Proposal for Standards – Consumer Electronics (Docket #12-AAER-2A), Networking Equipment

[redacted]

for California Energy Commission's Invitation to Submit Updated Information

Christopher Hankin
INFORMATION TECHNOLOGY INDUSTRY COUNCIL
202-626-5753
chankin@itic.org

Andrea Deveau
TECHNOLOGY NETWORK
805-234-5481
adeveau@technet.org

Danielle Coffey
TELECOMMUNICATIONS INDUSTRY ASSOCIATION
703-907-7700
dcoffey@tiaonline.org

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INTRODUCTION AND SUMMARY

The Information Technology Industry Council ("ITI"),[1] the Technology Network ("TechNet"),[2] and the Telecommunications Industry Association ("TIA")[3] welcome the opportunity to comment on the Commission's Request for Revised Proposals and Information in the Appliance Efficiency Standards Rulemaking, as it pertains to networking equipment.[4] The members[5] of ITI, TechNet, and TIA appreciate the Commission's thoughtful approach to the consumer-facing aspects of energy efficiency and applaud the Commission's overall efforts to reduce power consumption, carbon emissions, and related consumer costs. For decades, California has been a leader in achieving significant improvements in energy efficiency, often made possible by technologies the State's information and communication technologies ("ICT") industry has pioneered. As electronics and information technology have become ubiquitous in the lives of Californians, all Americans, and citizens around the world, policymakers' focus on these types of products is understandable. It is logical for the Commission to consider how energy consumption in this space, including in communications networks, can be reduced.

The proposal currently under consideration for networking equipment, however, relies on faulty assumptions regarding (a) the networking equipment marketplace and (b) the efficacy of the federal ENERGY STAR standard as a proxy for clearly delineating retail network equipment intended for residential consumer use.[6] ITI, TechNet, and TIA respectfully disagree with the

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[1] ITI is the premier advocacy and policy organization for the world's leading innovation companies. Our

[2] TechNet is a leading voice for the policies and practices that foster innovation. It is the technology industry's strongest fundraising network and most effective policy advocacy organization, with a strong impact on federal and state policy issues critical to U.S. innovation and economic competitiveness. TechNet seeks to promote a technology-led innovation ecosystem and is committed to advancing the public policies and private sector initiatives that make the U.S. the most innovative country in the world. More information is available at http://www.technet.org/about/who-we-are/.

[3] TIA represents the global information and communications technology industry through standards development, policy advocacy and market intelligence. TIA's hundreds of member companies innovate the products and services that empower communications in every industry and market. Our members work through TIA's voluntary, consensus-based standards process to promote efficiency, interoperability and innovation in the ICT industry. TIA is accredited by the American National Standards Institute (ANSI). More information is available at www.tiaonline.org.

[4] Staff Webinar, *Request for Revised Proposals and Information; Appliance Efficiency Standards Rulemaking*, Jan. 15, 2014, available at http://www.energy.ca.gov/appliances/2013rulemaking/documents/2014-01-15_webinar/2014-01-15_Staff_Presentation.pdf ("January 2014 Staff Presentation").

[5] The member companies of TechNet, ITI and TIA employ well over 1,000,000 jobs in California alone and it is technology companies that are demonstrating an exponential increase in investment and employment into the future.

[6] Some commenters, including NRDC and the California Investor-Owned Utilities ("IOUs"), recommend that the Commission adopt an energy efficiency standard for the majority of residentially-focused small network equipment (where there is sufficient data available) and a test and list requirement for emerging small network equipment (specifically, fixed wireless devices) and small network enterprise equipment

Commission staff's conclusion that this proposal "contain[s] a sufficient core factual basis to support a regulation" and merely "could benefit from additional and updated information" regarding the scope, focus, and framework of a regulation.[7] To the contrary, the proposal does not articulate a valid energy efficiency standard. The focus on the number of ports is completely arbitrary, and inclusion of all equipment with integrated wireless capability is overreaching. Overall, this proposal misses the mark with respect to the key issue in characterizing network equipment: *functionality*.

Specifically, as discussed in more detail herein, the Commission should not develop a draft Title 20 regulation based on the current standards proposal for the following reasons:

- *First*, the proposal does not establish an adequate means to distinguish between network equipment purchased by consumers for home use (presumably the intended focus of the Commission's inquiry) and other network equipment, and it therefore is overbroad. Because the 11-port threshold and integrated wireless criterion are unreliable differentiators, the proposal risks sweeping in network equipment intended for enterprise and commercial uses. The Commission consistently has focused on residential equipment in this proceeding, and the inclusion of commercial equipment would expand the scope of potential regulation beyond the Commission's apparent intent. For example, the category, as currently defined, will include enterprise wireless access points. These access points operate collaboratively in large numbers to support hundreds or thousands of users in business, education and government facilities.

- *Second*, enterprise and commercial equipment is fundamentally different from consumer-grade network equipment, and its functionality cannot be optimized if power usage is capped under a standard intended for residential devices. Enterprise and commercial equipment is selected by knowledgeable, trained professionals who can measure the benefit of energy efficiency against other equipment features to select the best option for their needs. No regulation is necessary to ensure that these purchasers have adequate information to make educated choices regarding energy efficient products. For example, an enterprise satellite switch may have the same number and configuration of ports as a consumer switch but the operational requirements are significantly different. The enterprise switch must support the VLAN, authentication and security requirements of the large network; it must integrate with the network management that controls the entire network; and it must support the quality of service, reliability and high availability requirements of the applications.

(to test and list to gather data). To classify "small network equipment," these parties propose to use the ENERGY STAR definition of "small network equipment," which is defined as "network equipment that is intended to serve users in either small networks or a subset of a large network. Small network equipment includes a) all network equipment with integral wireless capability and b) other network equipment meeting [certain] criteria," including that it is "designed for stationary operation," "contains no more than 11 wired physical network ports," and is primarily configured "for operation outside of standard equipment racks."

[7] January 2014 Staff Presentation.

- *Third*, it is unworkable and ultimately harmful to consumers to include in any energy efficiency standard the type of "pro-sumer" equipment that is intended for residential use only in connection with a service provider network as a managed device. Service providers guarantee a quality of service and have intimate and proprietary knowledge of their networks; they are best suited to select devices that will allow them to meet consumers' needs, including, but not limited to, energy efficiency. Moreover, the Warren-Alquist Act requires the Commission to undertake a cost-benefit analysis prior to adoption of any energy standard. The Commission must consider the substantial costs that new regulatory obligations would impose on networks, costs that ultimately would be borne by consumers. For example, a service provider that offers a network-based home security function will specify and provide a router that can be monitored as part of the centralized service management and that has been tested to be secure and robust enough to guarantee the service availability. If the service provider is denied the use of specific devices then management and operational costs will be increased while the perceived value of the service will be reduced.

- *Fourth*, the Commission should recognize ongoing, voluntary industry efforts designed to increase the energy efficiency of networking equipment in the enterprise/commercial and pro-sumer spaces. These initiatives underscore that regulation is not necessary for these products. In any event, the Warren-Alquist Act requires the Commission to consider alternative approaches, measures, and costs before setting standards. As time has shown, tremendous efficiency gains have resulted not from mandatory government requirements but as a result of market and consumer demand, vigorous innovation and competition, and voluntary initiatives. The Commission must at least consider whether voluntary industry efforts or other approaches, such as testing and reporting, and incentives provided to consumers to purchase lowest power products already in the marketplace, can adequately satisfy its energy efficiency objectives without the adverse effects associated with a broad-brush standard.

Unlike many other products targeted by energy efficiency advocates, network equipment (and its energy usage) varies significantly based on its complex, highly configured, and customized nature.[8] A zeal for energy efficiency should not mistake the forest for the trees. Reduced power consumption in ICT products only is beneficial if it does not negatively impact critical equipment functionality. There is no upside for consumers to slashing energy usage simply for the sake of touting improvements in efficiency, without consideration of the scope of the covered equipment and the wide variety of characteristics and functions that distinguish devices from one another. In fact, a regulation which trades device functionality for energy

[8] Indeed, the proposal appears to be entirely misplaced, given various commenters' arguments in previous filings that the scope of the March 2012 Order Instituting Rulemaking on Appliance Efficiency Regulations did not include network equipment, nor did the August 2011 scoping workshop. This omission appeared to reflect the reality that networking devices, system architectures, and consumer markets are rapidly evolving and are ill-suited to broad categorization and regulation. The reason for the proposed shift is not clear. It is not appropriate for the Commission to change gears now and expand this proceeding to include network equipment of any type.

efficiency may actually sacrifice opportunities for greater energy efficiency gains through use of multifunction devices and software designed to optimize energy use on a broader scale.

Because of the unique aspects of network equipment, ITI, TechNet, and TIA encourage the Commission to carefully consider the adverse implications of regulating such equipment in this proceeding. The consequences of regulatory action at this time, among other things, would be to inhibit device and network functionality, increase costs for consumers in excess of any benefits delivered by regulation, and sacrifice opportunities to achieve greater energy efficiency gains. As an example, purchasing multiple units (network switch, wireless access point and WAN modem) may reduce energy consumption on a per-device basis, but would likely consume more energy in the aggregate relative to one higher-powered unit (a multiport router AP unit). These outcomes would be at odds with the Commission's statutory mandates for appliance efficiency regulations.

The realization of the State's energy goals pursuant to the Warren-Alquist Act and other laws, and the health of the State's economy, depends upon continuing a vibrant, innovative ICT sector and the State's continuing technology leadership. Our industry is innovating in many ways every day, including in the area of energy efficiency. New, more efficient products are displacing old technologies at a rapid rate. That innovation should not be constrained by artificial thresholds and indiscriminant mandatory caps.

DISCUSSION

The goals of the proposal under consideration – environmental stewardship, increased energy efficiency, decreased carbon emissions – are all laudable, and member companies of ITI, TechNet, and TIA are leaders in this space. It is the specifics of the proposal – notably, the proposed mandatory standards – that the Commission should reconsider for the reasons discussed below.

I. THE PROPOSAL IS IMPERMISSIBLY OVERBROAD AND INCONSISTENT WITH THE CEC'S STATED INTENT IN THIS PROCEEDING.

While networking equipment designed for household use presumably is the intended focus of the Commission's inquiry, the proposal under discussion does not sufficiently delineate this category of device. There are many types and classifications of network equipment, and there are no standard or industry-recognized definitions that can be used in a normative manner to distinguish categories. Products are diverse, complicating easy categorization. Such complexity bedeviled the Environmental Protection Agency ("EPA") and stakeholders in trying to draft the Version 1.0 ENERGY STAR Small Network Equipment Specification ("SNE"). Despite a two-year process with stakeholders, the final specification did not adequately segregate commercial or enterprise class networking equipment from retail consumer networking devices. The ENERGY STAR definition of SNE that the Commission is contemplating as a potential starting definition of this proceeding represents EPA's unsuccessful attempt to neatly subdivide the entire network equipment domain into two broad categories for the purposes of developing ENERGY STAR specifications. Although ENERGY STAR has attempted to draw a line between "small networking equipment" and "large networking equipment" based on the number of ports, the industry consistently has explained that this number is completely arbitrary and, in

many cases, an inaccurate proxy for identifying retail consumer products.[9] As examples of the issues created by the ENERGY STAR definition:

- The definition does not take into account the number of users associated with a device. The functional requirements of a device depend largely on the number of users on the network associated with the device rather than the number of network ports of the device itself. Additional functions may include deep packet inspection, secure tunneling and encryption according to commercial or statutory requirements.

- The ENERGY STAR SNE specification provides no power adder or exclusion for products that support specific capabilities for vertical segments or government required security features such as FIPS 140-2, HIPAA, Payment Card Industry (PCI), etc. These features are being incorporated into networking equipment instead of in dedicated security devices in order to reduce cost, complexity, and energy consumption in corporate campus environments. The addition of these features drives significantly higher power consumption in these devices than the consumer class products found in the retail sales outlets.

- Currently, there are seven total products on the EPA ENERGY STAR for Small Networking equipment website. Six of these products are classified as "routers" but include wireless access points. The average power of these six wireless router products varies from a low of 2.4W for a low performance wireless router to 9.24W for a wireless router with 802.11AC, gigabit Ethernet, and full proxy capability. If one merely reviews the average power draw without taking into account differences in functionality, one might conclude that a 9.24W router should not be allowed. If the Commission were to cap power draw based on the average of these products, however (thus barring sale of a 9.24W router), it would not be possible to manufacture and sell in California an 802.11AC, gigabit Ethernet, full proxy wireless router. Exclusion of the highest power systems in this data set from the market would mean that there would not be any high performance routers available in the California market, a result that is inconsistent with the Commission's consumer-oriented directive and that clearly would not benefit consumers.[10]

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[9] In joint industry comments, industry stated that the definition being used for SNE "does not match real-world uses of the equipment and will result in enterprise-grade equipment being tested in comparison with consumer-grade equipment." *See* Joint Industry Comments of CEA, ITI, and TIA ENERGY STAR Small Network Equipment Version 1.0 (Mar. 25, 2013), available at www.tiaonline.org/sites/default/files/pages/3-25-2013%20Joint%20Industry%20Comments-Energy%20Star%20SNE.pdf

[10] Public Resources Code section 25402(c)(1): "The standards adopted or revised pursuant to this subdivision shall not result in any added total costs for consumers over the designed life of the appliances concerned. When determining cost-effectiveness, the commission shall consider the value of the water or energy saved, impact on product efficacy for the consumer, and the life cycle cost to the consumer of complying with the standard. The commission shall consider other relevant factors, as required by Sections 11346.5 and 11357 of the Government Code, including, but not limited to, the impact on housing costs, the total statewide costs and benefits of the standard over its lifetime, economic impact on California businesses, and alternative approaches and their associated costs."

If the 11-port threshold were to have any meaning, in virtually all circumstances a piece of equipment with 11 or fewer ports would constitute networking equipment for household use, and a piece of equipment with 12 or more ports would not. However, this is not necessarily the case. The question is how equipment is used in the real world, and this determination is not based on the number of ports. We note that an Amazon.com search on "computer networking equipment" lists 119 routers, 68 access points and over 200 Ethernet switches with fewer than 11 ports. A more comprehensive search of available products from all sources would yield an even greater number, the vast majority of which would be intended for enterprise and commercial use. The proposal also covers all networking equipment with integrated wi-fi capability, a criterion that clearly applies to many enterprise and commercial devices alongside a small number of residential devices.

Since the proposal would subject numerous devices that are not residential or even intended for small networks to new regulation, it is inconsistent with the Commission's stated intent to focus this proceeding on network equipment for residential use.

II. ENTERPRISE AND COMMERCIAL EQUIPMENT SHOULD NOT BE SUBJECT TO STANDARDS INTENDED FOR HOUSEHOLD USE NETWORKING EQUIPMENT

As an overall matter, enterprise and commercial network equipment is fundamentally different from retail consumer equipment and should not (and cannot) be addressed holistically with such equipment – this will result in a group of devices so large that it is impossible to develop and implement meaningful standards. Functionality for networking equipment intended for enterprise and commercial customers cannot be optimized if power usage is capped under a residential standard. For example, the link security feature (defined by IEEE Std. 802.IAE), which is considered necessary for networks with sensitive information, would not be feasible for networking devices that are constrained only for purposes of marginal power use reductions.

Unlike most retail consumer equipment, enterprise and commercial equipment is selected by knowledgeable, trained professionals who can measure the benefit of energy efficiency against other equipment features to select the best option for their needs. Their focus properly is on the overall functionality of the equipment. Measuring energy efficiency without taking into account how the equipment is used and the optimal function it is intended to serve will lead to unintended outcomes that are at odds with the Commission's statutory mandates. Professional buyers take a long-term, business-impact view and are able to balance the broad interests of driving industry to a better place, maintaining customer satisfaction, and saving energy *and other network* costs. Applying efficiency standards to this class of equipment would be unnecessary and counterproductive.

III. SERVICE PROVIDERS ARE BEST SUITED TO BALANCE THE ENERGY EFFICIENCY AND FUNCTIONALITY OF PRO-SUMER EQUIPMENT

It is unworkable and ultimately harmful to consumers to include in any energy efficiency standard "pro-sumer" equipment that is intended for residential use only in connection with a service provider network as a managed device. Although pro-sumer equipment is ultimately intended for use in a residential setting, it is service providers, rather than consumers, who are

best situated to balance the optimal functionality versus energy usage. Service providers guarantee a quality of service and have intimate and proprietary knowledge of their networks; they are best equipped to select devices that will allow them to meet consumers' needs, including, but not limited to, energy efficiency. (As noted above, professional buyers are able to knowledgeably shop for and purchase products that balance various priorities, including energy efficiency.)

Moreover, the Warren-Alquist Act requires the Commission to undertake a cost-benefit analysis prior to adoption of any energy standard.[11] The Commission must consider the substantial costs that new regulatory obligations would impose on networks, costs that ultimately would be borne by consumers. In addition to direct costs to consumers, the Act in this instance would also require the Commission to consider the cost to service providers to develop and obtain new equipment consistent with the proposed standard. These costs would be subsumed within the Commission's mandate to evaluate "the total statewide costs and benefits of the standard over its lifetime" and "economic impact on California businesses."[12]

The NRDC's own study[13] shows that most consumer purchased networking devices currently consume around 50kWhr/year and few households have more than one of these devices. Therefore the total potential benefit is necessarily small. The normal direction of technology development leads to reductions in cost for consumer devices (which are often accompanied by reductions in energy consumption as a side effect); changing the focus of development by regulation will disrupt this trend and will lead to increased costs for the consumer.

IV. VOLUNTARY INDUSTRY INITIATIVES IN THE COMMERCIAL/ ENTERPRISE AND PRO-SUMER PRODUCT CLASSES REPRESENT THE FASTEST, MOST RELIABLE, AND LEAST EXPENSIVE PATH TOWARD THE COMMISSION'S NETWORKING EQUIPMENT ENERGY EFFICIENCY GOALS

The Commission should recognize the benefits of ongoing, voluntary industry efforts designed to increase the energy efficiency of networking equipment in the commercial/enterprise and pro-sumer spaces. For commercial and enterprise networking equipment, efforts are well underway to comply with identified industry standards for energy efficiency. Indeed, energy efficiency already is becoming a competitive differentiator for enterprise networking equipment. Pro-sumer equipment is not far behind, with standards development in progress. In energy efficiency and other areas, tremendous gains have resulted not from mandatory government requirements but as a result of market and consumer demand, vigorous innovation and competition, and voluntary initiatives. These initiatives underscore that regulation is not necessary for these products. In addition, networking equipment products and markets are evolving rapidly. In such an environment, the potential costs of regulatory action are likely to be especially high relative to the benefits that could be obtained through regulation.

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[11] Public Resources Code section 25402(c)(1)

[12] Public Resources Code section 25402(c)(1).

[13] http://www.nrdc.org/energy/files/residential-network-IP.pdf

In any event, the Warren-Alquist Act requires the Commission to consider alternative approaches, measures, and costs before setting standards.[14] Thus, under the statute, the Commission must at least consider whether voluntary industry efforts or other approaches, such as testing and reporting, or providing incentives to consumers can adequately satisfy its energy efficiency objectives without the adverse effects associated with a standard. In this regard, the Set Top Box Voluntary Agreement (VA), signed by a diverse group of conservationists, providers and the equipment industry, provides for new energy standards that will improve set top box efficiency and that are already achieving significant energy savings. The VA was expanded to include specific provisions committing the parties to commence joint efforts to develop energy efficiency measures for small networking equipment (SNE) such as residential modems and routers. The work is now underway to craft SNE energy efficiency measures that also allow for rapid innovation in the equipment that supports Internet and broadband services.

SPECIFIC REQUESTS: DATA AND ANALYSIS

ITI, TechNet, and TIA welcome the opportunity to provide data and analysis to the Commission, as it is clear that the proposal currently under consideration does not accurately reflect technical or marketplace realities. We also are happy to serve as an ongoing resource to the Commission in this regard.

Request 1. Include analysis of newly released performance data for ENERGY STAR qualified small network equipment.

There is very little data available on the ENERGY STAR "Small Network Equipment" category, and the program as currently constituted is of questionable longevity.

As discussed above, ITI, TechNet, and TIA believe that the ENERGY STAR SNE definition is not the correct starting point for the Commission's inquiry. It is telling that there currently are only seven total products on the EPA ENERGY STAR for SNE website.[15] Six of these seven products are classified as routers, and include wireless access points, and the seventh is classified as an IAD that also includes a wireless access point. Four of the categories defined in the program requirements are not represented at all. As an example, the average power varies from a low of 2.4W for a low performance wireless router to 9.24 for a wireless router with 802.11AC, gigabit Ethernet and full proxy capability.

If we were to draw conclusions based upon this limited data set it would be that adding full proxy capability to an 802.11AC capable wireless router drives an increase of about 3.5W and should therefore be disallowed. Exclusion of the highest power systems in this data set from the market would mean that there would not be any high performance routers available in the California market.

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[14] Public Resources Code section 25402(c)(1)

[15] https://www.energystar.gov/certified-products/detail/526/partners

The members of ITI, TechNet, and TIA are strong supporters of the ENERGY STAR program and, importantly, have a commercial incentive to design and build products that meet ENERGY STAR specifications. But if a specification does not reflect the reality of the marketplace and desired device functionality, the result is what we see here. Based on the evidence, one must conclude that the program requirements are skewed very strongly towards one type of product to the detriment of other product types. All seven of the devices are designed for the residential consumer market and would be considered to perform an equivalent function for a home user. It is not clear from the data whether any of these devices support additional functions such as VPN or firewall or what level of performance they can sustain. The tested power varies by a factor of more than three without any clear reason. In sum, we question the longevity of the ENERGY STAR SNE program as currently constituted, given the clear barriers to entry and the resulting low level of participation. In turn, the questionable efficacy of the program makes it a poor choice as a foundation of the Commission's inquiry on networking equipment.

Request 1A. Compare relative performance to NRDC study.

It is impossible to assess the performance of ENERGY STAR SNE products relative to the NRDC study. As an initial matter, the NRDC study represents a limited analysis of a handful of consumer devices that were purchased in low-end retail outlets and all serve largely the same purpose. It is unclear how NRDC extrapolated the data collected on tested power consumption to calculate average domestic use and the related total energy footprint. The study does not include any analysis of market share or penetration for these devices, either by type or vendor. This calls into question the results of the study and suggests it is not an appropriate justification for a program as broad as the ENERGY STAR SNE program. Nor does it offer a good base for comparison here. There are only three products that are listed in both the ENERGY STAR and NRDC data sets. While these products appear to have similar average power values, the limited size of the ENERGY STAR SNE data set makes it impossible to perform any meaningful and relevant comparison between the two data sets.

Request 1B. Initial Market Share.

As previously described, an informal search of Amazon.com found a large number of devices. The seven products from two suppliers claiming ENERGY STAR SNE compliance represent an insignificant fraction of this market. Particularly as five of the categories in the SNE program requirements have no qualified products available. More reliable market share information is available from market research organizations, some of which will break the market down by segment (enterprise vs. consumer) as well as measuring the product volumes associated with each market.

Request 2. Provide data on commercial network equipment – ATIS 0600015, ECR network and telecom equipment data, and other available efficiency/energy/power information.

We are not aware that such data is currently available.

Request 3. Provide information and data regarding technology trends: Wi-Fi power scaling technologies; market penetration of Energy Efficient Ethernet; market trends towards use of gateway devices.

In terms of technology trends, the network equipment market remains immature with respect to both technology and architecture. Unlike mature, single function technologies typically subject to energy usage mandates, network equipment technologies continue to rapidly evolve and transfer and consolidate functionalities in different parts of the network. With the increasing connectivity of the smart home, the potential for convergence of other unanticipated functionalities into network equipment is extremely high. VoIP, home security systems, home health monitoring and home energy management are a few examples of current and future functionalities being integrated into home network equipment, and there are doubtless many other applications and functionalities that could converge in network equipment that we cannot anticipate. Mandating energy conservation standards at a main communications gateway to the home such as a router, where significant changes in functionality are most efficient and likely to occur will negatively impact innovation and competition in the marketplace and could result in higher energy consumption overall and higher costs to consumers. Any regulatory consideration of network equipment should consider the unanticipated consequences that will arise from mandating energy usage for equipment where the future of the technology and competing technologies are difficult if not impossible to anticipate, the pathway to efficiency gains are not clear, and the functionality of the network equipment products is in a state of flux.

In general, market penetration information should be obtained from market research studies. One good example is the IDC Worldwide Quarterly Ethernet Switch and Router Tracker. Product vendors do not have the same access to unbiased, broad market views. Similarly, the view of future market trends is highly dependent on the business interest of the producer; endorsing one specific view could be seen as detrimental to those who are pursuing a rival policy.

We note that the Commission may benefit from reviewing the IDC tracker and similar papers. These materials accurately capture the marketplace and the way the industry evaluates it – for example, in terms of classes of products, the intended customer, etc. They certainly underscore that commercial/enterprise and even pro-sumer equipment are substantially different from the type of residential equipment the Commission has said it intends this proceeding to address.

In the field of WiFi, there are a number of power management technologies that encompass both standards based and proprietary techniques. Standards, such as IEEE 802.11h and IEEE 802.11v are becoming ubiquitous, allowing more efficient management of the access point power and techniques to conserve client energy. Proprietary power management technologies function independently within the device and do not have any significant effect on the external behavior. Most devices employ some power management technologies as a matter of good design practice.

Energy Efficient Ethernet is now widely available for some physical layer interfaces and is becoming ubiquitous for new systems that use those particular interfaces. However, the standard that defines Energy Efficient Ethernet for speeds above 10Gb/s and for fiber optic

interfaces has not yet been ratified and it can be expected that products will not be available supporting EEE for these interfaces for some years to come. It should also be noted that some high performance network applications may require a configuration of EEE that conserves less energy as a tradeoff for performance.

Request 4. Provide power supply information: percentage utilizing external power supplies; power supply sizing, max output versus typical operation; current efficiencies.

The vast majority of networking equipment use external power supplies (EPS), and such power supplies are currently regulated by the U.S. Department of Energy.

Request 5. NRDC and other data sources show large power variance between products that perform similar tasks and have similar data capacity (data shows some devices use 2-4 times as much power as the lowest power devices.

The NRDC data set consists of consumer products and does not provide any information on commercial or enterprise class networking products. Below is a table of wireless routers extracted from the NRDC paper. Columns indicating ports, port speeds and radio capabilities that indicate performance capabilities of these products were added. The final column indicates the Energy Star SNE specification limit that would be applied to that product. The table indicates adoption of the SNE specification would eliminate the majority of the high performance (802.11AC, 802.11AD) products from the California market.

Product Class	Manufacturer	Model Number	USB Ports	Qty Ethernet Ports	Speed of Ethernet Ports	Features	Radios x Antennas	Power (W)				Energy Star SNE Limit
								WAN Test	LAN Test	Wireless Test	ENERGY STAR average power	
Router	TRENDnet	TEW-711BR		5	10/100	802.11 bgn (2.4Ghz)	1x2	-	1.8	1.6	1.7	4.8
Router	Mediabridge	Medialink MWN-WAPR150N		5	10/100	802.11 bgn (2.4Ghz)	1x1	-	2.9	2.9	2.9	4.8
Router	Cisco	Linksys WRT54GL		5	10/100	802.11 bg (2.4Ghz)	1x2	-	4.6	4.2	4.4	4.8
Router	D-Link	DIR-655		5	10/100/1000	802.11 g/n Single Band	1x3	-	5.7	4.4	5.1	6.8
Router	Netgear	WNDR3400	1	5	10/100	802.11/a/b/g/n Simultaneous Dual Band 2.4G and 5G		-	5.7	5.3	5.5	5.2
Router	D-Link	DIR-665		4	10/100	802.11/a/g/n	2x3	-	6.4	5.0	5.7	4.7
Router	Apple	Airport Extreme A1354		4	10/100/1000	802.11 a/b/g/n		-	8.4	7.3	7.8	7.6
Router	Apple	Airport Extreme (5th Gen)	1	4	10/100/1000	802.11 a/b/g/n simultaneous dual band 2.4 and 5G	3x3	-	9.0	7.7	8.4	7.6
Router	Netgear	R6300-100NAS	2	5	10/100/1000	802.11AC with a/b/g/n 60Ghz/2.4Ghz/5.0Ghz		-	10.4	9.6	10.0	9.4

Similar trends can be found in switches, access points, modems and gateway devices with the highest performance and capabilities, devices which dominate the highest power segment of the

category. Applying Energy Star SNE specification limits to the NRDC data set of devices would eliminate the following percentages of products from the California markets:

- 55% of routers
- 55% of Switches
- 25% of access points
- 31% of Modems
- 50% of Gateways

The NRDC study also includes many entries designated as measured in home environment where the power was measured using a Kill A Watt power meter. This type of meter is not only un-calibrated but certain versions are known to exhibit very significant errors in measured values when used for measuring input power into switching power supplies.

Request 5a. What causes one network device to consume less than the other?

As discussed above, the ENERGY STAR SNE program is not a useful starting point, and it does not yield sufficient data to draw meaningful conclusions. Using a limited data set and recording only limited features and functions of these products could lead to virtually any conclusion with respect to the basis for variations in power consumption. For example, if we use the ENERGY STAR SNE qualified products for this analysis, full network proxy capability would be the indicated driver of increased power consumption. In reality, however, increased power consumption in networking equipment generally is driven by a combination of capabilities, performance and quality of service at a particular performance level.

In this regard,

- Performance in its simplest form might be sustained bandwidth or maximum useful data rate (as measured in ATIS TEER). For simple wired Ethernet this is bounded by the interface data rate, although complex functions may limit the useful data rate significantly below the maximum rate supported by the interfaces. In simple wireless devices the interface speed and some measure of complexity is often indicated by specification version such as 802.11 a, b, c, g, n, and ac. All of these have different maximum bandwidths and generally follow the rule of higher power is required for higher bandwidth.
- The power consumption of simultaneous dual band Wi-Fi products scales with the number of spatial streams available.
- Capabilities include a host of potential added functionality in the networking device and may include:
    - Security features such as virus scan, encryption and decryption, routing limitations and control
    - Support for Campus, Branch, or Teleworker connectivity
        - Support large numbers of users with dynamic bandwidth allocation between users
        - Balancing load from many users across many access points
        - Automatic passing of user credentials between access points
    - Deep or stateful packet inspection
    - Role Based Access and Virtual LANs

    - Multi-device Redundancy and/or Failover capabilities
    - Ability to support government requirements such as:
        - Section 508 of the Rehabilitation Act
        - FIPS 140-2 (Federal Information Processing Standards for Cryptology)
        - National Security Agency Suite B Cryptography
- Quality of service describes how well a device achieves any given performance and feature set under a given set of workload requirements. Although many products may claim to support 20 users the end user experience under these conditions can vary greatly between intermittent connectivity and dropping of network connection to barely noticeable slowing of network connection.
- Maturity of data rate specification -- Often when a new higher bandwidth or data rate specification is released early designs will consume much higher power consumption than mature implementations of the previous lower bandwidth/data rate designs. System architectures evolve through software versus hardware implementations and successive generational optimizations as well as process improvements that all lead to more efficient performance.

Request 5b. Are there costs associated with those differences?

In general added performance and features drive higher computational demand in networking devices and increased power and cost.

The power differences in networking devices in the NRDC study cannot be attributed to explicit investment in low power. Networking systems are designed for particular cost and performance targets. As higher power typically equates to higher cost, the products are designed to consume the minimum power necessary for the particular application requirement. In many cases, differences may be observed due to the rapidly changing technology underlying the system design. As implementations of a new technology or standard mature, the power consumption falls rapidly at first and then declines more slowly. Attempting to infer the cost of meeting new power limits based upon the price of existing units in the market is inappropriate. One must establish and prove a cause and effect relationship before you can have any confidence in such conclusions. Such an approach is particularly problematic when conclusions are drawn from very small samples sizes of wildly varying products without reference to the maturity of the design.

Request 5c. What are the pros/cons to product performance?

Pros and cons of product performance depend greatly on the application. Performance above what is needed by the application is generally not noticed while performance below what is needed can be detrimental to the usefulness of the product. Consumers won't accept a movie that is jerky or halts on occasion, while business environments may lose significant employee productivity or customers if network connectivity is unreliable. Costs associated with higher performance leads to competitive pressures that encourage development of multiple distinct versions of similar systems with differing capabilities or performance levels. In applications where workload is shared across multiple devices, limiting performance of a specific device drives the need for more devices to do the same job. This in turn diminishes the energy efficiency of the network as a whole.

SPECIFIC REQUESTS: SCOPE

Request 6. What equipment is too complex to measure efficiency or power consumption and why?

Current industry standard energy measurement practice uses simplistic methods in order to compare energy consumption of devices that are candidates for a specific networking application. However, such a method relies on the expertise of the network designer to choose only devices that are appropriate for the application to be part of the comparison. It would be inordinately complex to design and implement a test that could verify the level of performance or functionality of an arbitrary networking product. Such an approach has been discussed many times in industry standards bodies (e.g. IETF, ATIS) and rejected. Furthermore, the test equipment used by manufacturers to verify the performance of a complex function (such as deep packet inspection or stateful packet filtering) generally exceeds the cost of the equipment under test by several orders of magnitude.

Request 7. What are the differences between indoor and outdoor equipment?

Outdoor equipment, such as AP (wifi access point), requires thermostatically controlled internal heaters to function in worst case thermal environments (i.e. -40C). Outdoor equipment also requires weather proofing, which often impacts the cooling and airflow of internal electronic components, potentially causing high power consumption.

Request 8. What are the relevant shipment volumes?

Market information is available from market research firms but is not generally available to be shared without the permission of those firms. (IDC data)

Request 9. Questions as regards ONTs as High Energy Consuming Devices

It is not clear what is meant by "high energy consuming device." ONT devices are necessarily limited to one device per household and it would be rare to find a device (even the most complex device) that consumes more than 100kWhr/year. Current shipment trends for ONTs may be obtained through market research. Future trends are the topic of great controversy and rival business strategies. There is a wide range of functionality for ONT systems (e.g. electrical/optical convertors; passive optical network terminators; home gateway devices; etc.).

ITI, TECHNET, AND TIA PROPOSAL

Rather than an 11-port threshold that is overbroad, unworkable, and potentially costly to consumers, ITI, TechNet, and TIA propose instead that the Commission divide networking devices into three classes, based upon application, sales channel, and deployment method: (1) Retail Consumer; (2) "Pro-Sumer"; and (3) Enterprise and Commercial. The following chart demonstrates classification of devices and the ITI/TechNet proposal for who is best suited to specify the necessary energy efficiency and what level of regulation may be appropriate.

Class of Device	Functionality	Who Determines Necessary Level of Energy Efficiency	Proposed Regulatory Approach
Retail Consumer		Consumer purchase based upon cost and information on packaging. May be influenced by programs such as Energy Star (or in state incentive program).	Energy Star SNE Definitions do not adequately describe retail consumer "small" networking devices, and changes to definitions and other steps would need to be taken (see "Discussion") prior to incorporation into CEC regulation.
Pro-Sumer	Devices specified and provided as part of a service package.	Devices specified by experts who can properly assess device performance and efficiency and who can document efficiency improvements over time.	None. Regulation inappropriate, as no power limit or efficiency measurement can take into account performance requirements of end-user desired services. Standard efficiency metric reporting would be useful in decision-making process.
Enterprise and Commercial	Devices critical to business function.	Network designer should assess performance and efficiency as part of the cost and value proposition to the business.	None. Regulation inappropriate, as energy savings in network equipment may drive increase in facility energy consumption. Standard efficiency metric, if available, would provide useful information to decision makers.

Further, and as already noted, the STB VA has been expanded to include specific provisions committing the parties to commence joint efforts to develop energy efficiency measures for networking equipment intended for small networks (NESN), such as residential modems and routers. The work is now underway to craft NESN energy efficiency measures that also allow for rapid innovation in the equipment that supports Internet and broadband services.