Cisco ASR 1000 Series Aggregation Services Routers: Achieving Energy Efficiency through Service Integration

Environmental responsibility has become an important topic of discussion in the last few years—not only in the general public, but in businesses as well. Many major corporations have begun to institute green policies that guide the manner in which they manage their operations. As companies work toward minimizing their effect on the environment, they must examine several areas:

- Business operations, especially as related to the effect of space, power, and cooling on energy consumption
- Supplemental benefits of carbon reduction such as reduced numbers of employees commuting and traveling
- Equipment longevity to forestall e-waste and management policies for the responsible retirement of obsolete equipment
- Selection of suppliers and vendors that operate their businesses in an ecologically conscientious fashion

The innovative, new Cisco® ASR 1000 Series Aggregation Services Router can be an important component in helping you achieve your overall environmental objectives. By consolidating the capabilities of multiple single-function devices and allowing you to instantly turn on new services, the Cisco ASR 1000 Series Router provides an energy-efficient and long-lasting deployment alternative. This approach offers you direct benefits, such as reduced rack space, power, and cooling requirements. In addition, it facilitates many secondary benefits, including the ability to reduce employee travel and training costs.

Power Efficiency Versus Power Consumption

One of the inherent challenges of implementing environmental policies in a network is establishing the most accurate method of determining the power efficiency of a particular deployment. Simply totaling up the maximum power requirements of a collection of devices does not provide a true picture. An individual networking device may have low power consumption, but if it is performing a single function that could be performed elsewhere, or if it requires multiple instances to accommodate the bandwidth and throughput requirements, it is not a power-efficient choice. You should base calculations of power efficiency on the functions a device performs and the speed at which it performs them. Then you should compare this variable to the efficiency of having the same functions performed on several discreet devices.

With these energy-efficiency criteria, it is important to compare how Cisco routers have become more power-efficient over time. Compared to the efficiency of Cisco routers in the year 2000, Cisco WAN edge routers have achieved up to a twentyfold increase in power efficiency. These numbers are based on a simple calculation of packets forwarded as a ratio of watts consumed. If we also consider the increase in capabilities in that timeframe that permit the replacement of single-function appliances, the power-efficiency quotient is higher still. The Cisco ASR 1000 Series Routers are the newest additions to this tradition of ever-increasing efficiency.

One of the most important ways in which the Cisco ASR 1000 Series Router can help in reducing your energy consumption is its capability to consolidate the services of multiple single-function appliances. Table 1 examines some of the important integrated services the Cisco ASR 1000 Series Router can provide.

Table 1. Appliances Replaceable by a Cisco ASR 1000 Series Router

Service Provided by Cisco ASR 1000 Series Router	Integrates or Replaces
High-speed, highly available WAN aggregation and Internet services	One or multiple standalone third-party WAN routers
Hardware-accelerated IP Security (IPsec) encryption up to 3.5 Gbps	Standalone encryption through one or multiple firewall or VPN appliances
Hardware-accelerated firewall services, up to 10 Gbps	One or multiple standalone third-party firewall appliances
Integrated Deep Packet Inspection (DPI), Network Based Application Recognition (NBAR) and NetFlow	Standalone Anomaly Detection and Mitigation Systems
High-density IPsec VPN aggregation and termination	VPN concentrator appliance
An embedded Cisco Session Border Controller (SBC) to handle next-generation voice and multimedia	Standalone session border controller
Cisco Performance Routing, for optimizing application paths through the network	Routing analytics appliance

Although the Cisco ASR 1000 Series Router can perform many functions, even a moderate consolidation of capabilities can have a surprising effect on energy usage. In a comparison of the 6-rack unit Cisco ASR 1006 Router versus a commonly deployed, comparable third-party router, supplemented by commonly deployed, comparable third-party firewall and IPsec services, significant power savings were achieved. It is estimated that the third-party appliance combination would use 18,011 excess kilowatts of electricity annually more than a Cisco ASR 1006 Router would use, while performing the same functions at the same speed. Using calculations based on U.S. Environmental Protection Agency metrics for CO_2 emissions, this estimate equates to 11,500 kilograms of CO_2 emissions. Table 2 explores this difference in more practical terms.

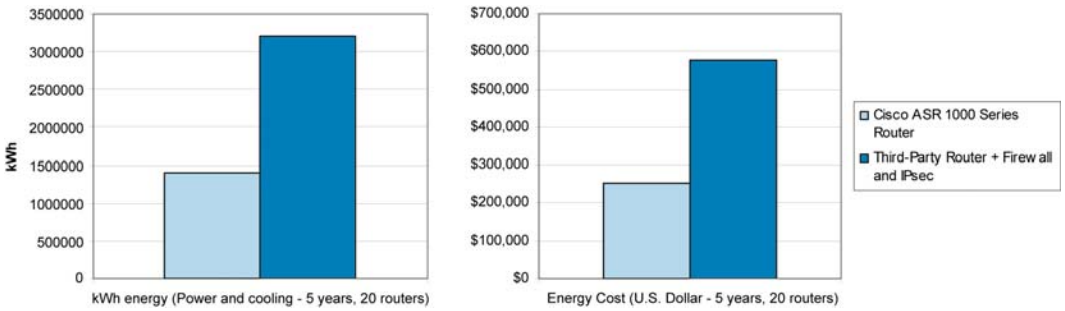
Table 2. Carbon Dioxide Equivalences

11,500 Kilograms of CO_2 Equates to:	
Gallons of gasoline	1304
Barrels of crude oil	26.7
Tons of waste recycled	4
Passenger cars not driven for 1 year	2.1
Household electricity use for 1 year	1.5
Acres of forest preserved from deforestation	0.08

Depending on the level of consolidation, the Cisco ASR 1000 Series Routers can significantly reduce the requirements for rack space, power consumption, and cooling. As further service integration occurs, savings grow proportionately as more appliances are eliminated. The versatility of the Cisco ASR Series Router allows for its deployment in multiple places in the end-to-end network—for use as a headend aggregation or Internet gateway or as the main router and firewall in regional aggregation sites. In larger branch offices, the 2-rack unit Cisco ASR 1002 Router can act as the vehicle for VPN or leased-line access to corporate headquarters.

With the deployment of each Cisco ASR 1000 Series Router, the power-efficiency benefits increase. Figure 1 shows the anticipated power savings over a 5-year lifecycle for a company deploying 20 Cisco ASR 1000 Series Routers in a variety of scenarios throughout its network. This comparison is, again, versus a comparable third-party router, supplemented by comparable standalone third-party firewall and IPsec appliances.

Figure 1. Energy and Cost Savings for 20 WAN Systems over 5 Years



The Cisco ASR 1000 Series Router supports an industry-standard, energy-efficient power supply, offering a minimum efficiency of 80 percent when under maximum load. When you deploy redundant power supplies, they operate in current sharing mode, so the system can use them evenly. Fan speeds will vary between 3600 and 7200 rpm based on system load and the Cisco ASR 1000 Series Router internal temperature monitoring. Under normal operations, power requirements should be 30 to 40 percent less than the maximum rated power for the system. The system power supplies are rated for higher maximum power than required during normal operation to provide overhead for future expansion.

Some enterprises have considered retrofitting their existing data centers to deploy DC power. This retrofit helps avoid the power inefficiencies incurred when AC power is converted to DC power. For such deployments, the Cisco ASR 1000 Series Router also offers a redundant DC power option.

As more businesses move toward 24-hour operations, network availability is another variable that can significantly affect the environment. The traditional solution for providing network availability has been to deploy at least two—and sometimes more—quantities of each device that provides critical services in the network. This approach not only requires more rack space, power, and cooling, it also generates significantly more electronic waste after the various routers and appliances are retired from service.

The Cisco ASR 1000 Series Router changes this equation. Using the field-proven Cisco Nonstop Forwarding with Stateful Switchover (NSF/SSO) technology, the Cisco ASR 1000 Series Router can respond to any software-related outage by providing fault containment and dynamic restartability with minimal packet loss. Exceptional among routers in this class, the Cisco ASR 1000 Series Router can run dual copies of the Cisco IOS® XE Software on a single route processor, switching to the recovery software image instantaneously upon detection of an outage. For larger

enterprise customers who want even further levels of resiliency, the Cisco ASR 1006 Router supports redundant hardware routing and forwarding processors, capable of zero packet loss during a service outage. (Note: Zero packet loss is based on route-processor failure. For forwarding-processor failure, minimal packet loss may occur for packets in transit at the time of the failover.) Thus, deploying a single Cisco ASR 1000 Series Router rather than a complex configuration of redundant routers and appliances can save on power consumption in the near term, and reduce e-waste in the longer term.

Supplemental Benefits of Environmental Policies

Implementing new environmental policies can be challenging, because it frequently entails a change in corporate culture and employee mindset. The end-to-end network can play a pivotal role in helping you through this process. For many companies, it makes ecological and budgetary sense to restrict employee travel. Telecommuting can also be an effective method of reducing carbon emissions, and it is supported by numerous governmental initiatives and incentives. However, to reduce travel and commuting demands, a company must have alternative, effective communications methods.

Some examples of such alternatives follow:

- Companywide video on demand to reduce training costs, including employee travel and facilities rental
- Unified communication technology over secure network access for optimal collaboration, resulting in reduced business travel
- Teleworking, which can significantly reduce auto emissions

To aid with the deployment of such advanced business applications, the Cisco ASR 1000 Series Routers can help assure the consistency of the user experience. Using a combination of firewall and encryption to help ensure privacy, as well as quality of service and application acceleration to facilitate the responsiveness of such real-time collaboration, the Cisco ASR 1000 Series Routers can smooth the user acceptance and adoption of these new, business-enhancing applications and energy-saving practices.

Reducing E-Waste

Electronic waste can be one of the most demanding aspects of a company's recycling policy. E-waste is not biodegradable, and may contain heavy metals or other toxic substances. As a result, used computer or networking equipment is frequently banned from landfills.

When you need to displace equipment in your network, Cisco offers a host of programs committed to sustainable business practices as well as innovation in operations, products, and architecture. The Cisco Technology Migration Program (TMP) creates incentives for customers to return IT equipment by allowing them to trade in old machinery against the purchase of new. The program is specifically designed to reduce the accumulation of scrap equipment in landfill sites.

Cisco also works with recycling companies to promote extraction of valuable metals and components from old equipment for reuse in new products. Government directives on the disposal of electronic waste, called Waste Electrical and Electronic Equipment (WEEE), and the use of hazardous substances in manufacturing (European Union Restriction of Hazardous Substances [RoHS]) pose new challenges to vendors and users of network equipment. Cisco is fully compliant with both, offering partners a "take back and recycle" program for equipment at the end of its life to

help ensure proper treatment, recovery, recycling, and environmentally sound disposal. Furthermore, Cisco works only with RoHS-compliant suppliers.

The modular design of the Cisco ASR 1000 Series Routers can also help reduce electronic waste while offering you investment protection. The router features field-upgradable route and forwarding processors and shared port adapters (SPAs), which allow you to obtain new processing power and feature richness as your business and networking needs grow—with only incremental expenditure. At the same time, it extends the longevity of the platform, and prevents the need for complete equipment upgrades, thereby forestalling the creation of e-waste.

In addition, further power savings and e-waste reductions are possible because the Cisco ASR 1000 Series Routers are powered by the Cisco QuantumFlow Processor (QFP). This processor combines the best attributes of both purpose-built application-specific integrated circuits (ASICs) and general-purpose network processors—providing hardware-accelerated speed without sacrificing flexibility. As you need new services, you can implement them directly and instantly on the QFP, with no need to add service modules or external appliances to your network. This approach benefits overall power efficiency while averting future electronic waste.

Working with Green Suppliers

A company's comprehensive environmental policy should also account for the environmental policies of its various suppliers and vendors. Cisco has undertaken numerous steps within its own environmental policy to help assure customers that they are partnering with a responsible, ecologically minded company.

Cisco understands and appreciates that IT is critical in helping meet green-related challenges. IT-related power demands, worker travel, and e-waste are all critical areas of concern in any organization's green efforts. Cisco is committed to being an industry leader in resource conservation. As a member of The Green Grid, a consortium of information technology companies and professionals seeking to improve energy efficiency in data centers, Cisco is working to achieve the consortium mandate of developing metrics and standards to manager power efficiency. (Refer to Cisco Energy Efficient Data Center Solutions and Best Practices at http://www.cisco.com/en/US/solutions/ns708/networking_solutions_products_genericcontent0900aecd806fd32a.pdf).

Additional environmental savings opportunities from Cisco include:

- An integrated services strategy for platforms, which automatically reduces the amount of packaging, shipping, and other related environmental effects
- Reduction of paper requirements by providing manuals for download from the Cisco Website; they are also available on CDs
- Distribution from multiple worldwide hubs, allowing for the reduction of the carbon costs of transportation during product delivery

Summary

The Cisco ASR 1000 Series Routers can be an effective addition to an overall corporate environmental policy by:

- Providing service consolidation, to achieve greater energy efficiency while at the same time delivering a comprehensive set of networking services to organizations of all sizes

- Reducing your company's effect on the environment with regard to contamination, pollution, emissions, and e-waste
- Enhancing your abilities to change and improve your business processes, through travel substitution and e-business and therefore control of your overall energy use

With a strong history of corporate stewardship and responsibility, and the Cisco commitment to innovation toward green IT, Cisco helps its customers stay up-to-date with regard to green initiatives. When taken in conjunction with the role of Cisco as an environmentally responsible supplier, customers who deploy the Cisco ASR 1000 Series Router can be assured that they have taken appropriate steps toward increasing their energy efficiency while lowering their carbon footprint.

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Printed in USA C11-4574218-00 02/08