Society is driven by digital data. The huge amount of information we add each day to the Internet is just one aspect: credit card, bank, health, phone and tax records; data produced at work; images, music, and so on – all generate a mountain of data which has to be stored somewhere. Add to that the many new, data-hungry services appearing weekly, which, almost incidentally, give rise to a further torrent of terabytes, and the exponential growth of data storage requirements is assured.

Providers of data centers, where much of this data is stored, operate in a rapidly changing industry. These changes are so profound that stable business models have yet to emerge. Acquisitions, mergers and bankruptcies coupled with technological advances have led to a lean market where prices are being forced down and infrastructure requirements are being dramatically transformed. To survive in such an environment, suppliers have to be very nimble indeed.

With over 50 data centers already built, ABB is a key player in this sector and provides all the infrastructure, except for the communications equipment itself, for these often mission-critical facilities. How, then, is ABB reacting to the enormous change in the data center market?

Data storage: Re-format

Closely tracking a fast-moving sector

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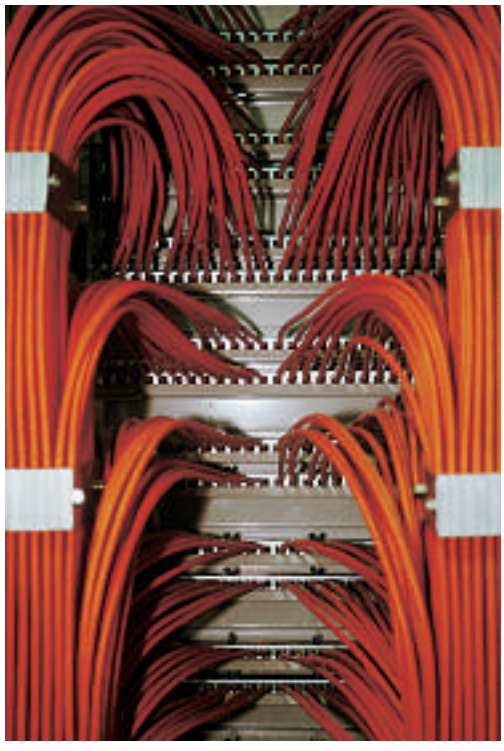
In the past few years, the data center market has changed dramatically, forcing many companies into consolidation or bankruptcy. Gone are the days when companies raised millions of dollars to acquire large industrial buildings and transform them into glittering, high-tech palaces filled with the latest telecommunication and data technology.

Whereas manufacturers of communication technology deliver the racked equipment in these, often mission-critical, facilities, ABB focuses mainly on the building infrastructure. Besides the very important redundant power supply, ABB also provides the redundant air-conditioning and the security system. Other key areas of ABB expertise are engineering and project management, installation and commissioning and, of course, providing products like transformers and switchgear. *GTS, Viag Interkom* and *Telia* are just some of the clients who have awarded design and equip contracts to ABB for their data centers.

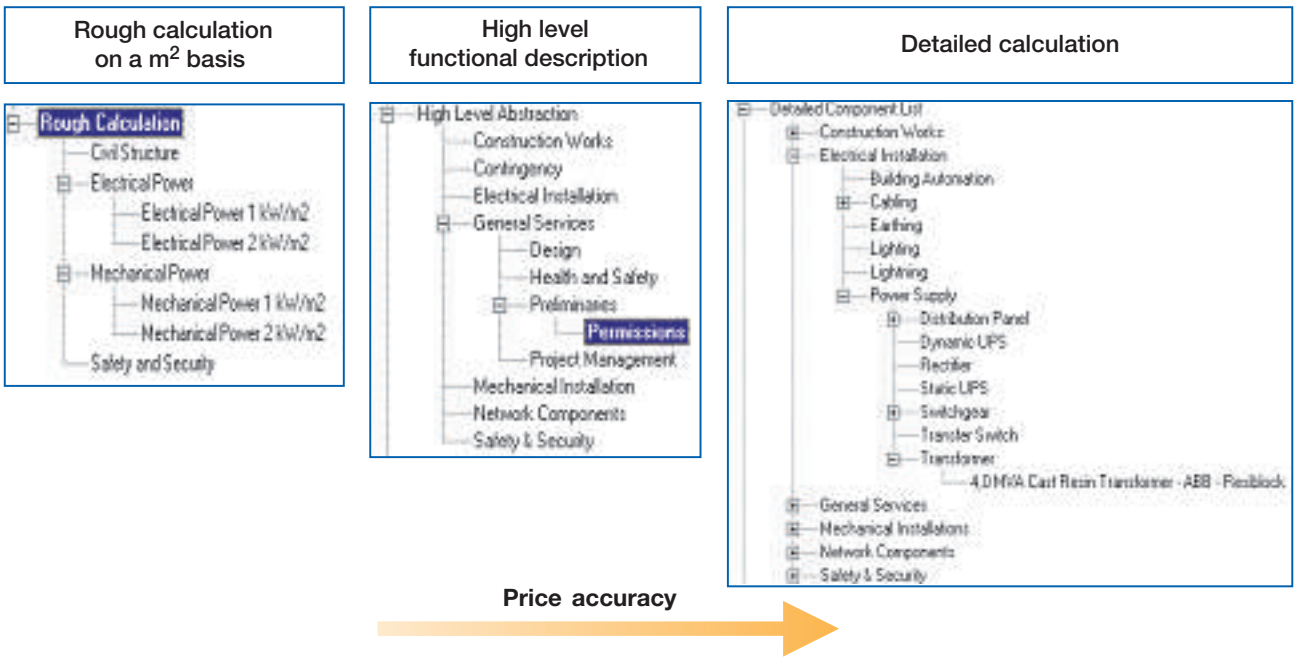
Now that the market has changed so much, data center companies have been forced to adapt their strategy and behavior. Simultaneous extensions of several data centers in different countries are a thing of the past, and rollout plans now better match the financial health of the companies. Similarly, most companies no longer build large data center spaces of 10,000 m² or more at once. Although the building space may be available, many companies instead outfit a rather more modest 300 m² or so until they have enough customer contracts to merit expansion. They then enlarge step-by-step, following the revenue stream.

Furthermore, data center company bankruptcies have resulted in a floor space surplus, making the acquisition of an existing data center an attractive alternative to building a new one. The lack of quality and design standards make re-build and re-design important criteria for the further operation and use of the building. This development forces not only the data center companies to rethink their business plans, but ABB too.

ABB has built more than 50 data centers, usually as 'Total Technical Solution Projects' in which the scope of work ranges from design right through



1 PopCalc is a web-based tool that simplifies the configuration of data centers.



to project implementation. However, there are now far fewer such jobs. Instead, ABB has to provide flexible and expandable designs for new data centers and clever re-design and re-building of existing ones. ABB has consequently switched its business model away from large project tenders to being a partner for the whole design and build process for modular data centers.

A tool for modularity – PopCalc

The key to flexibility and expandability in data center design is *modularity*. Modular and interchangeable design models can be used to represent different data center concepts with different dimensions, power supplies or cooling schemes. ABB has developed a set of tools and standards for implementing such design concepts 1.

PopCalc is a prominent example. It is a web-based calculation tool for data centers which contains all the design information and prices needed to quickly generate alternative designs.

A key element of PopCalc is its component tree structure. This allows the user to model his projects simply by adapting the tree structure to his current requirements. In this way, it is very easy to generate alternative configurations by selecting an existing setup and replacing the relevant components.

A further advantage of PopCalc is the

fact that the user does not have to start from scratch each time but can adapt an existing design. Knowledge and resource sharing and also reusability are thus guaranteed. The tool is based on a underlying SQL database on a central server in Germany and uses a local front-end to allow the database to be addressed from everywhere in the world.

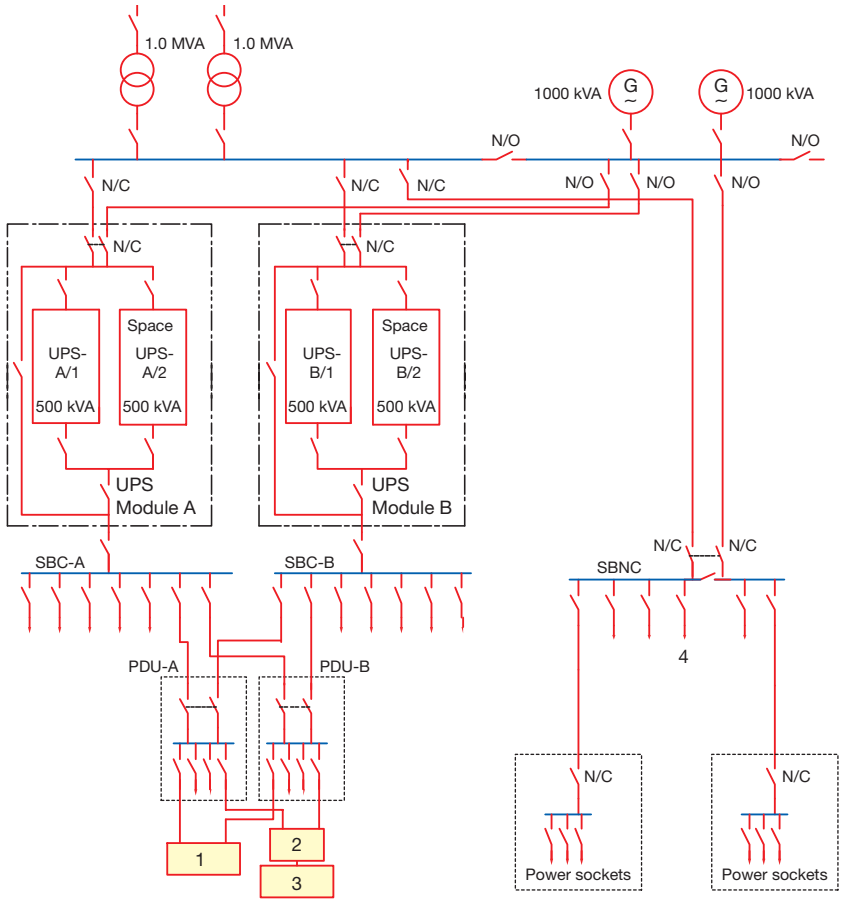
Dimensioning power

One of the most difficult things to provide in a modular fashion is power. Usually, the power supply provided for an industrial site has to be dimensioned for the future largest expected load. This is immediately in conflict with the aim of providing only that which is needed now and thus putting off further investment until it is needed.

Traditional configuration

A 'traditional' data center with a size of 500 m², 2000 m2 or even 10,000 m² would have been planned assuming a power consumption of around 1 kVA per m² for the racks containing the telecom equipment and 0.75 kVA per m2 for the cooling and technical infrastructure.

A 500 m² facility would, for example, need a 875-kVA power supply. With a redundancy of n+1 this could be realized with two 1000-kVA transformers and low-voltage switchgear consisting of a normal power panel and a power panel for the emergency supply. Furthermore, two emergency 1000-kVA diesel generators and two 500-kVA static UPS systems for the critical loads of the racks would be necessary 2.



2 Traditional configuration for a 500 m² data center, assuming a redundancy of n+1

SBC	*Switchboard critical load*
SBNC	*Switchboard non-critical load*
PDU	*Power distribution unit (power supply to data racks)*
N/C	*Normally closed contacts*
N/O	*Normally open contacts*
1	*Equipment with dual power input*
2	*Redundant switch*
3	*Equipment with single power input*
4	*Duplex power system (utilities, chillers, pumps, CRACs and DC system)*

The design philosophy for a 2000 m² site is similar. Here, the 3500-kVA power supply can be based on five 1000-kVA transformers instead of two, as well as one low-voltage switchgear system with a normal and an emergency power panel. Five 1000-kVA diesel-generator sets and eight static UPS systems, each rated 500 kVA, provide backup for critical loads.

Here, too, the redundancy is n+1. An alternative philosophy could have the emergency power supply realized with a rotary UPS system instead of a static one. Instead of eight UPS systems, the rotary alternative would be based on just five. The main differences here are the price and physical size. The rotary system is, for a 2000 m² facility, cheaper and needs less space. For the 500 m² data center the static system is cheaper and similarly sized.

Growing when needed

Today, the planning and design of such a data center is quite different. The size of the area to be outfitted and the power supply dimensions are no longer fixed parameters. The size of the data center, particularly the space used for equipment, will increase during the lifecycle of the facility as more clients rent space, necessitating an increase in power and cooling.

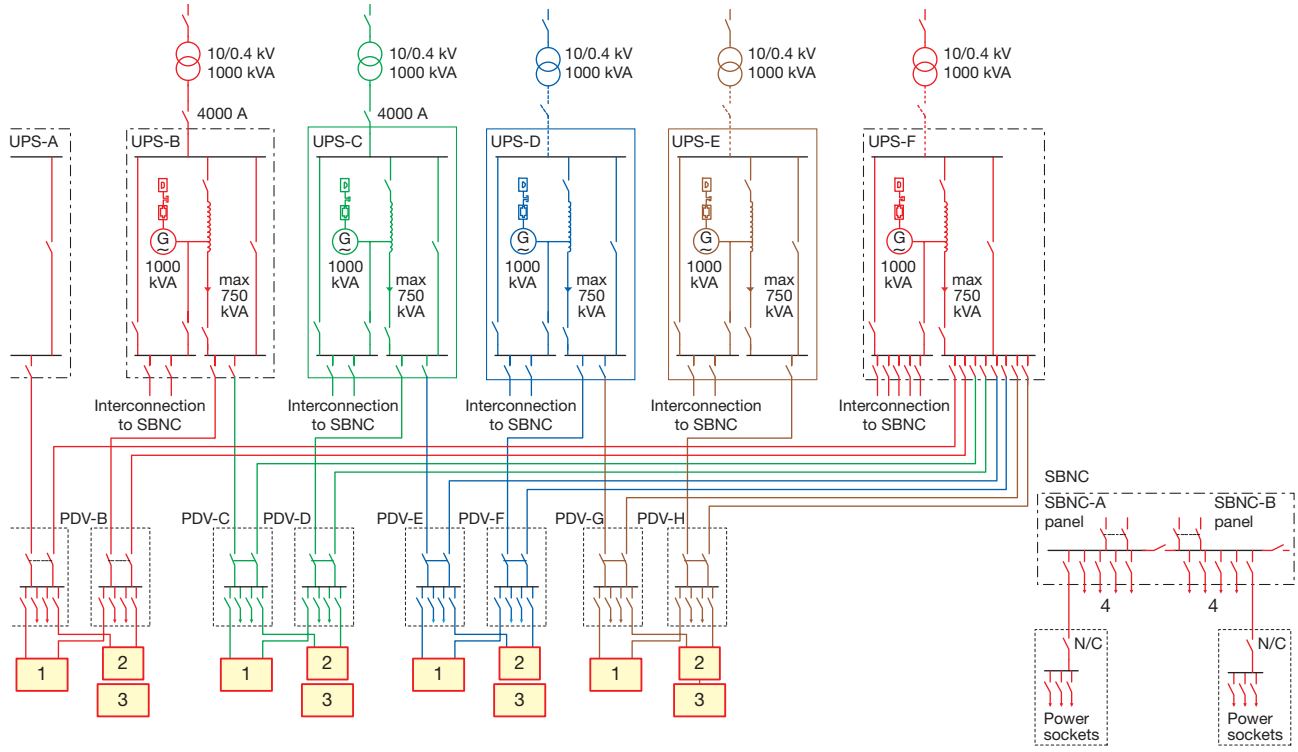
In addition, modern telecom equipment is densely packed, resulting in a higher number of servers per rack. This means that even though data centers are now built in phases, the basic power supply capacity provided by the local utility has to be planned from the beginning. Furthermore, this power supply has to ultimately deliver more energy than in the past as rack power requirements of 1.5 kVA per m² are now not uncommon.

All this means that generators, transformers and UPS systems need to be modular and to be able to grow along with demand.

Flexible and expandable

The 500 m² and 2000 m² site examples above describe two rigid and independent concepts. The following example, however, describes a *flexible* and *expandable* concept for a 500 m² data center capable of being enlarged to 2000 m².

3 Concept for expanding a 500 m² data center to 2000 m²
Phase 1: red; phase 2: green; phase 3: blue; phase 4: brown
Other notation, see Fig. 2



Expanding a data center in four stages from 500 m² to 2000 m²

Stage	*Size in m²*	*Total size in m²*	*Power needed*	*Installed power to preserve n+1 redundancy*
1	500	500	500 x 2.5 kVA = 1250 kVA	3 x 1000 kVA = 3000 kVA
2	500	1000	1000 x 2.5 kVA = 2500 kVA	4 x 1000 kVA = 4000 kVA
3	500	1500	1500 x 2.5 kVA = 3750 kVA	5 x 1000 kVA = 5000 kVA
4	500	2000	2000 x 2.5 kVA = 5000 kVA	6 x 1000 kVA = 6000 kVA

Based on an uprated power consumption of 1.5 kVA per m² for the telecom equipment and a consequently higher 1.0 kVA/m² rating for cooling and other technical infrastructure, the total power budget is now 5000 kVA for the final stage of expansion. This power capacity has to be installed from day one to avoid costly power grid upgrades.

However, for a 500 m² data center only three 1000-kVA transformers and three 1000-kVA rotary UPS systems would be needed. For a second phase with an additional 500 m², one more 1000-kVA transformer and one more 1000-kVA UPS system are required to preserve n+1 redundancy. A third phase would need another transformer and another UPS. The total after the fourth phase is six 1000-kVA transformers and six 1000-kVA rotary UPS systems (see *table*). The installation of the cooling equipment would be analogous.

Risers, cable trays and ducts also need to be installed at the beginning in preparation for later expansion. Available space and other important parameters like the floor loading have to be considered, too.

The first phase has the highest square-meter price, but this decreases for subsequent phases as most of the equipment is installed in phase one 3.

There is no doubt that the data center market will continue to evolve rapidly in the years to come and that providers and suppliers alike will be required to adapt accordingly. By offering modular data center solutions based on a flexible and expandable infrastructure, ABB can assure their continued prominent participation in this exciting and exacting technological environment.

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