IT RACKS – WHAT PART DO THEY REALLY PLAY IN YOUR DATA CENTER?

This paper provides an overview of 19" cabinets for data centers, as well as the various versions and equipment features that need to be considered when choosing components. In addition, it explores the standards that have been developed with the aim of ensuring that cabinets operate reliably within a data center.

INTRODUCTION

Want to assess how a nation's economy is performing? Data center infrastructure and equipment is a leading indicator because countries that have the right infrastructure in place are ready to face the future of digital commerce. What are the main criteria for data center operators to future-proof their data centers?

Availability and security of applications rank at the very top of the list of key requirements for data center operation, and the people responsible for setting up IT infrastructures also find their choices driven by rising energy costs and increasing packing densities. Participate in any market-specific discussion, attend any industry event, or peruse any brochure on the subject, and it's guaranteed that integrated DCIM software solutions, standardized data centers straight from the box, environment and power management, as well as cooling solutions geared toward more efficiency and higher packing densities will feature prominently. All these solutions have their place, and all play their part in helping operators get to where they want to be – but this journey all too often neglects one crucial element of IT infrastructure – the 19-inch cabinet – despite its crucial role in protecting sensitive electronics that process applications and data.

The IT cabinet is much more than a sheet-metal box or a couple of welded steel rods. What are the relevant standards and other aspects that need to be considered? Below we explore some of the areas leading the cabinet selection process.

19 INCHES – THE DIMENSION OF CHOICE

Among the sheer variety of network technology and server cabinet solutions available on the market, the 19-inch dimension is often the only standardized feature they all have in common. It is, in fact, the most important standardized value within the electronics industry – and more specifically, in IT infrastructure applications.

The standard in question is IEC 60297, which specifies the principal dimensions that chassis and cabinets have to adhere to and ensures compatibility across components and cabinets. It is important to note that it defines the grid and the pitch of a mounting surface measuring 19" (482.6 mm) in width and divided incrementally, where one rack unit (U) equals 44.45 mm.

There are also standards governing the uprights used in assemblies – ETS 300 119 (ETSI) and IEC 60917 (25 mm metric) – although these rarely come into play in the context of data centers.

IT CABINET DESIGN

A 19" cabinet generally consists of a rack to which 19" assembly uprights and cladding parts are attached. At its heart is a basic frame made from either welded steel or bolted aluminum. This structure not only makes it easy to fit various cladding parts, it also provides a flexible canvas for creating a whole range of cabinet configurations.

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PAINT FINISH

Cabinet features that may appear trivial at first glance can in fact have a more significant role to play, and color is a simple, practical example of this. IT cabinets are typically black or light gray, but now there is a growing trend toward white – especially in larger installations. This color choice may be more susceptible to scratches and staining, but bright surfaces help reduce the lumen ratings required for room lighting, opening up potential for efficiencies.

GND/EARTHING

For safety reasons, all live parts are connected to a central GND/earthing point based on IEC 61969-3; every cabinet with a configuration involving electronic components should undergo testing in line with this standard. Testing at the factory is the best option for the operator, as it translates into a lighter workload and helps ensure assembly is performed correctly.

FLAMMABILITY

This requirement relates to plastic parts and gaskets whose flammability classification is tested in accordance with UL94. It requires the use of halogenfree materials that should, at minimum, meet the criteria of UL94 HB.

PROTECTED ACCESS

Beyond access control measures for buildings and computer rooms, the cabinet represents the last line of defense for data center equipment. Operators must be aware of this, particularly for sensitive applications and data. Given the limited number of locking system manufacturers in the market and a low level of standardization, there are only a few standard keys available to choose from. If the application requirements call for it, operators should choose locking cylinders with less common inserts. For applications with more stringent security requirements, IT cabinets should be set up to accommodate a range of electronic locking systems.

While these cabinets are not usually classified according to resistance level – as is the case in outdoor applications, for instance – it is recommended to use at least a three-point lock on cabinet doors to protect from unwanted access to equipment. In cabinets measuring 2,000 mm or more in height, one-point locks provide nothing but a psychological barrier, as the doors can still be opened quickly and easily using simple tools – or even no tools at all.

DIMENSIONS

The 42 U cabinet, normally measuring 2,000 mm in height, still represents the most commonly used dimension in data centers. Cabinets measuring 47 U (2,200 mm) and above are becoming an increasingly popular choice because of their highly efficient use of space, but it is important to remember that installing servers in the upper rack units of cabinets on this scale may require special tools.

When it comes to width, server cabinets with a 600 mm dimension are common, as many cabinets require only a very small amount of space for cabling. 800 mm is another standard width, designed for cabinets in which more space is required for cabling – and depending on the manufacturer, there may be other width dimensions available. Cabinets measuring 1,000 mm wide are also becoming more and more common, especially among operators of larger data centers. These are usually integrated into a row of cabinets and provide ample room for cabling.

It is important that the 19" plane can be recessed at different depths when installed, as this allows the rack to support a range of applications. Equipment that can be adjusted easily to adapt to future requirements is useful, which is why platforms with a 19" grid that is integrated directly with the upright are not always the most appropriate choice for data centers.

Uprights are usually installed directly on the rack in the case of cabinets measuring 600 mm wide, but the market has begun to see the emergence of two solutions for cabinets of 800 mm in width. For applications with smaller load-carrying capacity requirements but enough space for cable ducting, the uprights are mounted to the rack using adapter brackets for reduced width or blocks. Lateral cross beams allow for a higher load-carrying capacity, but – depending on the configuration – may restrict the clearance available for cable ducting.

LOAD

Standard IEC 61587-1 specifies certain static load requirements, although it is important to note that transporting and raising the cabinet are integral parts of the testing performed in this area. In practice, there are two load categories – static and dynamic – with racks subject to different requirements for each.

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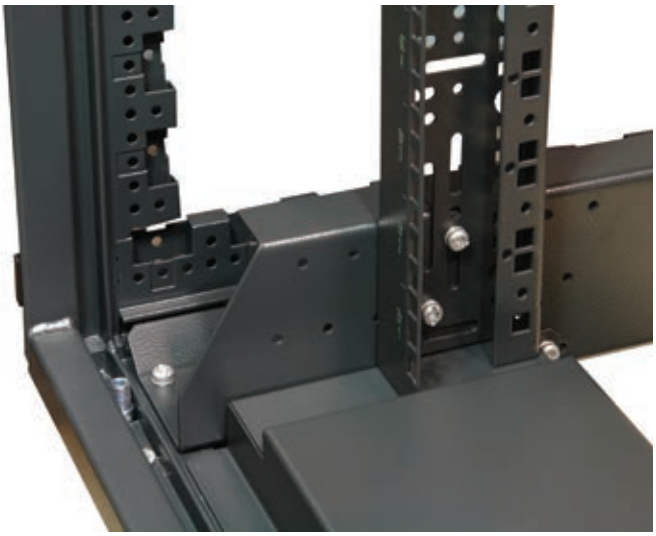
STATIC LOAD

In this scenario, an empty cabinet is transported to the site where it is going to be used, set up, fitted into a row, and equipped. The main load is assembled on the 19" plane. Static loads create stress points on the 19" uprights and the fixing points, as well as in the bottom area of the rack. There is no standard specifying the exact test procedure. However, it is common practice to use a safety factor of 1.25, meaning that the actual load applied in the test will always be greater than the actual load-carrying capacity. Any deformation is measured at five points on the rack and fixings at minimum over a period of at least 72 hours, to show the effect of exerting a greater load on a cabinet over an extended period. The weight is removed gradually during both loading and unloading, to account for elasticity in evaluating potential deformation.

Modern data center environments need to accommodate static loads of around 1,200 kg – but applications that require a higher load-carrying capacity are surfacing as well.



DYNAMIC LOAD

The dynamic load is considered in cases where cabinets are set up at the factory and delivered to the site where they will be used. The equipment is exposed to vibration during transportation and to other stressors when it is lifted, with the vertical cabinet uprights of the rack being particularly exposed to additional loads. This requires dynamic load reinforcement for both the rack corners and the vertical cabinet uprights. Depending on the load requirements, it may also be necessary to install vibration-dampening pallets alongside the stiffening elements, designed to absorb vibrations during transport.

STRUCTURED CABLE MANAGEMENT

A structured cable management system is another essential requirement for any cabinet, to accommodate both the bending radii of copper and fiber optic cables and to reduce air resistance, which negatively impacts the cooling efficacy of the equipment during operation. Appropriate cable management accessories such as brackets, channels, and trays must be used to ensure that cables are properly managed and tension free. Not only do accessories play an important role but the flexibility of the fixing points on the cabinet and the adaptability of the cabinet platform are also significant factors to consider. Keeping the data center's requirements in mind, it should be possible to combine the various products with ease and assemble them with as few complications as possible.Furthermore, given the option to incorporate not only cable management systems, but also mechanical accessories such as slide rails and shelves, operators should ensure that there are enough clearances, fastening areas, and assembly options to accommodate current distribution and environment monitoring equipment.

AIR MANAGEMENT

IT cabinets may be subject to mechanical requirements such as stability, security, and standards, but they also provide a key opportunity for boosting air management equipment efficiency. With the exception of a few switches, IT equipment is cooled from front to rear in a system where cool air is drawn in at the front of the cabinet and then blown out toward the rear. Heat is absorbed from the air as it flows through the equipment, keeping electronic equipment at the proper temperature that is right for operation. Regardless of the cooling strategies selected for the equipment, the result is that a cool zone develops in the front, specifically, in front of the 19" plane, and a warm zone at the rear. Maintaining efficient operation means preventing resistance in the air flow as well as air short-circuits, which occur when cool supply air production mixes with warm exhaust air.

AIR RESISTANCE

To keep air resistance to a minimum, operators must maintain as high an air flow rate as possible when using perforated doors. Doing so may work against measures designed to give the doors stability. Assuming they are sufficiently stable, perforated doors with a honeycomb or hole structure can achieve air flow rates of 75 to 80%. Cold aisle containment, an aircompartmentalizing solution that is energy-efficient and involves very low investment costs, has emerged as the technique of choice for both new installations and retrofitting of existing cabinet rows. Since the containment door provides access control, there is no need to install cabinet doors in the aisle.

Choosing the right panels and gaskets for a cabinet is an essential part of setting up a containment system. Frequently, quick cardboard fixes and makeshift gaskets can be replaced with the use of a flexible panel system from the start when cabinets are being specified. 19" planes are recessed at different depths depending on the application requirements. In a no-frills server expansion, the operator does not require any cabling

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space at the front and the 19" plane is therefore recessed as little as possible for maximum use of space. If the intention is to connect to the network, it is standard practice to incorporate network cabinets at regular intervals into a row of server cabinets. The patch panels and switches installed in this case do require cabling at the front, which requires not only installation of a recessed 19" plane, but also connection of network cabinets to server cabinets with 19" planes recessed at different depths. The use of panels with cable through-duct openings that are properly sealed is recommended, to ensure cables in the cabinet are routed from front to rear. Air baffles should be provided as necessary for equipment with side-to-side cooling.

HEAT EXCHANGERS

Where the packing density per cabinet is high, it is worth investing in systems that feature active air-to-water heat exchangers. This requires cabinets to be properly sealed, to reduce potential condensation formed in the cabinet system as room air is drawn in. All the leading air-to-water heat exchangers on the market feature condensate management, although this does mean that the heat exchanger operates as a dehumidifier, and could result in the system operating with a lower cooling capacity or less efficiently. As there is no standard governing heat exchanger impermeability, the IP code can be applied as a guide value in practice: This refers to a classification that defines the degree to which the equipment is protected from dust and water. Cabinets featuring an integrated heat exchanger, or enclosed heat exchanger cabinet systems, should, at a minimum, meet the criteria of the IP5x degree of protection where 5 means equipment is protected against harmful quantities of dust.

SUMMARY

As requirements have changed over time, IT cabinet design keeps evolving to accommodate them. If data center operators take note of the abovereferenced recommendations, they will be well-equipped during the planning and design phases of their project. Finally, by carefully selecting a cabinet configuration that matches the desired application, they are able to achieve significant cost savings and set up an IT infrastructure suitable for housing future generations of electronic components.

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ABOUT THE AUTHOR

Markus Gerber graduated in business administration in the market and communications research department of the Hochschule Pforzheim. He has worked for nVent since February 2007. He held the position of project leader in the introduction of a comprehensive service concept, and since January 2009 has adopted a variety of roles in product management for cabinets. Additionally, he can boast a successful track record of working on numerous datacoms projects in the EMEA region.

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