

Powering Sun's Energy-Efficient Datacenters

Modular power distribution for today and tomorrow



Summary

- Sun's "pod" design enables modular and scalable electrical systems. Right-sizing from day one and into the future provides crucial flexibility and cost savings.
- Simplifying the system reduces human error when expanding or reconfiguring the datacenter. Monitoring exact power usage in real time — from the utility feed down to the power strips internal to the racks — enables intelligent forecasting and planning.
- Universal Electric's Starline Track Busway installs faster than traditional electrical systems and uses power outlets that can be changed quickly to support evolving IT requirements.
- APC's Symmetra MW UPS provides essential energy efficiency on day one and scales easily to accommodate future growth.



Technology is changing at an amazing pace, creating more efficient and powerful computer systems in much smaller spaces. This space compression and compute performance expansion is requiring much higher power capacities per rack, forcing the need for a very flexible power distribution and delivery system within the datacenter.

Sun's next-generation datacenter designs include flexible and adaptable electrical systems. This provides the ability to change power configurations in minutes and the capacity to easily accommodate future power demands — without disrupting datacenter operations.

Datacenters house a mixture of equipment with a wide variety of power needs. To complicate matters, IT equipment is changing with a much higher frequency than the typical life expectancy of the datacenter. For example, a datacenter might be designed with a life expectancy of 10 to 15 years; however, most IT equipment refresh cycles are on the order of 2 to 5 years. This frequency of change requires a datacenter electrical design with the capability to handle anywhere between two and four complete IT equipment refreshes. The design also needs to be able to adapt to equipment relocation within the datacenter. These

requirements drive the need for a flexible, adaptable electrical system with higher power and different power outlet configurations.

Unfortunately, traditional datacenter power implementations — with dedicated hardwired conductors for each power outlet through overhead or raised floors back to main distributions panels and circuit breakers — are neither flexible nor adaptable, and are expensive and time consuming to change. With traditional electrical systems, datacenter architects must preplan every outlet, even though it is nearly impossible to predetermine the power requirements for each rack in each location when the datacenter goes live, let alone for future requirements. When inevitable changes occur as a result of growth and/or equipment upgrades, the costs for electrical changes can be significant — both in terms of manpower and the risk of outages.

Consolidating and standardizing datacenters

To reduce its costs and impact on the environment, Sun is consolidating real estate, and in the process, datacenters. One of Sun's biggest and most expensive assets is its global technical infrastructure, which is the foundation for the engineering, services, sales, and support community at Sun. Sun's labs and datacenters are where the innovation happens, products are developed, testing is conducted, and customers are supported. It is critical that this environment enable the Sun community to continue to deliver the innovation that makes Sun thrive. Until recently, however, each space developed on its own, sometimes in converted offices or conference rooms, without design standards.

To eliminate inefficiency and reduce environmental and economic costs, an internal team was established and asked to develop datacenter design standards. Sun's philosophy for datacenters and lab spaces is to design everything to be as power efficient as possible while simplifying inevitable changes. Simplifying the system also helps reduce human error, which can contribute for up to 90 percent of power interruptions. Everything is designed around the current and anticipated future requirements of a datacenter rack. These requirements are then applied to a "pod," a self-contained group of racks and/or benches that optimize power, cooling, and cabling efficiencies. The pod acts as a building block of the datacenter and helps Sun standardize power, cooling, and cabling needs for both the datacenter and the utility yard supporting the datacenter.

Given the state of technology today, the current design assumes a starting requirement of 4 kW per rack, upgradable in 4 kW chunks to as high as 30 kW per rack. With these specifications in

mind, Sun designed a flexible, adaptable, and scalable electrical system — with their partners Universal Electric and APC — that is now an accepted standard for Sun's datacenter design.

Flexible, adaptable power solutions in the datacenter

Starline Track Busway

After extensive investigation and analysis of industry solutions, Sun selected Universal Electric's Starline Track Busway as the best fit to replace the traditional hardwired electrical system. Sun uses a combination of 225- and 400-amp busways to distribute power from the main electrical rooms to the server racks. The busway system design allows for simple installation, change, and removal of power outlets. IT staff or facilities personnel can add and remove plug-in outlets and electrical equipment at any point along the busway without shutting down the main busway system. This means any location in the datacenter can have the power supply reconfigured without affecting anything else in the space — and without risking an unplanned outage.

Starline Track Busway is the simple, versatile, fast, and economical solution for supplying power to electrical loads. The busway can be tapped at any location with a variety of plug-in units, eliminating panel boards, long runs of conduit and wire, and expensive installation costs for dedicated power outlets. It also dramatically decreases human error. With dedicated circuit breakers located at the rack, troubleshooting outages or reconfiguring supplies is very easy.

In the Sun datacenter design, two busways are required per pod. Only five conductors per busway run through each conduit back to the panel, rather than three to four wires per outlet. This reduces the amount of copper by up to 15 percent and dramatically cuts installation

times. With copper becoming increasingly expensive and in demand from developing countries, the savings in the future could be substantial.

The busways are powered by large distribution boards located in external electrical rooms outside the space. The distribution panels can support multiple buses and reduce the amount of distribution panels located on walls and datacenter spaces.

Benefits of Starline Track Busway

With Starline Track Busway, Sun now has the ability to quickly adapt to changing power requirements in datacenters and labs. The benefits of the system are evident the first time something changes. For example, the day one requirements for Sun's Santa Clara, California, datacenter were different from the original plan. These changes forced electrical outlet locations and types to be reconfigured, which in a traditional datacenter would have incurred more time and cost or result in IT equipment layouts that were less than ideal. However, with the Starline Track Busway system, Sun was able to quickly and easily adapt to the changes in layout — without any substantial time or cost to the project. And, if the day one requirements are less than initially anticipated, busway components can be easily relocated to another location in the datacenter or to another datacenter rather than abandoning them in place. The ability to right-size from the beginning provides flexibility and economy that is unheard of in today's datacenters.

Other benefits include:

- Easy, fast, and inexpensive to change — With the Starline Track Busway system, there is no need schedule datacenter power outages to reconfigure outlets, work on live panels, or shut down panels to add, move, or change outlets. With traditional wire-mold

“The Starline Track Busway works like track lighting on steroids. We easily twist in new cans at any point along the busway with no need to shut down the main source. And the busways also have IP connections, so we can track power usage in real time and intelligently forecast and plan for the future.”

Mike Ryan

Design Engineer (PE)
Sun Global Labs and Datacenter Design Services

deployments, it is often necessary to pull new cable through existing conduits, which puts every conductor in the conduit at risk.

- **Completely reusable components** — Busways can be completely disassembled, relocated, and reassembled to any location. Spare components can be ordered and kept in inventory for fast changes. Components are fully tested and very reliable. All parts for busways of the same amperage are interchangeable and can be used on any bus in the datacenter. Repairs or changes can be quickly effected by simply replacing components.
- **Simple design** — A single system incorporates multiple copper conductors for single- and three-phase power in an insulated housing that allows the user to plug in outlet boxes, drop cords, and circuit breakers at any point along its length.
- **Reduced human error** — Circuit protection is maintained at the point of use rather than at a remote panel that is often far away, making the power system easier to troubleshoot and repair and reducing the possibility of compounding the problem with human error when troubleshooting. In traditional systems, breakers in panels are often mislabeled or not updated to reflect changes, which makes them extremely difficult to troubleshoot.
- **More usable space** — With datacenter floor space at a premium, every square foot is critical. The busway reduces the number of breaker panels installed on walls and/or in power distribution units (PDUs) installed on the datacenter floor. This results in more usable space for IT equipment and server racks.
- **Completely scalable** — Datacenter electrical designs are often outdated before they are ever installed. The busway system is completely scalable, enabling components to be added as need rather than completely installed in the beginning. This provides the flexibility to make changes from day one without rewiring the datacenter.

Monitoring the busway

It is important for Sun to have the ability to monitor and know the exact power usage of the datacenter. Starline Track Busway provides monitoring units to measure and display each phase current in real time, perform alarm functions, and provide remote communication for main power busways. With this information, in addition to metered rack power strips, datacenter managers can intelligently forecast and plan for the future. They know the exact capacity and load of each rack, pod, and datacenter, and therefore know where they can install new or upgraded equipment. In addition, monitoring helps ensure the electrical system is balanced across phases, leading to better energy efficiency and ultimately costs savings.

Scalable electrical yards

Sun's modular datacenter design makes it easier to design scalable utility yards as well, where the same principle of modularity is applied to uninterruptible power supply (UPS) units. Sun selected the APC Symmetra MW UPS and installed three 800 kW UPS units across two lab buildings. One lab building UPS is sized and installed for 800 kW, with an area to add another 800 kW unit. The other lab building is sized with two 800 kW UPS frames, but due to the APC scalable power module design, initially both UPS frames are only populated to half of the frame's capacity — each UPS currently supports 400 kW with easy growth to 800 kW with little or no impact to the datacenter. Anticipating this growth, Sun ran conduit above the datacenters to support 800 kW.

Benefits of Symmetra MW UPS

Sun selected the APC Symmetra MW UPS primarily for its modular design and energy efficiency.

- **Energy efficiency** — Testing proved that Symmetra MW offers up to 97-percent efficiency. Over a 10-year period, the possible energy savings could exceed \$1 million on the three installed UPS systems.

- **Modularity of the UPS helps to maintain energy efficiency** — The Symmetra MW UPS is like a blade server in the sense that power capacity can be reduced or increased by adding or removing modules. The UPS frames at Sun's Santa Clara facility are capable of growing in 200 kW increments up to 800 kW. This modularity allows Sun to operate the UPS at its most efficient power levels. By using this type of UPS, if demand grows faster in one building and slower in another, Sun can transfer power modules from one UPS to another. This allows Sun to have the flexibility of always right-sizing the UPS.
- **Fast modular repairs** — Fast repairs are possible due to the modular design. Should a failure occur, the failed module is replaced. Fewer parts are required and many are fast to replace, making maintenance simple.
- **Redundancy for reliability** — Important UPS subsystems are redundant with the UPS frame to enhance UPS availability. For example, if there is one more 200 kW module than is required to power the load, the UPS is redundant within the frame. In this scenario, all of the installed bays of power modules share the load. However, if any one bay of power modules fails, the remaining power modules continue to deliver UPS power to the loads. The operations management center is notified through alerts to schedule the failed module to be replaced. The result is more control over the availability of Sun's operations.

- **Real-time monitoring** — Many data points within the UPS and its subsystems are IP monitored. This helps ensure that operations staff are continuously aware of the operating parameters of the UPS either remotely or when standing beside the UPS control panel.

Best practices

- **Standardize on modularity of the systems** — Modular designs, from the rack to the utility yard, enable efficient scalability and predictability.
- **Use track busway for simplicity and flexibility** — The ability to quickly change electrical components is critical to datacenter flexibility.
- **Closely monitor power usage** — Newer systems have higher densities per rack footprint, requiring closer monitoring down to the rack level to enable predictive power system conditions.
- **Provide locations for future growth** — Today, average datacenter rack loads are approaching 6 kW, but in a few years these loads are likely to increase to an average of almost 10 kW. As datacenter loads increase, it is imperative to have preplanned locations for future electrical equipment. When locations for future switch gear, transformers, distribution panels, and more are anticipated and planned for during the datacenter engineering and design phase, it is much easier to significantly grow capacity.
- **Plan for capacity growth** — A good electrical design allows for capacity increases while reducing the impact to the datacenter. Planning the location of future equipment and electrical pathways in advance is essential, for example, installing the electrical

Learn More

For more information on Sun's energy-efficient datacenters and additional design features, visit sun.com/eco. To learn more about Universal Electric, go to uecorp.com.

conduits for future electrical infrastructure equipment. The cost of running additional conduits at the time of construction adds very little to the overall project costs, especially when compared to the cost of running the conduit through finished spaces later in time. Electricians must run conduit anyway, so running a few extra is fairly trivial. Planning ahead saves time, money, and datacenter disruption when it is necessary to expand.

Energy-efficient adaptability and scalability

Sun's new modular pod design provides the foundation for implementing flexible, adaptable, scalable, and efficient electrical systems for the company's datacenters and lab spaces. With the Starline Track Busway and Symmetra MW systems, Sun now has the ability to expand and grow the entire electrical system with minimal cost and impact to the datacenter. In addition, real-time power data enables Sun to grow datacenter capacity intelligently and as efficiently as possible, supporting the increasing needs of customers, without drawing more power from utilities or incurring additional cost.



Sun Microsystems, Inc. 4150 Network Circle, Santa Clara, CA 95054 USA Phone 1-650-960-1300 or 1-800-555-9SUN Web sun.com

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