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continuous power availability

SWISS MADE

What is Availability?

Article

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Ensuring a continuous supply of electrical power is vital in safety-critical environments such as hospitals, data centres, and commercial institutions, where even the shortest of duration interruption may cause significant financial losses or even endanger lives. An Uninterruptible Power Supply system is used to provide power when the main source is interrupted or even fails, it also ensures high levels of power quality. Therefore, ensuring the highest possible level of availability of a UPS system is of paramount importance. UPS manufacturers often refer to availability but what does this term actually mean?

What is Availability?

Availability is the degree to which a system is operational. The 'overall-uptime' if you like, or the readiness of a system to provide a corrective service. In other words, will your UPS work as and when its needed?

Availability or 'overall-uptime' can be used to provide a quantifiable comparison between systems. Just as Hertz is a metric for frequency and Amps for current, Availability is a metric for overall-uptime. It is defined as the fraction of time a system is operational during its expected lifetime and it is dependent on many factors, for instance the type of architecture of the UPS.

How is Availability Expressed?

To make a straightforward comparison between different systems, availability is expressed with a number of nines. For example, "Four nines" availability means that availability is 0.9999, in other words, the system will be fulfilling its purpose 99.99% of the time.

Although this metric represents the uptime during the lifetime of the systems in our industry, Availability is usually measured in a year period (overall-uptime per year) so that the math is easy to apply. An Availability of 4 nines means that 99.99% of the 8760 hours (h) in a year the system will be performing its function or 99.99% x 8760h = 8759.124h.

This, consequently, results in a Downtime per year of 52.56 minutes (m). (8760h - 8759.124h = 52.56m)

The below table shows examples of different system availability and the corresponding Downtime per year.

Table, Availability level. Vs Downtime per year

99.99% "four nines"	>	52.6 minutes
99.999% "five nines"	>	5.26 minutes
99.9999% "six nines"	>	31.56 seconds
99.99999% "seven nines"	>	3.16 seconds
99.999999% "eight nines"	>	315.58 milliseconds
99.9999999% "nine nines"	>	31.56 milliseconds

How is Availability Calculated?

To calculate Availability two other variables come into play. MTBF and MTTR (Meantime Between Failure and Mean Time to Repair).

A simple mathematical representation of Availability is the result of A= MTBF/(MTBF+MTTR)
MTBF is a reliability metric usually represented in the number of hours a component or a set of components in a system will work before it fails. While the MTTR is the time it will take to repair a system to put it back to work after the failure occurred.

As you can see from the above calculation, Availability is the result of both variables. To achieve a greater Availability the MTBF should be as high as possible and the MTTR should be as low as possible, resulting in a high overall-uptime.

Now the question is, how do I increase MTBF and reduce MTTR in a system?

There are many variables to consider, top, middle, and low-level system architecture, mitigation of human error, the quality of the components used and the manufacturing processes. All of these are particularly important to achieve higher MTBF and lower MTTR.

How Architecture Influences Availability

How a UPS has been developed starting from the top, middle and low-level architecture is one of the most critical elements in the system.

To put this in perspective, think of a house. Its main purpose is for you to live in it. The amount of time you can live in that house is called “house Availability”. If you build a house by using a loose structure and poor building materials, the house will not be standing for long (MTBF) and re-building it will take a long time (MTTR). As a result, the amount of time you will be able to live in that house will be low, making the “house Availability” low.

Now, think of it in a different way, to build the house you choose the right materials: bricks, cement, windows etc, and you choose the right structure. Then you think of any possible scenario that could occur and reinforce the house against them, for instance, an earthquake, fire or flood. Now, you hire a builder that can guarantee the quality of construction. In this scenario, the “house Availability” will be much higher.

The same thought process applies to UPS systems when it comes to deciding which architecture to use, which components to select, how the system will be built and how the end user will interact with it in a safe way. All these elements impact the level of Availability.

Different UPS architectures ranging from a single standalone UPS to a distributed modular UPS will all result in completely different levels of Availability. However, to make comparative calculations, if availability is the degree to which a system is operating when its needed, we also need to consider the time it takes to repair a system and return it to full operation.

We could go deeper into the calculations of every component and its influence in the system from a mathematical point of view, however, we will keep it simple and leave that topic for another article.

Advanced Architecture and Quality.

With an advanced architecture and high-quality standards, it is possible to improve availability or uptime by multiple orders of magnitude.

CENTIEL's Swiss made Distributed Active Redundant Architecture introduces numerous proprietary technologies to improve the overall-uptime. Specifically, the completely distributed architecture even including the control logic (the decision-making technology) allows the communication between UPS units to be maintained even when one of the parallel buses has failed. The unique parallel bus configuration and redundant self-isolating capability of the distributed Static Bypass Switch means that CENTIEL's completely distributed architecture increases the system's MTBF and decreases MTTR. As a result, CENTIEL's unique approach that combines these innovative features with modular architectures achieves the highest levels of availability or 'uptime' of 99.9999999% or nine-nines.

A further benefit of CENTIEL's architecture is safe-hot-swap capability. This means new modules being replaced within a frame can be isolated and fully tested before connecting to the load. With only hot swap functionality, this is not possible and a fault in a new module could cause the whole load to be dropped. With CENTIEL's architecture, even firmware upgrades do not require manual bypass. Any scope for human error is reduced as much as possible.

Although availability or overall-uptime can be reduced to a number for comparative purposes, the calculation is based on the real design architecture of a particular system. CumulusPower™'s leading levels of availability and load protection are more than simply a number or a hollow marketing claim, they reflect the genuinely superior nature of the UPS' design architecture and its performance in the field. Its high level of availability or overall-uptime crucially means the downtime of critical load protection is taken to just milliseconds per year.

For more information please see: **www.centiel.com**

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