ENERGY EFFICIENCY FOR TELECOM GROWTH

AN ELTEK WHITE PAPER

HIGH EFFICIENCY POWER: CARRIER MOTIVES FOR ENERGY EFFICIENT DC POWER SYSTEMS EXPAND FROM COST CUTTING TO NEW SERVICE DEPLOYMENT

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TELECOM POWER TRENDS

The Driving Force

The business case for high-efficiency DC power systems used to be focused on saving money on power OPEX. But now telecom service providers need more power for deploying cloud, entertainment and other services and are turning to HE systems as one way to meet that need.

Cost savings and environmental responsibility have been the driving reasons for looking to high-efficiency (HE) technology to power telecommunications networks. But new services like cloud, VoIP, IPTV and others are becoming an important component of network operator sales and profitability. As new networks are built and new computing services deployed to provision these services, energy efficiency is quickly becoming a tool for growth in addition to operating expense (OPEX) savings. Some operators, like Verizon, are publicly stating that energy efficiency has become critical to their ability to offer new capabilities and services.

The impact is great both for wireless networks, which are facing quadrupled demand for data services, and for wireline networks as enterprises increasingly tap carriers for cloud services. Service providers are building out their networks to meet demand and are finding that upgrading to the latest generation of equipment not only saves power and space, it is essential for rolling out new revenue-generating services as well.

Telecommunications equipment accounts for about one percent of all power used globally and this amount will inevitably increase. Much of this demand will be at telecommunication equipment sites, which are already reaching maximum power capacity with existing power systems. Approximately 135,000 base station sites currently exist in the U.S., many of which have outdated equipment, space constraints and limited ability for growth. In fact, according to a report from analyst group Visant Strategies, Inc., almost 60% of these sites lack the backhaul capacity to even support a 4G network. Carriers facing these challenges would prefer to utilize existing deployed equipment such as cabinets, racks, shelters, environmental systems, etc. rather than spend large portions of their CAPEX budgets on additional space and thermal accommodations for the network gear that is needed to provide new services.

Figure 1: Telecom Data Center

The key constraint, however, for telecom data centers or network nodes on how much service can be provided is not the outdated equipment, space constraints or even backhaul limitations, but quite often the amount of energy available to power that service.

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Faced with a power model akin to you running all your holiday lights from a single AC outlet, network operators are striving to get the most out of their power. They are realizing that an easily achievable method for generating more power at a reasonable cost is through the implementation of high efficiency power equipment.

Historically, between 10 percent and 20 percent of the power used in telecom networks is lost in the conversion from the AC power of the electricity grid to the DC power that is necessary for powering telecom networks. High efficiency equipment both saves operating expenses by lowering energy costs, and it frees up resources formerly used for existing applications to be leveraged for new services. These new services provide additional revenue, driving future growth.

Energy Consumption in the Telecom Industry

The telecom industry is a major user of energy—about one percent of the world's total consumption, which translates into billions of kW hours per year. Driving the exponential growth in telecom energy use is the explosion of demand for new cloud, entertainment and mobile broadband services that leverage carrier networks.

Energy prices have reached historically high levels and there is growing concern over the security of the world's electricity supply and our continued dependence on fossil fuels. The impact of the carbon dioxide (CO_2) emissions from telecom equipment installations, air pollution and global climate change are becoming a high profile discourse throughout the world and there is growing recognition that the world's non-renewable energy resources are being depleted.

Governments around the world have instituted incentive programs to encourage the use of alternative energy sources and are attempting to regulate CO_2 emissions. Whether motivated by energy cost savings, incentive programs or a "green" consciousness (or all of the above), network service providers are beginning to recognize that energy efficiency must be implemented in order for them to continue to afford to upgrade and power their networks.

Companies like AT&T, Deutsche Telecom, NTT, Telefonica, Verizon and other large service providers have adopted environmentally responsible policies for energy conservation and emphasis has been placed on lower power consumption for radio, transport access, switching and other network equipment. But as demand for broadband devices and services continues to climb and carriers continue to build out wireless networks to meet that demand, they are challenged to achieve significant reductions in their need for DC power.

Verizon's field operations group has gone public with its plans to expand its power efficiency program to help deploy new revenue-generating services. The company points out that many in the industry mistakenly believe that the volume of voice, data and video services a telecom facility can provide is predicated on the size of the facility and the amount of network equipment that can be housed in that facility. In reality, however, the amount of power available to operate the equipment in a given facility—data center or network node—is the real constraint on how much service can be provided. Facilities are running out of power before they run out of physical space.

"Facilities are running out of power before they run out of physical space."

As a result, a key focus for Verizon is now to find and implement high efficiency upgrades to older equipment to maximize power efficiency and free up space so new services can be deployed. These initiatives are not only concerned with improving density and capacity to manage existing services, but actually finding new capacity for new services.

DC POWER SYSTEM EFFICIENCY

Background

Telecommunications networks typically use DC power due to its reliability, safety and easy integration with battery backup systems. Rectifiers are the devices in a DC power system that convert the AC electricity from a public utility network to a regulated DC voltage to operate telecommunications equipment and recharge backup batteries. As with any power conversion method, there are associated inefficiencies in the conversion process, and power vendors have worked over the years to improve the efficiency of DC rectifiers and reduce the waste heat and CO_2 emissions that are the result of those inefficiencies.

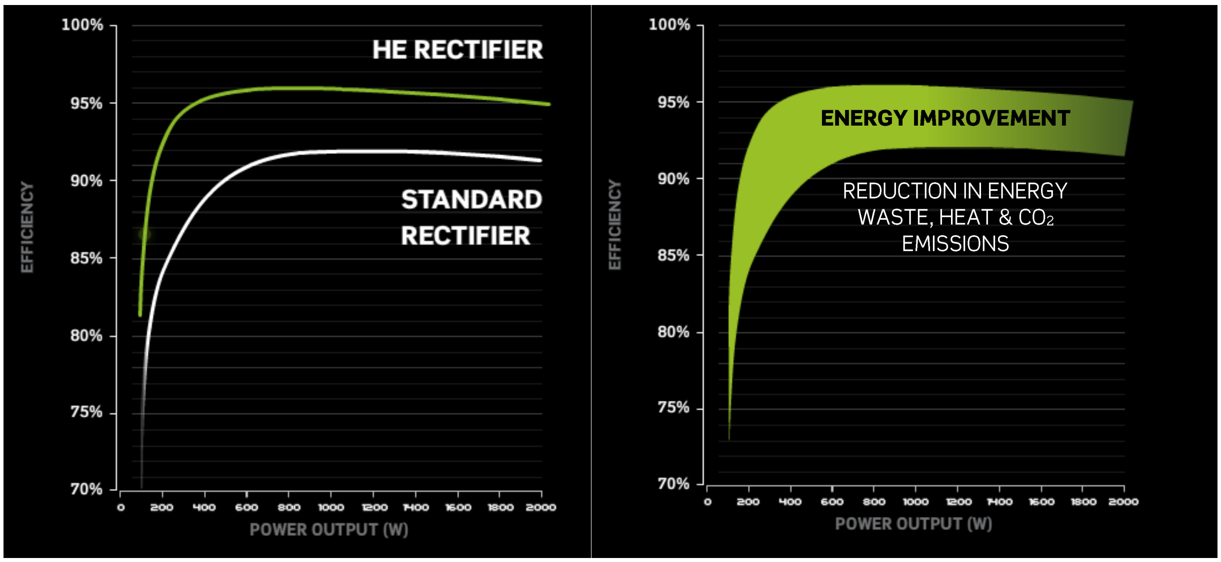

Figure 2: 96% High efficiency rectifier compared with 92% efficient rectifier

Switch mode rectifier technology was first introduced in the late 1970s and was revolutionary in the power density and efficiency improvements it enabled. Typical efficiency for first generation switch mode rectifiers was about 85 percent, operating a 20 kHz switching frequency.

Switch mode technology has continued to evolve, and in the 1990s a breakthrough was made when metal oxide semiconductor field effect transistor (MOSFET) technology was combined with improved soft switching topologies and control solutions. This yielded significantly higher switching frequency and partly lossless switching, which further improved density and efficiency. Today's typical 48V rectifiers achieve efficiencies of 90 percent to 91 percent and some best-in-class rectifiers can even reach 93 to 94 percent efficiency.

The Importance of Rectifier Efficiency

It is easy to underestimate the importance of a few percentage points difference in rectifier efficiency. One can look at 90 percent efficiency versus 96 percent efficiency and not be particularly impressed with the difference, especially if there is a cost consideration for upgrading to a more efficient rectifier to achieve a six percent improvement.

In actual fact, however, even one percentage point can make a huge difference when considered in terms of power loss. As an example, consider a typical power system that needs to deliver 8,000W of 48V power at a site. To generate that 8,000W of output power using 90 percent efficient rectifiers, a DC power system will utilize 8,889W of AC input power. In that conversion, 889W is lost power in the form of heat.

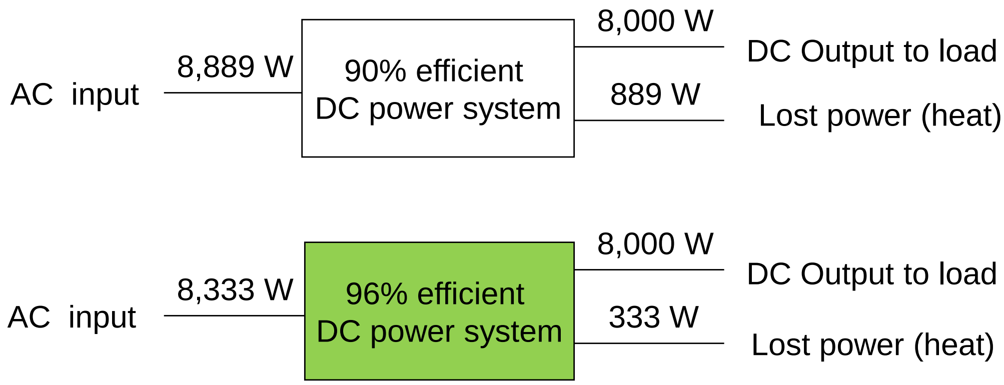

Figure 3: Energy waste reduction from a high efficiency DC power system

The use of 96 percent efficient rectifiers will require 8,333W of input power and will result in only 333W of power losses. The use of the higher efficiency rectifiers reduces power losses by 556W—a 63 percent loss reduction, which equates to a 6 percent overall reduction in energy usage.

The use of the more efficient rectifier will save 4,876 kWh of energy annually. At $0.10 per kWh, that results in about $487 of savings per year for that single system.

To put that savings in perspective, consider the total power consumption of Verizon. The company recently reported that its power consumption for one year was 8.9 billion kWh, which generated more than 7.1 million metric tons of CO_2. This represents not only a massive utilization of energy, but also an annual estimated cost of almost $900 million (at $0.10 per kWh). The majority of this energy is associated with the DC power systems that support Verizon's network. If Verizon could achieve a 6 percent reduction in overall energy usage, it would translate to a savings of 534 million kWh per year in electricity (worth $53 million per year) and a reduction of more than 426,000 tons of CO_2 emissions.

*"If Verizon could achieve a 6 percent reduction in overall energy usage, it would translate to a savings of **534 million kWh** per year in electricity worth **$53 million** per year and a reduction of more than **426,000 tons** of CO_2 emissions."*

LEC Case Study

The significant impact of cost savings gleaned from even a few percentage point reduction in energy usage has begun to resonate with telecommunications providers as they consider not only the cost of replacing and maintaining legacy equipment, but also upgrading to 4G and a more server-centric infrastructure for new cloud services. A recent Eltek case study highlights just this scenario.

The study involves an Eltek customer—one of the largest local exchange carriers in the United States—providing local, long distance, high-speed data and wireless services to residential and business consumers.

The ferroresonant power plants in several of the company's central offices had been in service for up to 14 years and were beginning to fail. While replacing the failed rectifiers was expensive, on the surface it appeared to be more economical than buying a new DC power system. However, there were several other factors to be considered. The ferro plants were very large and took up a significant amount of floor space. The power plants achieved only 77 percent efficiency at best, which meant a lot of wasted power at a time when power demands were increasing due to subscriber growth and the resulting new service activation. The ferro plant's low efficiency was driving up electricity-related operating expenses. Additionally, the poor efficiency generated a lot of heat in each CO, which required increased cooling, further driving up electricity OPEX.

Finding the right answer meant optimizing the return on the investment, and that involved both CAPEX and OPEX considerations. The carrier's teams collaborated to set a two-year payback objective for any power system they purchased.

Eltek's Scalable Power pack DC Power System, which boasts up to 94.5 percent efficiency with a capacity of up to 10,000 amps, was a leading contender. For the customer, one of the operational benefits of the Scalable system was that it could work with the existing distribution bays and copper cabling, thus saving the cost of replacing the entire system. Increased efficiency was one of the main drivers for the customer's transition to the Eltek Scalable power system, which provides nearly 20 percent more efficiency than legacy systems.

Figure 4: Scalable DC Power System for central office & data center applications

With the scalable power system upgrade, this major U.S. carrier has realized substantial cost savings and an excellent payback period. The company has eliminated the ongoing costs of servicing its aging systems and the Eltek Scalable system generates significantly less heat than the legacy equipment, meaning the carrier is able to save in air conditioning costs as well. The carrier team particularly liked that the payback period was a short 13 months, nearly halving the initial two-year payback period. The customer started its central office upgrade with one location in Texas and has now completed a total of 10 site upgrades with Eltek Scalable Powerpack systems throughout its U.S. locations.

Breakthrough technology

Eltek has been the technology leader of the DC power systems industry, driving the development of rectifiers with the highest efficiency and power density. Recognizing the need to assist carriers with reducing their operational costs and impact on the environment, Eltek began in 2008 to convert its entire rectifier line to high efficiency power. Today, Eltek is the global leader in green HE solutions for every telecommunications application while the rest of the industry is only now beginning to address these challenges.

Figure 5: Flatpack2 HE high efficiency rectifier

The company's flagship Flatpack2 HE rectifier reduces energy waste through a unique design that boosts AC to DC conversion efficiency up to 96.5 percent. Since its introduction, Eltek estimates that the deployment of more than 300,000 Flatpack2 HE rectifiers worldwide has cut nearly 350 million kilowatt hours in wasted electricity, reducing CO_2 emissions by approximately 238,000 tons, and saving carriers more than US $40 million in power related operating expenses.

CONCLUSION

Carriers are recognizing that the impact of highly-efficient power systems is shifting from cost reduction to service provisioning and revenue growth. Eltek continues to be a global leader in this market; having installed more than 300,000 HE systems and helping carriers meet their cost-reduction and new service deployment goals.

By using Eltek's high efficiency power products, network operators can reduce their overall operational expenses, wasted electrical energy and carbon footprint. Moreover, due to its compact form, high capacity and efficiency, operators can accommodate equipment for new or enhanced services which are vital for competitive service offering and revenue growth.

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