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White Paper – Data Centre in a Standard Container

ENCLOSURES | POWER DISTRIBUTION | CLIMATE CONTROL | IT INFRASTRUCTURE | SOFTWARE & SERVICES

FRIEDHELM LOH GROUP

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Executive summary

Many companies are finding it increasingly difficult today to expand their data centers within the existing premises. High prices for additional floor space and diverse statutory regulations pose great challenges for IT managers. Alternatives are needed as locations for new server racks. The so-called Data Center Container from Rittal is one option, enabling IT facilities to be moved outdoors, without compromising on the demanded security and flexibility. With a capacity of up to 329 U, the container provides ample space for server installations. The basic version can be expanded with a whole range of functions to further enhance security and convenience, though even the basic version offers a high degree of comfort and considerable energy-saving potential through the use of direct free cooling. Another feasible application for the Data Center Container is to bridge an otherwise unavoidable loss of IT services during moves or renovation work. The most important IT functions can be maintained even if the main data center has to be taken offline. The short-term availability, a high level of security and individual configuration options permit users to set up an ultramodern data center within the shortest possible time.

Introduction

A data center is the core IT facility in practically all medium and large-size enterprises nowadays. For online traders and service providers, in particular, business success is dependent on fully configured and functioning IT systems. As an enterprise grows, the demands placed on such IT systems increase accordingly, above all in respect of data center capacity.

An ever larger data center occupies more and more space. Even where the company premises were initially planned with appropriate reserves, the scope for expansion is eventually exhausted. The management must then decide either to forego further growth, and with that also an increase in turnover figures, or else to find another way to expand IT capacity. As the first option is naturally out of the question for every self-respecting entrepreneur, a suitable means to accommodate additional servers must be found. Preferably immediate availability and above all the creation of additional suitable rooms are here the key challenges.

With the Data Center Container, Rittal thus offers a solution which permits not only short-term deployment, but also adaptation to the most varied scenarios connected with data center expansion. The Rittal Data Center Container (RDCC) is a fully functional data center comprising several racks and accommodated in a transportable container. Building upon a basic version, a wide range of options enables functionality to be expanded and in this way an individually tailored data center to be configured within the form factor of a standard shipping container.

Objective and requirement

With time, constantly expanding data centers eventually come up against spatial limitations. In any particular building (complex), a fixed area is usually set aside for the company data center. As every enterprise expects a certain growth, and thus makes advance provisions for expansion of its IT facilities, the rooms are often somewhat larger than necessary at the beginning. This initially leaves IT managers adequate reserves for future enlargement. Information technologies, however, have developed at a previously unknown pace in recent years, and many data centers are already feeling space constraints. The assignment of new rooms for additional IT capacities is then usually inevitable.

At this point, the responsible managers face further problems. Companies with premises in city center locations are confronted with prohibitive prices for the leasing of supplementary floor space. In the case of buildings under monument preservation orders, extensions or conversion may even be impossible for legal reasons, and a completely new building is likewise rarely a feasible alternative. What is needed is a data center which accommodates a maximum of computing power within the smallest possible space and can furthermore be installed independently of the existing rooms.

Even a move to another building is potentially problematic. Such moves can take several weeks, during which the interruption to normal working will also mean a loss of profits for the company. If core IT services are not available, staff have no access to indispensable corporate data and are unable to communicate with their business partners via e-mail. A second data center can here serve to maintain essential functions. The staff are able to continue their normal work while the servers in the main data center are transferred to the new building. The loss of working time and the impact on revenues are minimised.

Even the expansion of IT capacities may pose serious challenges. Normally, the installation or expansion of a data center demands very intensive planning, and consequently considerable time and work input. In project business, however, it may happen that substantial computing capacity must be made available within a very short time. If the required capacity is lacking, the only option is to extend the existing data center. But how can the necessarily long planning lead here be reconciled with short-term needs? The only solution is procurement of a compact, yet fully functional, high-capacity and immediately available data center.

Rittal Data Center Container

With its so-called Data Center Container, Rittal has developed a compact, mobile data center, whose 7 racks offer up to 329 U of installation space. The empty container provides an effective floor space of 15.2 m^2 with its inside dimensions 5722 x 2664 x 2896 mm (L x W x H). With external dimensions of 6055 x 3000 x 3250 mm (L x W x H), no special permits are required for transport via public roads. This fact at the same time reduces the planning and processing time.

The container to be seen in Figure 1 is suitable above all for outdoor installation and is thus not bound to a particular environment. The interior panelling of the closed wall elements offers fire protection in accordance with DIN 4102 and withstands fire for a duration of at least 30 minutes. As an option, it is possible to incorporate panelling with a 90-minute fire protection rating. The safety door is also burglar-resistant in accordance with resistance class RC2 (EN 1627/1630), with the option of upgrading to resistance class RC3. The data center inside the container is thus well protected against external influences. The installed components, however, must still be provided with a power supply and means of communication with the outside world without compromising the fire protection. Special bulkhead systems satisfy this requirement and enable cables and piping to enter the container from outside. The connecting elements are passed through precisely fitting rubber glands and subsequently enclosed to produce a fire-, gas- and weatherproof seal. In this way, the retrofitting of additional cables or pipes, or else the removal of current installations, can be implemented quickly and simply.

Figure 1: Rittal Data Center Container

Features

The basic version of the Rittal Data Center Container already features all most important functions, but can still be expanded as required with a wide range of individual option packages.

Basic container

A container offers space for up to 7 racks. In the case of 2,200 mm racks with 47 U each, this adds up to 329 U of rack space for component installations. The racks are mounted on a raised floor with a height of up to 300 mm. The control room substructure ensures particular strength and supports higher loads than a normal raised floor construction. In addition, the raised floor helps to cool the components. The cold air is routed via the floor to the enclosures, where slotted plates enable it to emerge upwards. Cooling efficiency is further enhanced by way of aisle containment. To this end, special plates are used to isolate the spaces in front of the enclosures. The cold air can then flow to the enclosures from the raised floor without mixing with the warm return air flow, which would otherwise result in a reduced cooling output. Figure 2 illustrates the function principle of cold aisle containment. The cold air flows through the raised floor to the servers and takes up their heat losses. The subsequently warm air is returned via the space above the enclosures. The aisle containment ensures that the cold and warm air flows remain separated and are unable to mix. The efficiency of this arrangement is significantly higher and thus reduces both energy consumption and impact on the environment.

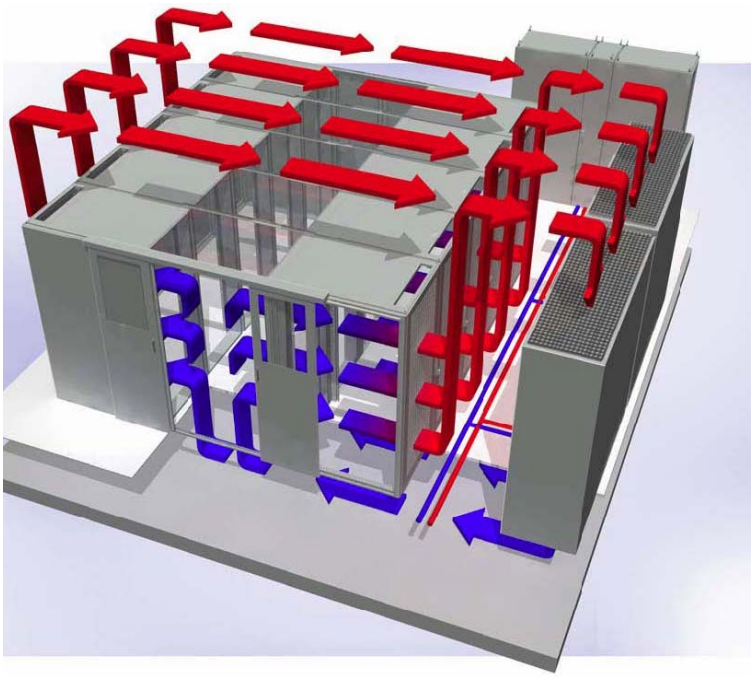

Figure 2: Function principle of cold aisle containment

The raised floor serves not only to route cold air to the enclosures. Cabling – and in case of special cooling solutions also piping – for the interconnection of the individual enclosures and their components can be accommodated under the raised floor. This solution avoids cable clutter on the floor, which would otherwise hinder access to the container. Underfloor cable routing, out of the way of personnel entering the data center, provides for a clearer layout and above all saves space.

The container receives its power supply from outside. To this end, a cable with a 5-pin CEE wall connector must be passed through the cable bulkhead and connected to the power distribution, which is accommodated in a further enclosure in the container. This enclosure is also present in the basic version and supplies power to all the other enclosures and their components.
One particular advantage of the container is the very fast deployment. All component connections are effected in a “plug-and-play” manner. The cables led into the container through the hard bulkheads must simply be connected at the corresponding points. Once the user's own electronics have been installed in the enclosures, the container is ready for immediate operation. The whole procedure is very simple and requires above all very little commissioning time, thus sparing the user considerable effort and costs.

Special options

Rittal offers the Data Center Container with a diversity of optional extra functions. A container data center can thus be configured individually to incorporate precisely the required functions and properties. Figure 3 provides an overview of the available additional functions.

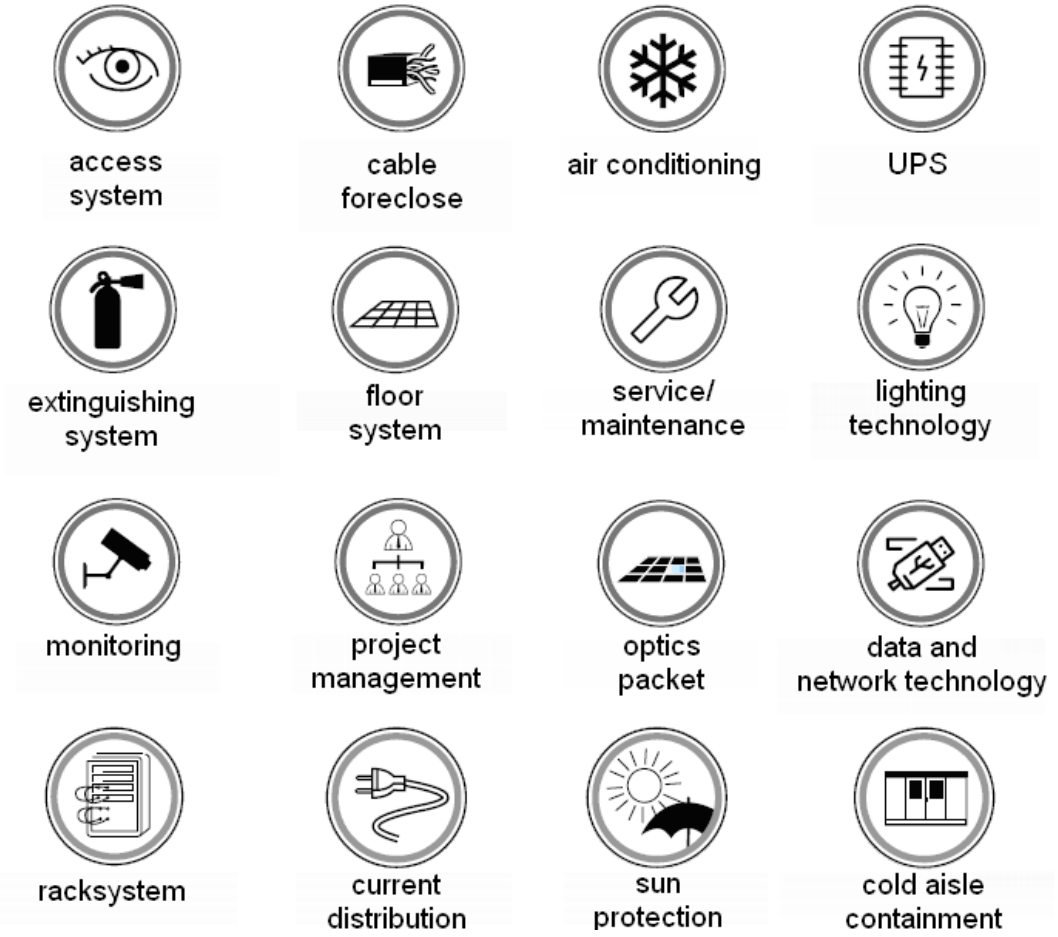

Figure 3: Special options

One important special accessory is a UPS, which can bridge the duration of power outages in accordance with the defined stored energy time. The servers installed in the racks are thus protected against sudden power disconnection, which would otherwise mean interruption of the IT services and possible data losses. The whole power distribution can be simplified with optional busbars. This not only provides for more clearly structured distribution, but also permits additional functions such as current metering and redundancy.
In general, all environmental parameters in the container can be monitored with the aid of the Rittal CMC III system. This system measures and monitors temperatures, humidities, etc. both in the container and in the individual enclosures, and presents the results to the user via a website. In case of critical states, a text message is sent by e-mail or SMS to the responsible technician, who can then intervene in good time to prevent an actual system failure. In conjunction with the management system “RiZone”, even more comprehensive monitoring scenarios are possible.
If, despite the constant monitoring, a fire either cannot be averted or is detected too late, the optional fire alarm and extinguisher system reacts accordingly. The extinguisher system “Rittal DET-AC XL” shown in Figure 4 detects outbreaks at a very early stage and extinguishes fires with a gas which is harmless to both personnel and the installed electronics. In this way, further spreading of the fire is prevented.
Freestanding containers can be augmented with sun protection. This is expedient above all in case of very hot ambient conditions, as it reduces heat build-up in the container, and in turn the load placed on the cooling. In fact, the whole outward appearance of a Data Center Container can be customised. Both high-quality attractive designs and inconspicuous frontages are possible. The user can thus view the container as a marketing eye-catcher, or else “hide” it unnoticed on his premises.

Figure 4: Extinguisher system

A Rittal Data Center Container can be supplied in many different versions. Depending on the intended location and the tasks to be fulfilled, the data center can be configured with an individual combination of optional functions to improve security, operational convenience or appearance. For more extensive tasks, an XL version of the container measures 12 metres in length and accommodates up to 16 racks. In this case, there is a total of 752 U of rack space for the servers[1].
The Data Center Container from Rittal is thus a flexible and universally applicable solution, which can be tailored individually to the customer's specific demands and circumstances. The user is able to set up a customised data center with practically no delay, and in this way not only simplifies planning, but also saves money and time.

[1] see GIT-Sicherheit

Direct free cooling

For cooling of the warm air expelled into the container interior by the servers, Rittal has chosen a particularly energy-saving technology: direct free cooling. With this cooling solution – as illustrated in Figure 5 – the air temperature outside the container is used to hold the inside temperature at the desired level. To this end, up to three cooling units with an output of 10 kW each can be mounted on the container. Together, they achieve a cooling output of 20 kW with “2+1” redundancy or 30 kW without redundancy.

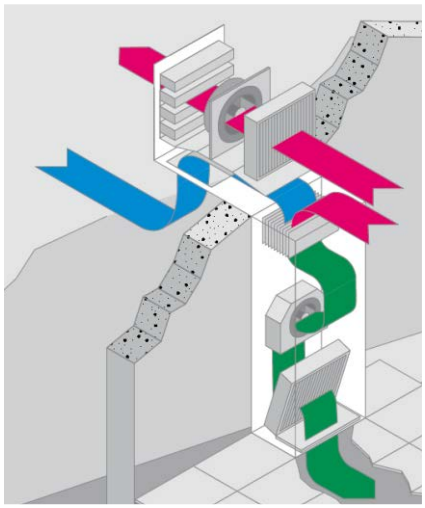

Figure 5: Direct free cooling

With direct free cooling, there are three different operating modes for the cooling units. In winter mode (autumn, winter, spring), as also to be seen in Figure 5, the filtered ambient air is simply mixed with a variable proportion of the return air flow to cool the air in the container interior. In mixed mode, (summer), the filtered ambient air is additionally cooled mechanically to achieve the required temperature. In summer mode (summer with increased ambient air temperatures), the intake of ambient air is stopped and the warm air returned from the servers is cooled in a closed circulation. Table 1 shows the periods of operation in each of the three modes over the course of a year, taking the example of a test installation in Frankfurt am Main (Germany).

Operating mode	Operating hours in h/a	% of annual operation
Winter	8,427	96.2
Mixed	297	3.4
Summer	36	0.4

Table 1: Operating hours in the different modes per year

Thanks to the high proportion of operation in winter mode, and consequently the reduced activation of the mechanical cooling, the energy consumption for climate control is reduced by up to 40% compared to conventional data center air conditioning systems.

Figure 6 provides a comparison of the annual energy demands for air-circulating cooling units and direct free cooling. This graph shows clearly that the energy consumption for direct free cooling is significantly lower than for a cooling system based on air circulation.

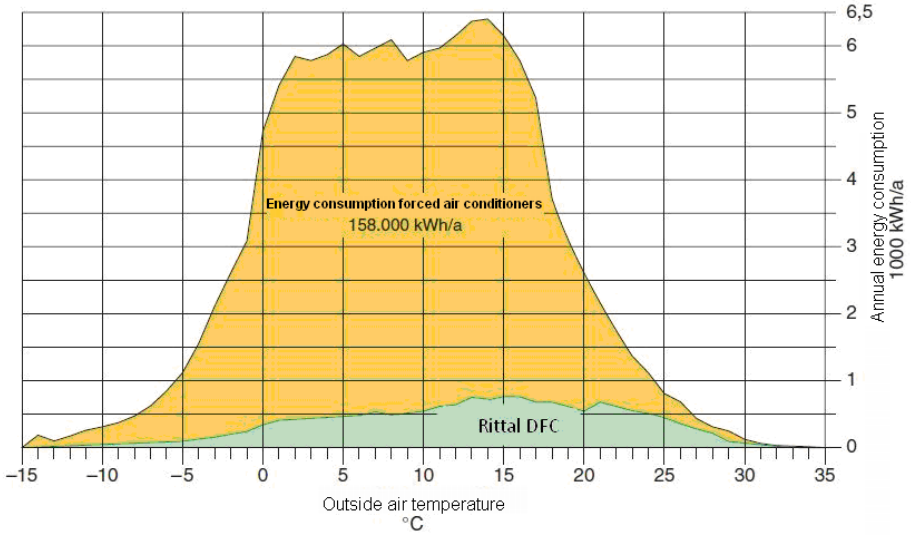

Figure 6: Annual energy consumption of circulating systems and direct free cooling

Thanks to direct free cooling, the Rittal Data Center Container achieves a PUE value (Power Usage Effectiveness) of less than 1.2[2]. “PUE is the ratio of the total power consumption of a data center to the power drawn by the actual IT equipment. The PUE value thus represents the efficiency of energy input.”[3] For the user, this means that a data center with a low PUE value functions particularly efficiently and above all saves energy.

In especially hot and dusty environments, direct free cooling cannot be used as effectively as in the above example, and so a differentiated cooling technology must be integrated into the container in such cases. The inline version of the Liquid Cooling Package (LCP) is able to achieve a greater cooling output. This solution also incorporates aisle containment, with LCP Inline itself being placed between the enclosures. The LCP unit cools the warm air from inside the container and then delivers the cold air to the servers via the cold aisle. Figure 7 shows an example with two rack rows and cold aisle containment. The servers are supplied with cold air within the contained aisle, while outside, LCP Inline (marked red) draws in and cools the surrounding warm air.

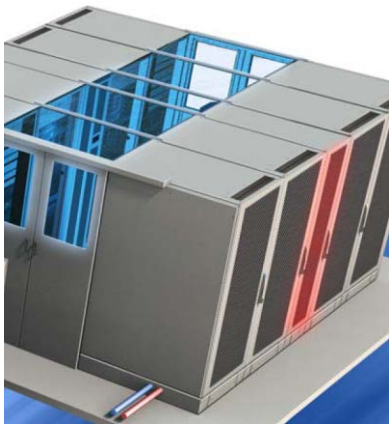

Figure 7: LCP Inline

The chilled water supply to the LCP units is provided by a recooler. Such recooling units function as indirect free cooling and are connected to LCP via piping under the raised floor.

This technology is suitable for a cooling output of up to 30 kW per rack[4].

[2] with the aforementioned proportions of the individual operating modes
[3] see ITWissen.info
[4] see Funkschau

Fields of application

A Rittal Data Center Container can be used in many different fields. Through its mobility, flexibility and immediate availability, it is an ideal solution for many applications. Firstly, the data center in a container can be used as a simple extension of existing IT facilities. A container solution is here meaningful above all for city center locations, as it occupies a minimum of space and can be placed inconspicuously. The attainable efficiency also permits deployment as a backup for an existing data center, as the additional energy consumption remains minimal.

Alternatively, the container can serve as a temporary data center, taking over the tasks of a core IT facility. This is an expedient solution above all in case of building modifications or renovation, as it enables operations to be maintained during the period of construction work. The necessity to shut down parts of a corporate data center is not the only relevant background to IT performance shortcomings. Where a system is already functioning at full capacity, bottlenecks may demand a short-term reaction by the responsible managers. In such cases, fast availability and simple plug-and-play installation provide for rapid relief.

There are today already some data centers which comprise only container modules. One advantage is that the overall facility can be divided into different sectors, but is nevertheless based on a uniform structure. Hosting providers, for example, can also assign servers holding the data of specific clients or regions to separate physical units, without affecting the company-wide hardware and software prerequisites. At the same time, such structuring provides for flexible scalability of the data center. The individual container elements are to all intents and purposes freely interchangeable; and if more capacity is needed, it suffices to simply add a further container module. The Rittal Data Center Container is thus able to serve not only as a temporary facility, but also as the user's main data center.

Summary

Whenever expansion of an existing data center is planned, Rittal offers a good solution with the Data Center Container. The IT managers of companies with city center offices, in particular, face major challenges when implementing expansion projects. The high prices for additional floor space and diverse legal regulations place seemingly insurmountable hurdles in their way. Moves to new premises and renovation work, both of which require IT services to be shut down temporarily, are further cases in which a substitute data center is required to be able to maintain core functions.

The Data Center Container can be deployed with the shortest possible delay. Thanks to the plug-and-play concept behind the container, the power supply and all network connections can be established quickly and simply. With up to 329 U of rack space, the 7 server enclosures offer the user ample scope for individual server organisation. The panelling guarantees optimum protection for the installed components and can be lent a custom appearance, if required.

The basic version of the container features all the most important functions, while a broad spectrum of special options enables security and convenience to be enhanced further. It is thus possible to configure a fully tailored and adapted solution. Through the use of direct free cooling, the container achieves a PUE value down to 1.2 and thus reduces both energy consumption and impact on the environment.

The container is not only suitable for use as a temporary data center. For many service providers, it may also be an expedient choice for the main data center, as it permits flexible scaling at any time. A data center which comprises several containers can be divided into separate sections and the container elements are readily exchangeable.

It is not least thanks to the immediate availability and individual configuration options that the Rittal Data Center Container is predestined for many different applications. With its energy-saving cooling solution and high level of security, it is an interesting alternative to a conventional data center.

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List of abbreviations

CEE	-	International Commission on Rules for Approval of Electrical Equipment
CMC	-	Computer Multi Control
DIN	-	Deutsches Institut für Normung (*German Institute for Standardisation*)
EN	-	European standard
U	-	(Height) unit
IT	-	Information Technology
LCP	-	Liquid Cooling Package
PUE	-	Power Usage Effectiveness
RDCC	-	Rittal Data Center Container
SMS	-	Short Message Service
UPS	-	Uninterruptible Power Supply
RC	-	(Burglar) Resistance Class
XL	-	Extra large

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