



DATA CENTERS

Ensuring profitability with innovative data center solution architectures

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ABB's comprehensive pre-engineered solution, based on three topologies, addresses the data center industry's electric needs: flexibility, scalability and cost-effectiveness to ensure timely start-up, operative reliability and maintainability.



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The data center industry has experienced unprecedented growth over the last decade. With the application of the Internet of Things (IoT) in all areas of work and play, the demand for computing power continues to accelerate – especially as the lure of big data gathers momentum. Recent advances in both IT hardware and software have

Attitudes about data centers have changed; they are seen as an integral part of business operations and revenue generation.

resulted in the virtualization of servers, cloud computing, and the ability to transfer some of the required reliability from the infrastructure layer to the software layer.

The data center market, once dominated by purpose-built on-premise enterprise data centers, has shifted to off-premise colocation and cloud data centers. With a global spend of over

USD 38 billion on colocation services predicted by 2023 and multi-tenant centers experiencing 5 percent growth in 2018, this trend will most assuredly continue [2].

The primary advantages of these increasingly popular services to enterprise clients is clear:

- Companies can easily rent colocation data center space from third parties or utilize cloud data centers, thus eliminating the need for infrastructure such as building, cooling and security.
- Companies can eliminate the need to manage IT components, including servers, data storage and firewalls.

Data centers for profit generation

The overall data center construction market growth is predicted to increase by 9 percent between 2019 and 2023. Nonetheless, the market is consolidating [1]. Coinciding with the technological expansion, companies are increasingly applying sound business practices to the design and construction of data centers →01.

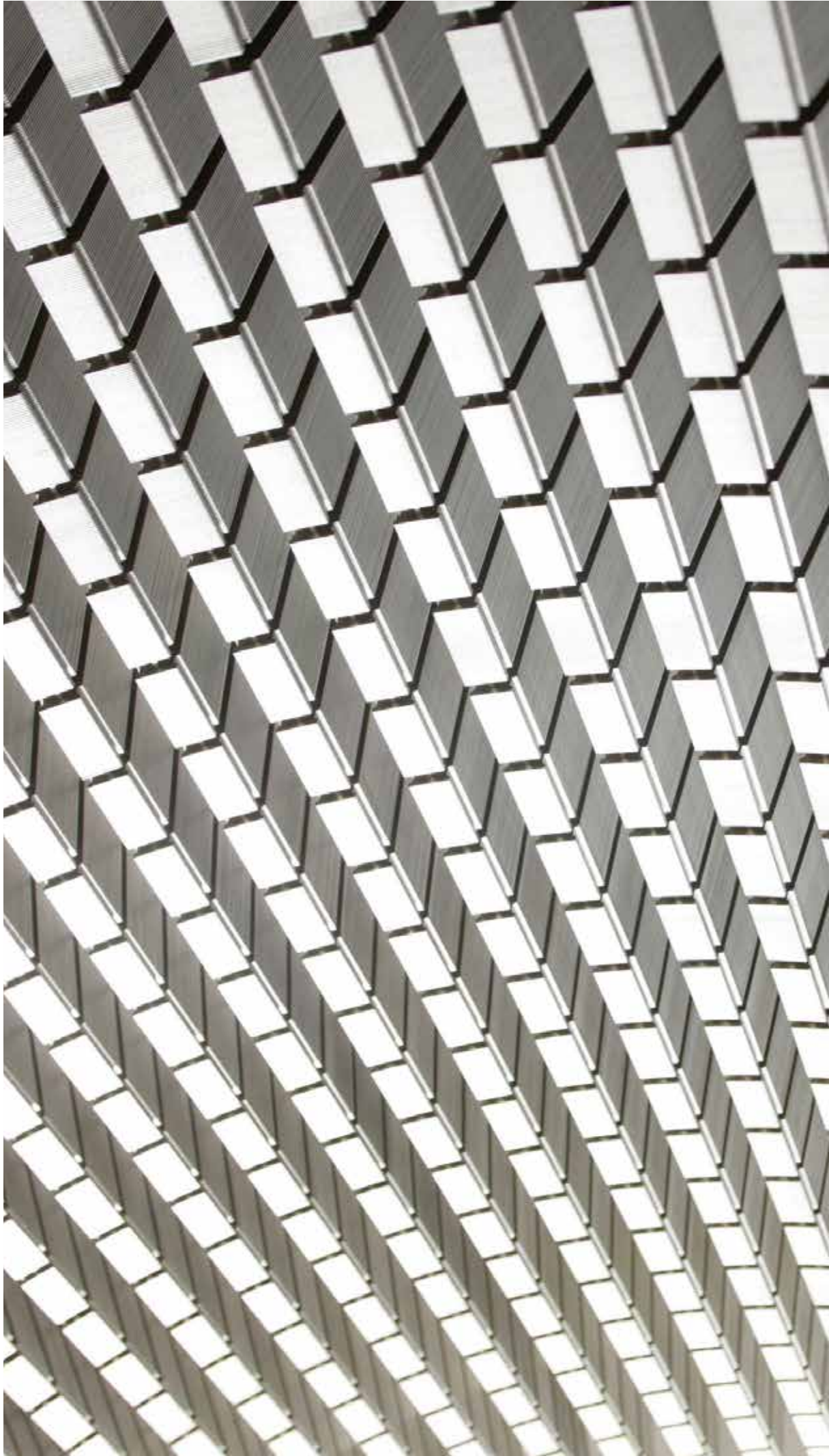
The purpose of data centers is still evolving; they are no longer just a necessary part of



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Nowadays, businesses can choose from on-premise enterprise centers to off-premise virtualized infrastructures that support applications and physical components across the cloud environment.



business operations, they are a profit generation center [1]. Attitudes about data centers within an enterprise have adjusted; they are now seen as an integral part of business operations and revenue generation. As a result, data center strategies are more attuned with business realities. Their costs – both capital and operational – are highly scrutinized. This scrutiny comes from both internal checks and balances with a company's finance office, as well as external environmental watchdog groups as greater attention is now paid to energy consumption [1]. To meet these expectations, the industry has had to revise its justification for data centers and incorporate new concepts about their design, construction and operation.

Recognizing and meeting industry demands

Reliability and maintainability are central to the successful operation of data centers and so companies must remain flexible. These centers must satisfy industry requirements for redundancy and fault tolerances: electrification designs must ensure that equipment replacement or removal from service will not impact the critical load.

ABB offers data center customers, including cloud and colocation industries, leading edge technologies to meet these challenges. By fulfilling modularity, flexibility and efficiency

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ABB offers data center customers leading edge technologies to meet tomorrow's challenges.

requirements for solution architecture, ABB ensures safe, secure and continuous operation in a rapidly evolving data center landscape.

Design standardization

The task of creating a flexible fortress-like data center that safely and securely stores and manages business-critical data and applications under every conceivable situation, while simultaneously accommodating both short-term and long-term growth, is daunting. Overall, this

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— 01 ABB and GIGA Data Centers developed an electrification solution of LV switchgear, dry-type transformers and UPS to support the IT server and network infrastructure of the GIGA Data Centers is shown.

— 02 A schematic system plus system topology is shown; this topology was the basis for the design of the packaged solution for GIGA Data Centers.

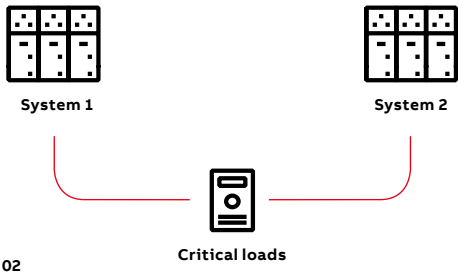
— 03 The shared redundant topology is similar to system plus system topology except that it uses multiple systems to increase utilization and reduce costs.

— 04 The block redundant topology is illustrated; this topology is commonly used in hyper-scale and colocation data centers.

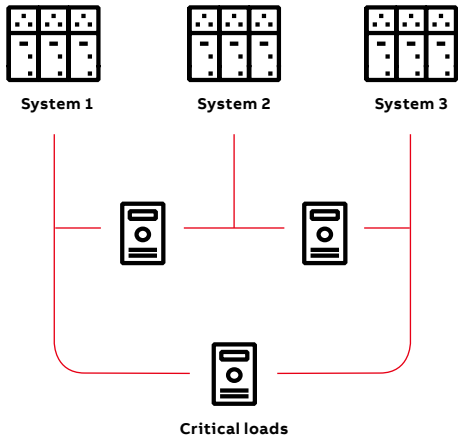
necessitates electrification designs that are more flexible and scalable. These designs should incorporate a standard block of power, repeated throughout the design, to allow for any future expansion. These design concepts offer significant improvements over previously conceived data center designs.

The standardization of design improves operational reliability, and yet these designs must be flexible enough to adapt to a myriad of site requirements. ABB’s design experts recognize these challenges and take into account site variables, eg, utility voltage, total size of the data center, and the optimal design for cooling based on the local climate →01. Scalable and repeatable designs are based on a standard size IT load that is taken as a building block. By using this tried-and-proven process, ABB ensures reliability and maintainability.

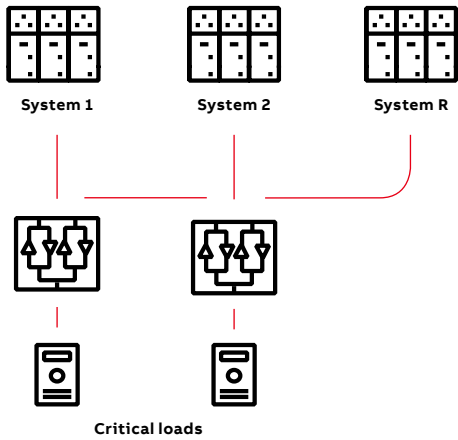
Short timeline
Fast track project execution, short cycle delivery times and the cost-effective utilization of assets are key to the success of data center projects as they have a direct impact on capital cost.



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Photo: GIGA Data Centers

In addition, design criteria will influence the electrification topology for the critical power distribution and impact cost.

Project implementation time is a particularly critical factor – one differentiated by uncertainty. Even though the demand for computing power

ABB fulfills modularity, flexibility and efficiency requirements for data center solution architecture.

continues to accelerate, growth is not easily forecasted. Determining the end-solution at the start can be difficult, especially for the colocation and cloud data center markets. Paradoxically, speed to market is a dominant requirement for new data center projects and for the expansion of existing ones. ABB takes all of these factors into account to create pre-engineered electrification solutions that are modular, scalable and efficient as well as versatile, thereby ensuring successful implementation on an extremely short timeline.

Electrical topology choice: a matter of function

Conventional electrical topologies, commonly used in data centers, can be implemented in several different configurations depending on exacting project requirements and site conditions. Factors that determine the actual configuration include: load kilowatts (kW), available utility service voltages, initial cost, etc.

Although most data center electrification systems are unique, there are only three main underlying topologies: system plus system, shared redundant and block redundant topologies.

As the name implies, the system plus system topology utilizes two completely independent systems to feed the critical load →02. The design is based on deploying IT equipment with redundant power supplies (sometimes referred to as dual corded loads). This topology is the basis of design for on-premise data centers, for example, enterprise-, financial- and government data centers as well as colocation companies.

Although the system plus system design has a proven reliability record, costs can be prohibitively high: a maximum utilization of assets is 50 percent. Thus, a variant of this topology is often

employed to reduce overall cost: system + utility. Here, the “system” has N+1 uninterrupted power supplies (UPS) while the “utility” has no UPS.

Colocation, hyperscale and cloud data centers generally use the shared redundant topology, which comes in a variety of configurations →03. The design is normally designated by the number of systems over the number of loads, eg, 3N/2 for three systems and for two loads, or 4N/3 for four systems and for three loads, etc. For example, using 1 MW blocks of IT load, a 3N/2 system would have 3 MW of capacity feeding 2 MW of IT load.

With this configuration, customers can improve utilization by up to 66 percent; 75 percent is possible with 4N/3. Consequently, this topology serves as the basis for the design of many colocation and hyperscale data centers and for hyperscale computing because the goals of big data and cloud computing environments are maximum performance, lowest possible cost, and peak power efficiency. While the use of the shared redundant topology does improve asset utilization, it nonetheless requires the operators to monitor loads.

Block redundant topology, also known as catcher topology, utilizes a static transfer



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— 05 Data centers paradoxically require extremely flexible yet standard solutions so they can expand or shrink as their needs change. ABB provides standard solutions that evolve with their customers' needs.

switch (STS) to transfer the critical load from the primary or active system to the reserve or catcher system →04. Such a topology is used by both hyperscale and colocation data centers. For data centers with single corded loads this topology is usually the most cost-efficient design. With the block redundant topology,

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ABB's package solutions ensure safe, secure and continuous operation in a rapidly evolving data center landscape.

an asset utilization of 80 percent is possible and there is no need to constantly monitor loads to maintain redundancy. The primary disadvantage of this topology is the reliance on static transfer switches; this increases the cost and complexity of the design. Block redundant depends on the ability of the catcher or reserve UPS module (or modules) to handle a step load. The active UPS can be loaded to full capacity. The reserve UPS has no load in normal operation. The reserve

system can be larger than the active systems. Block redundant can be applied with single cord or dual corded IT loads. As such, if single corded IT loads are used, the static transfer switch is a single point of failure.

Pre-engineered solutions: limited site-work and smooth startup

ABB developed standard solution architectures, a pre-engineered integration of products for all electrical distribution needs from the utility service to the rack, based on these three topologies. ABB's comprehensive solutions are the answer to the data center industry's specific electric needs: flexibility, scalability and cost-effectiveness to ensure a short and sweet startup along with operative reliability and maintainability. Flexibility also helps customers to address future needs as the data center grows and IT needs evolve →05.

All pre-engineered solutions can be easily duplicated or slightly modified to serve most data centers on the market →06. A package includes: substations, medium voltage (MV) switchgear, transformers, low voltage (LV) switchgear, LV switchboards, UPS systems, power distribution units (PDU), remote power panels (RPP), and IT busways.

Solution architecture: a collaboration story

In 2018, ABB with its acquisition of GE Industrial Solutions, began collaborating with GIGA Data Centers to develop a critical power distribution design for their new data center in Mooresville,

In 2018, ABB and GIGA Data Centers collaborated to develop a critical power distribution design for a colocation data center.

North Carolina, USA. As a colocation data center company, GIGA endeavors to make flexible and modular data center technology available at a competitive cost to all its customers, not just to

hyperscale data center customers. GIGA turned to ABB because of their solid expertise in providing flexible, innovative technical electrification solutions within a challenging time frame.

Having acquired a long rectangular building suitable for conversion into a data center, GIGA and ABB jointly worked to design a system that would support 60 MW of IT load. Amazingly, the first phase of data center conversion was completed in less than six months. Subsequently, ABB's expert team and GIGA's mechanical, electrical and plumbing consultants collaborated to design a flexible, scalable and efficient packaged solution based on a system plus system topology. This design is scalable and has the capability of expanding in increments of 2 MW of IT load. ABB's electrification solution for GIGA Data Centers included LV Spectra Switchboards, TLE UPS modules (to support the customer's IT

ABB'S EHOUSES AND SKIDS FOR COLOCATION DATA CENTER

Colocation data center customers prefer scalable electric equipment to fulfill their various sizing needs and meet delivery and commissioning goals. ABB's skid units and electrical house (eHouse) packages enable data centers to address these challenges. Common to traditional construction methods, packaged solutions are typically supplied as individual components with installation and interconnections provided by third parties.

Such a solution is an open frame mounted, compact unit with factory installed equipment and interconnections. Because they are pre-engineered, pre-installed and pre-tested, indoor skid solutions can be built off-site parallel to other construction efforts, thereby accelerating the construction schedule.

The eHouse is a pre-fabricated, pre-engineered and pre-tested system; it is an environmentally controlled building with factory installed equipment and interconnections. By testing all components prior to shipping, ABB ensures that risks in the field are minimized. These units are easy and cost-effective to install and can be placed close to



the main loads. Although, usually permanently installed, they can be relocated as a colocation center grows or a customer's IT equipment is changed.

With eHouses, customers can accelerate their construction schedule and save space. Such one-piece systems are suited for data center projects that must reduce on-site work, eg, remotely located centers where qualified personnel are unavailable or labor is expensive or difficult to manage. By optimizing layouts through modular design and leveraging skidding and eHouse technologies, ABB helps customers reduce cost.

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06 Electric package solutions, such as skids, and eHouses, help customers meet sizing and commissioning goals.

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07 GIGA Data Centers located in North Carolina, USA depended on ABB to achieve start-up on a tight timeline.



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server load), Decentralized Parallel Architecture (DPA) UPS (for the site server load: facility optic fiber and network), UPS maintenance bypass cabinets, lithium-ion battery systems, lighting panel boards, and dry-type transformers. The DPA

and commissioning of all equipment to the commissioning of all systems. ABB's successful end-to-end solution is a compact and efficient data center that delivers the power distribution and protection performance GIGA needs today with the potential to expand in the future →07.

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ABB's end-solution is a compact and efficient data center with the power distribution and protection performance GIGA needs.

ABB's complete electrification package solutions based on standard designs provide data center customers with flexibility and scalability so they can build and run data centers efficiently today and gives them the ability to react swiftly to market changes. •

References

[1] E. Olson, "Industrial automation in data centers: Growing revenue potential one server at a time", in ABB Conversations, July 2014, Available: <https://new.abb.com/cpm/data-center-automation/additional-offering/data-center-perspectives/industrial-automation-for-data-centers> [Accessed: May 5, 2020].

[2] C. Flanagan, "Gaining a Competitive Edge", ABB white paper, 2017, pp. 1-11.

UPS was chosen as it is more effective for lower power requirements and can scale as GIGA expands. Lithium-ion batteries were the logical choice: they are smaller and lighter and can run at higher temperatures than lead-acid batteries, thereby obviating the need for an additional cooling system.

ABB's packaged solution included all project management and field services from the start-up



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