Simultaneous coefficient of data center IT racks

Article Overview

The simultaneous coefficient represents the fraction of IT racks expected to draw full power simultaneously, used to size power and cooling infrastructure efficiently.

Definition and Purpose

In data center design, the simultaneous coefficient (also called diversity factor or utilization factor) is applied to account for the fact that not all IT racks will operate at maximum power at the same time. It allows planners to avoid over-provisioning electrical and cooling systems while maintaining reliability. For example, if a data center has 100 racks each rated at 10 kW, but only 70% are expected to draw full load simultaneously, the simultaneous coefficient would be 0.7, and the effective load would be 700 kW rather than 1,000 kW .

Calculation Considerations

o Rack Power Rating: Determine the maximum power per rack based on server density and equipment type. Modern high-density racks can range from 8 kW to 12 kW or more .

o Utilization Factor: Apply a realistic utilization percentage to reflect typical operational load rather than theoretical maximums .

o Redundancy and Growth: Include additional capacity for N+1 or 2N redundancy and future expansion, which affects the effective simultaneous load .

o Space and Thermal Constraints: Consider airflow, cooling efficiency, and physical space, as high-density racks may require more cooling even if not all racks are fully loaded simultaneously .

Practical Application

o Power Planning: Multiply the total number of racks by the rack power rating and the simultaneous coefficient to determine the required UPS and PDU capacity .

o Cooling Design: Use the effective load to size CRAC units, hot/cold aisle containment, and liquid cooling systems .

o Redundancy Strategy: Combine the simultaneous coefficient with redundancy planning (N+1, 2N) to ensure uptime without excessive over-provisioning .

Example

If a data center has 50 racks at 10 kW each, and the simultaneous coefficient is 0.8:

o Total theoretical load: 50 x 10 kW = 500 kW

o Effective load considering simultaneous operation: 500 kW x 0.8 = 400 kW This 400 kW figure is used for

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UPS sizing, PDU distribution, and cooling capacity planning, while additional overhead is added for redundancy and future growth .

Key Takeaways

o The simultaneous coefficient optimizes infrastructure investment by reflecting realistic operational loads.
o It is influenced by rack density, equipment type, utilization patterns, and redundancy requirements.
o Proper application ensures reliable power delivery, efficient cooling, and cost-effective data center operation
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We developed this TradeOff Tool to help data center design managers and users understand the electrical and

Almost thirty percent of the power consumed by data centers (DCs) is attributable to the cooling of IT equipment

Learn how kW per rack impacts colocation pricing, energy efficiency, and performance. Discover best practices to

RACK POWER ARCHITECTURE EFFICIENCY CALCULATOR Inputs Results ... Data Center Characteristics N. America X United

How to size, lay out, and cool data center server racks the right way. A practical guide to

Inside a data center, a labyrinth of servers and high-tech networking gear are arranged in specialized

The thermal performance of data centers is numerically studied for different configurations of computer room air

Use this TradeOff Tool to estimate the power required by a data center with traditional, or AI/HPC servers. Configure different server,

Data Center Rack Density Has Doubled. And It"s Still Not Enough Can solutions like direct-to-chip cooling and rear

PUE (Power Usage Effectiveness) A key performance metric: PUE = Total Facility Power / IT Equipment Power Goal: < 1.5 for

Thermodynamic optimization of a rack-level water-cooling infrastructure in high load data centers based on

the

Estimate data center rack counts from power targets. Include space, growth, and overhead for safer planning. Get clear totals for

Introduction Data center physical infrastructure capacity management is defined as the action or process for ensuring power, cooling,

Uptime Institute Tier I-IV guide for data center generators. N+1 vs 2N redundancy, fuel storage hours, maintainability, and AI rack

This best practices approach ensures that a user will get the greatest value from rack selection and helps to ensure that the data

However, data center racks are arguably live loads because the heaviest portion of the rack is the server itself, which

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