

## When does an equipment frame become a server cabinet?

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Computing and communications equipment has been located in racks, usually 19-inch based, for at least the last thirty years. Racks, or frames, come in all shapes and sizes; from a few 100 mm high to over two metres high; 600 or 800 mm wide and from 600 to 1200 mm deep. The internal fittings are usually based on a 23-inch pitch for telecommunications and 19-inch for everything else. A handful of EIA, IEC and ETSI standards cover the physical dimensions of the rack, such as EIA-310-D. The vertical spacings for the installed equipment are based on Rack Units, or just 'U', where one U is 44 mm.

The main frame of the rack can be based on a four-post construction, i.e. to make a rectangular frame, or the space-saving two-post system which is essentially two pieces of vertically placed metal spaced 19-inches apart (apologies for mixing metric and imperial units here but that is the common practice!). A server rack needs to be a four-post enclosed unit.

The four-post frame can be further dressed up with sides, a top, front and back doors and a plinth to sit on. A smoked glass or Perspex door at the front has traditionally been a popular finish. A frame suitably dressed is then often referred to as a cabinet however we shall use the generic term 'rack' throughout.

Let's remind ourselves what the rack is for;

- To hold and securely locate electronic equipment
- To provide an organised routing for power and communications cabling
- To assist in the airflow and cooling of the equipment
- To provide the above in an aesthetically pleasing construction

So what is the difference when people often refer to 'server' racks and cabinets? There is no formal definition but what people have in mind is a rack designed to hold high-density arrays of servers and blade servers in a data centre/computer room environment.

Of course it isn't just for servers, although they will take up the biggest space allocation: we will also see KVM switches and controllers, routers and switches, Fibre Channel SAN equipment, storage devices and a scattering of real keyboards and video monitors.

Let's try and build up a definition of a server rack.

### Size

Usually 600 mm wide and with a useable internal space of 42U for 19-inch rack-mounted equipment. This gives a rack height of just over two metres. Slightly larger (and of course smaller) versions are available but 42U seems a popular choice. Depth is at least 800 mm but may be up to 1.2 m. A one-metre depth allowance seems average

### Ventilation

This is a key area of differentiation. A server rack must cope with the ventilation demands of many kilowatts worth of electrical equipment. A standard glass-fronted rack with horizontal fan tray fitted can only cope with the cooling demands of less than a kilowatt.

It would appear that a suitably ventilated rack, supplied with adequate chilled air through a standard floor tile, can cope with about two kilowatts of heat dissipation, where the motive force through the rack is only provided by the fans within the server units themselves.

The amount of ventilation required is stated by several sources and is expressed as a ratio of 'open' space to overall door area, e.g.;

- ....servers require that the front and back cabinet doors to be at least 63% open for adequate airflow. **SUN**
- One method of ensuring proper cooling is to specify a rack doors that provide over 830 in<sup>2</sup> (0.53548 m<sup>2</sup>) of ventilation area or doors that have a perforation pattern that is at least 63% open. **APC**
- Racks (cabinets) are a critical part of the overall cooling infrastructure. HP enterprise-class cabinets provide 65 percent open ventilation using perforated front and rear door assemblies. To support the newer high-performance equipment, glass doors must be removed from older HP racks and from any third-party racks. **HP**
- ...the cabinet should either have no doors or, if required for security, doors with a minimum 60% open mesh for maximum airflow and is best not equipped with top mounted fan kits. **Chatsworth**
- Ventilation through slots or perforations of front and rear doors to provide a minimum of 50% open space. Increasing the size and area of ventilation openings can increase the level of ventilation. **TIA 942**

When the heat load goes above about 2 kW (about 5 average servers) then an escalation policy is required, which can take the form of;

- Increasing floor tile vent size up to 75% open area
- Replacing floor tiles with fan assisted grate tiles
- Adding specialised fan units to the top and/or bottom of the rack
- Using cabinets where the entire rear door is a fan unit

The above solutions will take the heat dissipation capability up to about 6 kW per rack. Above that then more specialised racks need to be used where the whole rack is fed by a chilled water supply. These designs can cope with loads in excess of 20 kW.

It is also important that the front to back cooling scheme adopted in such racks is not compromised by gaps in the rack allowing cooled air to mix with hot air drawn back through the gaps (*Thermal Guidelines for Data Processing Environments –ASHRAE*). For this reason all gaps in the rack must be filled in with blanking plates. Also excessive gaps for cabling at the side of the racks should be sealed with an air dam kit and any cable entry points at the bottom of the rack should also be sealed with a brush strip.

### Power

The rack needs to be powered and in Europe this would generally be provided by a 16 or 32 amp, 230 V single phase feed through an IEC 60309 connector. At least two feeds are required for redundancy and backup purposes so a dual 32 amp feed would be counted as supplying 32 x 230 = 7.36 kVA (remember that useful power is measured in watts, which is amps x volts x power factor).

For loads above 7 kVA then either more 32 amp feeds are supplied or a three-phase supply is provided which would normally deliver at least 22 kW through a five-pin version of the IEC 60309 connector. For three-phase supply Regulation 514-10-01 of BS 7671 requires a warning notice to be secured in such a position that the warning is seen before access is gained to live parts.

Within the rack the power is distributed by what is widely known as a power distribution unit, or PDU. There does not seem to be a widely accepted definition of a PDU and at its simplest it is just a power strip of sockets that distributes the incoming electricity to the rack equipment. However more functionality is available in the form of;

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## Data Centre Design and Training

- Sequential start up
- Automatic crossover switch between two supplies
- Power line conditioning
- Reporting function about status and power usage. This in turn may be a simple LED readout on the unit or part of an IP addressable managed system

### Control and monitoring

A data centre server rack must be secure and be able to monitor and report its environmental status back to some central control point. The monitoring system may be part of a building-wide Building Management System (BMS), an add-on localised monitoring scheme or a built in rack-monitoring scheme designed and dedicated to the task. TIA 942 states '*A Building Management System (BMS) should monitor all mechanical, electrical, and other facilities equipment and systems.*'

The rack sensor system should be able to detect the following;

- Temperature
- Smoke
- Water
- Humidity
- Access
- Vibration
- Airflow
- Particles in the incoming airflow

And respond with one or more of the following;

- Visual alarm on top of cabinet
- Audible alarm
- Networked alarm
- CCTV

### Conclusion

A server rack is a complex piece of engineering that goes far beyond a simple metal frame and box. Successful computer room design must take all the requirements of the rack/cabinet and its location into account to build a reliable data centre.

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