Corporate Citizenship and Sustainability – Product Sustainability

At Juniper, we design, develop, and sell routing, switching, and security products and services for high-performance networks. These products and services enable our customers to build reliable, secure, cost-effective, and highly scalable networks for their businesses while achieving agility, efficiency, and added value through automation.

Whether our customer is a global service provider, enterprise company, or public sector organization, the network is critical to their success. We innovate systems and software solutions that transform networking as we know it, helping our customers achieve superior performance and reducing the overall cost of ownership.

Together, our mix of products and service offerings helps customers convert their legacy networks into more valuable assets that provide increased performance, reliability, and security for end users. Our commitment is to build more than a network, and as part of that commitment, our products and service offerings must be designed to be both resilient and sustainable.

Eco-Design Program

Our product designers and suppliers identify, prioritize, and recommend environmental improvements through a company-wide eco-design program, which is based on our New Product Introduction (NPI) process. The eco-design guidelines are derived from evolving customer expectations and regulatory requirements and influenced by the expertise of our employees and suppliers. The priorities of the Juniper Networks eco-design initiative include:

- **Materials Innovation:** The reduction of the amount of materials used in our products and development of materials that have less environmental impact and/or more value at their end of life
- **Design for Recyclability:** The design of products that are easier to upgrade, reuse, and/or recycle
- **Energy Efficiency:** Reduction in energy needed to manufacture and/or use our products

Furthermore, life cycle assessment (LCA) is used to quantify the environmental impacts of a product across the entire life cycle, from design to End-of-Life (EOL) disposal.

Sustainable Design: Minimizing Resource Impacts

We recognize that Juniper's greatest impact on the environment comes through our products. It's why we consider opportunities to decrease that impact and improve efficiencies at every stage of the product's life cycle, from the materials we use and a product's energy footprint, to packaging and EOL solutions.

We believe sustainably designed products are not only better from an environmental perspective, they're also more reliable, as evidenced by their lower failure rates.

Material Choice and End of Life

As part of our eco-design approach, we carefully consider the materials that go into our products and how they re-enter the ecosystem at the end of their useful life. Like technology devices, networking equipment must be designed and developed in compliance with regulations governing the use of hazardous materials and EOL solutions. Juniper is committed to maintaining compliance with all federal, state, local, and foreign regulations that have been adopted with respect to the environment. These include the Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS); the Regulation concerning the Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH); and the Waste Electrical and Electronic Equipment (WEEE) directive. Juniper products are designed to be easily dismantled for recyclability, and those parts that are not recyclable are clearly labeled.

To enable customers to extend the useful life of Juniper products in an environment of rapid change and growth, Juniper products are designed and built for flexibility. Many of Juniper routing, switching, and security solutions are built to be interoperable with other vendor systems, to be scalable to meet the growing demand of terabytes per second of system throughput, and to be flexible in being deployed in a number of different network designs and fabrics.

More detailed information on Juniper's approach to hazardous materials, EOL considerations, and eco-design can be found here.

Case Study

Juniper Gets the Lead Out to Comply With RoHS 2

One of Juniper's major initiatives for 2015 included compliance with RoHS, the Restriction of Hazardous Substances, a European Union directive meant to improve the environmental friendliness of hardware components. All companies selling products to EU countries were required to become RoHS 2 compliant by July 21, 2016.

Juniper became compliant with RoHS I in 2006 and with RoHS 2 in 2015, which, among other directives, requires products to be lead-free. Like most technology companies, Juniper still has lead in some components, such as the solder, and in other limited usages.

We established a three-pronged approach to designing, manufacturing, and testing impacted products:

Compliant: Most Juniper products have been converted to full RoHS 2 compliance and are available globally.

Restricted availability: A very small percentage of Juniper products can't currently meet RoHS 2 requirements, so they are only available on a restricted basis, and only to customers outside the countries impacted by RoHS 2. We will continue to work on needed replacements.

End-of-Life and transition: We have announced EOL for a number of older products and have been working closely with customers to move them to Juniper's newer architectures and technologies.

RoHS 2 compliance has been a massive effort, touching most teams across Juniper. Success means not only an ecological benefit, but enables continued business with and support of our customers.

Continuing on this effort, Juniper is part of an industry review committee to evaluate and prioritize the elimination of other hazardous substances and inform future environmental product compliance requirements.

Product Packaging

Part of our commitment to building more than a network includes packaging our products in ways that are environmentally responsible and, increasingly, sustainable. Our first priority in packaging is to protect our products, as damaging them would unnecessarily waste valuable resources. Each year, we evaluate opportunities to redesign packaging in ways that will optimize costs while increasing the use of reclaimed or recycled materials, including biodegradable packaging.

In recent years, our internal Logistics group has had success rethinking the size, weight, and layout of our boxes, crates, and buffering materials. Our goal is to reduce the size and weight of packaging, while retaining the same performance, and to choose the most sustainable materials whenever possible. The packaging design principles revolve around five priorities: (1) use of materials that can be recycled or reused; (2) minimizing total size and weight; (3) considering alternative materials that have a reduced environmental footprint; (4) managing total cost of product packaging and logistics; and (5) quality.

The transition from foam packaging material to Reflex thermoformed high-density polyethylene (HDPE) plastic cushions on our 1 U and 2 U systems is an example of Juniper successfully executing on all five packaging design principles. Compared to the traditional foam packaging, the Reflex design is manufactured from 100% recycled HDPE plastic and is 100% recyclable and reusable, resulting in approximately 400 tons of plastic recycled since 2009. Additionally, the Reflex thermoformed cushions are formed around the specific dimensions of the product, allowing us to reduce the size of our packaging. This means we get comparable cushioning with a smaller packaging footprint. In addition to reducing waste and input resources, it has reduced the environmental impact associated with logistics and distribution by allowing more shipments per truckload and units stored per warehouse. This transition has enabled Juniper to reduce material cost while providing equal product protection.

Another example is the redesign of the wood crates used to ship Juniper Networks® MX480, MX960, and MX960ECM 3D Universal Edge Routers. Our goal was to keep the same strength, material, and basic design while reducing manufacturing and logistics costs. The 1-inch plywood was slimmed to 6 mm plywood, lowering the weight from 178 pounds to 95 pounds, a significant reduction for every system shipped. After testing and assuring their quality, we implemented the new crates in 2014. We estimate the total annual savings from redesigned packaging to be approximately $1.9 million.

Sustainable Design: Energy Efficiency

The Information Communication Technology (ICT) sector accounts for approximately two percent of all greenhouse gas (GHG) emissions, mostly due to energy-intensive data centers. As the digital economy and ICT-enabled solutions advance, it's expected that an additional 2.5 billion people will become connected by 2030. With a more connected world comes the opportunity to increase efficiencies, including the way business is conducted, the way healthcare is managed, and the way agricultural crop yields are improved upon. It is through seizing these opportunities, as well as more energy-efficient hardware, that the Global e-Sustainability Initiative (GeSI) underscores the potential for the ICT sector to drive a 20 percent reduction in global GHG emissions by 2030, which would hold emissions at 2015 levels.

As the platform for ICT-enabled solutions, the network that Juniper builds is the means for enabling growth and innovation, while also serving as the source of crucial energy efficiencies. It's why environmental sustainability, and especially energy efficiency, is central to Juniper's design and development approach.

Making energy efficiency a driving force in the design and manufacture of Juniper's products leaves us in an excellent position to comply with or surpass potential regulatory standards for many of our products. To manage risks from efficiency regulations, we have been engaged in voluntary initiatives and programs. As a member of the Energy Consumption Rating Initiative, Juniper has played an active role in developing specifications for rating energy consumption in network and telecom devices. Juniper is also an active member of the Alliance for Telecommunications Industry Solutions STEP Committee, which created a Methodology for Measurement and Reporting of Wireless Base Station Standards.

Energy-Efficient Products

The evolution of networking equipment has been rapid. While today's equipment has far greater capacity and speed than it did a decade ago, the trade-off has been energy efficiency. We saw this early on at Juniper and made it a priority to position ourselves as a leader in power and energy efficiency, while still maintaining the functionality and speed to support the growth of the network. Our goal is to make every new product more efficient than the last, and help our customers shrink their energy and carbon footprints.

Every Juniper product is measured in throughputs per watt, and we've managed to reduce the watts per bandwidth with each product iteration. Additionally, Juniper products are independently third-party tested for energy efficiency compliance to the following standards:

- AT&T ATT-TP-76200, Issue 20, June 2016
- ECR Draft 3.0.1, December 2010
- EPA Energy Star
- ETSI ES 203 136 v1.1.1, May 2013
- Verizon VZ.TPR.9205, Issue 6, March 2016

Energy consumption specifications are made available on product technical sheets, another tool which both helps customers focus on their energy goals and helps Juniper stay in front of energy efficiency and product labeling standards.

Juniper participates in 80 PLUS, an innovative, electric utility-funded incentive program to integrate more energy-efficient power supplies into desktop computers and servers. The 80 PLUS performance specification requires power supplies in computers and servers to be 80 percent or greater energy-efficient. This makes an 80 PLUS-certified power supply more than 33 percent more efficient than current power supplies. As of 2016, Juniper has twelve products that are 80 PLUS-certified.

We will continue to focus on energy efficiency, recognizing this as a significant opportunity to assist our customers reduce the total energy consumption and greenhouse gas emissions from their own operations due to the use of networking products.

SDN

Juniper's SDN strategy enables companies to accelerate the design and delivery of new services, lower the cost of network operations, and provide a clear path to implementation.

In 2015, we extended the capabilities of Juniper Networks NorthStar Controller. These enhancements provide visibility and control into additional layers of the network and fully support and handle dynamic traffic, such as that driven by mobile and cloud applications. This traffic-engineering controller is capable of automatically controlling and programming multiple network layers, enabling service providers to increase utilization by dynamically adjusting to changing network conditions in real time and at the click of a button.

For many years, the network core was considered too manual, too rigid, and too complex to adjust. This limited the ability to change the core to adjust to new services for fear of crippling the entire network. Today, we are bringing unprecedented levels of scale, automation, and programmability to transform the network core into an agile platform that unleashes new levels of efficiency for flexible service creation.

MX Series 3D Universal Edge Routers

To meet the requirements of data centers within a network, there may be a desire to use an energy-efficient lineup of routers, with models supporting various scales using the same architecture. The MX Series has built-in agility and can be easily upgraded at any point to provide strong scalability options when demand for even higher capacity arises in the future. This is especially crucial as network technology continues to advance daily.

MX Series 3D Universal Edge Routers are also a great example of how Juniper designs for power efficiency at the system, card, and component level, using a wide range of power-optimizing features:

- An Ambient Temperature knob lets customers align system cooling requirements to the actual conditions in their facility.
- Modular Interface Card (MIC) Aware Power Management gives customers provision line card-level power based on the actual installed MICs.
- Feature Aware Power Management gives customers provision power based on actual Modular Port Concentrator (MPC) configuration.

These features help customers align MX Series power configurations to their actual use case and can dramatically improve power efficiency and reduce power-related costs.

PTX Series Packet Transport Routers

PTX Series routers provide the platform for the Converged Supercore® architecture, a model for optimizing IP/MPLS core, peering, metro, and converged IP and optical networks. These routers are built for superior performance, optical transport integration, and elegant deployment. They support high-density 100GbE environments and offer industry-leading energy efficiency of less than half a watt per gigabit per second (Gbps).

With the launch of the PTX Series, we pioneered, among other ground-breaking achievements, record energy efficiency of 1.5 W per gigabit of throughput. Since then, we have continued to enhance the PTX Series, delivering market-leading energy efficiency of 1.2 W per gigabit of throughput in 2014, and further improving energy efficiency of 0.5 W per gigabit with the 3 Tbps FPC3 line card in 2015.

The environment will remain a focus area across multiple aspects of our business.

About Juniper Networks

Juniper Networks challenges the status quo with products, solutions and services that transform the economics of networking. Our team co-innovates with customers and partners to deliver automated, scalable and secure networks with agility, performance and value. Additional information can be found at Juniper Networks or connect with Juniper on Twitter and Facebook.

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