SX)	4.0	4.0	
SFP (GPON)	5.0	5.0	
Base Allowance: Broadband Modems (by WAN Interface)	Tier 1 (watts)	Tier 2 (watts)	
ADSL2plus	2.4	2.2	
VDSL2 (8, 12a, 17a, but not 30a)	3.2	3.0	
VDSL2 (all above profiles including 30a)	4.7	4.5	
DOCSIS 3.0 basic configuration (4x4)	4.7	4.5	
DOCSIS 3.1 (no FDX)	15.2	13.6	
G.fast	4.2	4.2	Reverse power feed (if available) should be disabled when testing
Base Allowance: LNE			
LNE other than Advanced LNE	2.0	1.5	
Advanced LNE	3.75	3.5	

Table 2 – Additional WAN Power Allowances

Adders for Additional Backup WAN Interface	Tier 1 (watts)	Tier 2 (watts)	Notes
Gigabit Ethernet WAN	0.7	0.4	
SFP Not Present	0.7	0.7	
SFP Present (1000BaseLX/SX or GPON)	2.0	2.0	
VDSL2 (8, 12a, 17a, but not 30a)	1.0	0.7	
Adders for Simultaneous Additional WAN Interface	Tier 1 (watts)	Tier 2 (watts)	
VDSL2 (8, 12a, 17a, but not 30a)	3.2	3.2	Use this adder for VDSL bonding
VDSL2 (profile 30a)	4.7	4.7	Use this adder for VDSL bonding
DOCSIS 3.0 additional power allowance for each additional 4 downstream channels above 4	1.5	1.3	e.g. a 16x4 cable modem has 12 downstream channels above 4, take $1.5 \times 3 = 4.5W$ adder. Not applicable to a DOCSIS 3.1 broadband modem or IAD.

Table 3 – Additional LAN Power Allowances

Adders for LAN interfaces and Additional Functionality	Tier 1 (watts)	Tier 2 (watts)	Notes
1 Fast Ethernet port	0.2	0.2	For each port
1 Gigabit Ethernet port	0.25	0.2	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	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	1.8	
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	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	1.1	For each radio. A dual-band Wi-Fi router would take $1.2 \times 2 = 2.4W$ adder.

Adders for LAN interfaces and Additional Functionality	Tier 1 (watts)	Tier 2 (watts)	Notes
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	2.2	
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	0.3	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	0.5	Applies in addition to 802.11n if supporting 256-QAM at 2.4GHz
HPNA	1.5	1.5	
G.hn	2.0	2.0	
MoCA 1.1/2.0 Single Channel	2.5	2.2	
FXS	0.3	0.3	For each port (up to two)
DECT	0.5	0.5	
USB 2.0 - no load connected	0.1	0.1	
USB 3.0 - no load connected	0.2	0.2	
SATA - no load connected	0.3	0.3	
Built-in back-up battery	0.4	0.4	If battery is present during test
Bluetooth	0.1	0.5	
ZigBee	0.1	0.2	
Z-wave	0.1	0.2	
PCIe Interface (Connected)	0.2	0.2	
Application Processor 5-10K DMIPS	1.0	1.0	

6. Usage rules for establishing the maximum allowable values:

- 6.1. One and only one base allowance (P_{Base}) shall be used from either the IAD group, the broadband modem group, or the LNE group in Table 1.
- 6.2. For an IAD or a broadband modem, the WAN interface is included in the base allowance. For an LNE device all interfaces should be taken as additional allowances from Table 3: LAN Power Allowances, even if a WAN interface is explicitly defined (because LNE does not have a WAN that connects directly to the service provider network, as is the definition of WAN in this document).
- 6.3. For VDSL channel bonding, add an allowance in the Adders for Simultaneous Additional WAN Interface group.
- 6.4. For DOCSIS 3.0 channel bonding above 4x4, add an allowance for every four downstream channels greater than 4. For example, a 16x4 cable modem will take an additional $1.5 \times 3 = 4.5W$ allowance.

- 6.5. A device can only take either the adder for a backup WAN interface with SFP Not Present (if the device contains an SFP cage that is not populated) or the adder with SFP Present, but not both.
- 6.6. A dual-band 802.11 Wi-Fi device that supports both 2.4 GHz and 5.0 GHz concurrently can take allowances for each radio, as described below:
 - 6.1.1. If a device supports dual-band 802.11n but not 802.11ac, then it would take at most two allowances for the 802.11n category (e.g. for a lower output power 2x2 device, this would be $1.0 + 1.0 = 2.0W$).
 - 6.1.2. If a device supports 802.11ac at 5.0 GHz, and 802.11n at 2.4 and 5.0 GHz, the device can take at most one allowance in the 802.11ac category and at most one allowance for the 802.11n category (e.g. for a lower output power 2x2 device, this would be $2.1 + 1.0 = 3.1W$).
- 6.7. A device that supports more than 2 RF chains (or spatial streams) per radio (i.e. a 2x2) can take one allowance for each RF chain greater than 2 for each radio (e.g. a device that supports 802.11ac at 5.0 GHz, and 802.11n at 2.4 and 5.0 GHz, with a 3x3 MIMO at 2.4 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 output power device.
- 6.8. A device can take either the low power Wi-Fi allowances or the high power Wi-Fi allowances but not both to characterize a specific radio in a device.
- 6.9. A device that includes 802.11n supporting 256-QAM at 2.4GHz can take a 0.5W allowance in addition to the appropriate (low power or high power) 802.11n allowance.
- 6.10. The DOCSIS 3.1 allowances for the broadband modem or IAD are defined for DOCSIS 3.1 devices that support 2 OFDM channels at 192 MHz and 4096 QAM and up to 32 SC-QAM channels at 256 QAM simultaneously in the downstream. A device that supports more than two OFDM channels will need to be evaluated under the new features process. A DOCSIS 3.1 broadband modem or IAD cannot take any additional DOCSIS 3.0 Simultaneous WAN Interface allowances.

7. Sample Calculations

- 7.1. **Product 1:** Integrated Access Device (IAD) with a DOCSIS 3.0 24x4 Cable WAN connection and the following LAN connections:
 1. Four Gigabit Ethernet ports
 2. Dual-band simultaneous wireless router using three receive streams of 5GHz 802.11ac and two receive streams of 2.4GHz 802.11n (both low power)

Feature	Tier 1 Allowance (watts)	Tier 2 Allowance (watts)
DOCSIS 3.0 base configuration (4x4)	6.2	6.0
DOCSIS 3.0 Additional Simultaneous WAN (each 4 DS channels above 4x4)	7.5 (5 x 1.5)	6.5W (5 x 1.3)
Four Gigabit Ethernet ports	1.0 (4 x 0.25)	0.8W (4 x 0.2)

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)	1	1
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)	2.1	1.8
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	0.3	0.3
Total	18.1	16.4

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

Feature	Tier 1 Allowance (watts)	Tier 2 Allowance (watts)
Advanced LNE	3.75	3.5
FIVE Gigabit Ethernet ports	1.25 (5 x 0.25)	1 (5 x 0.2)
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	1.1
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)	2.5	2.2
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	0.8 (2x0.4)	0.6 (2x0.3)
USB 2.0	0.1	0.1
USB 3.0	0.2	0.2
Total	9.8	8.7

ANNEX 3 – 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 features 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.
12. The Steering Committee may adopt appropriate modifications to the Test Method and/or additional rules governing the applicability of new feature allowances.

ANNEX 4, Part A – SERVICE PROVIDER SIGNING FORMS

The undersigned Signatories agree to the Voluntary Agreement.

AT&T Services, Inc.

Signature: /s/ Thomas Keathley
Name: Thomas Keathley
Title: Senior Vice President, Wireless Network Architecture and Design
Date: April 17, 2015

Cablevision Systems Corp.

Signature: /s/ Robert Clyne, Sr.
Name: Robert Clyne, Sr.
Title: SVP-Video Engineering
Date: April 17, 2015

CenturyTel Broadband Services, LLC d/b/a CenturyLink

Signature: /s/ James Feger
Name: James Feger
Title: VP Infrastructure Support
Date: June 22, 2015

Charter Communications, Inc.

Signature: /s/ Jay Rolls
Name: Jay Rolls
Title: Senior VP & Chief Technology Officer
Date: March 17, 2015

Comcast Cable Communications, LLC

Signature: /s/ Mark Hess
Name: Mark Hess
Title: Senior Vice President
Date: March 12, 2015

Cox Communications, Inc.

Signature: /s/ Kevin T. Hart
Name: Kevin T. Hart
Title: Executive Vice President & Chief Technology Officer
Date: March 20, 2015

Frontier Communications Corporation

Signature: /s/ Steve Gable
Name: Steve Gable
Title: Executive Vice President and Chief Technology Officer
Date: October 11, 2017

Time Warner Cable Inc.

Signature: /s/ Peter C. Stern
Name: Peter C. Stern
Title: EVP, Chief Product, People and Strategy Officer
Date: March 6, 2015

Verizon Communications, Inc.

Signature: /s/ James J. Gowen
Name: James J. Gowen
Title: Vice President Supply Chain Operations and Chief Sustainability Officer
Date: April 3, 2015

ANNEX 4, Part B – VENDOR SIGNING FORMS

The undersigned Signatories agree to the Voluntary Agreement.

Actiontec Electronics, Inc.

Signature: /s/ Brian Paul
Name: Brian Paul
Title: CFO
Date: February 24, 2015

ARRIS Group, Inc.

Signature: /s/ Jim Brennan
Name: Jim Brennan
Title: SVP, Supply Chain
Date: February 18, 2015

D-Link Systems, Inc.

Signature: /s/ Michael Boschma
Name: Michael Boschma
Title: Director of Product Management
Date: March 17, 2015

Netgear, Inc.

Signature: /s/ Andrew Kim
Name: Andrew Kim
Title: SVR Corporate Development and General Counsel
Date: April 29, 2015

Ubee Interactive, Inc.

Signature: /s/ Maria Popo
Name: Maria Popo
Title: President
Date: March 20, 2015