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DATA CENTER

INTEGRATED SOLUTIONS

POWERED BY EXPERTS

THE **GLOBAL SPECIALIST**
IN ELECTRICAL AND DIGITAL BUILDING INFRASTRUCTURES

legrand®

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THE LEGRAND GROUP

A global player

The Legrand Group is a global specialist in electrical and digital building infrastructures, with more than half of its activity in the commercial and industrial fields. In response to major market developments, the Group is continuing to strengthen its position in up-and-coming, ambitious markets.

Within a context of increasing globalization, in which projects are more and more complex, the support of a knowledgeable, reliable partner is essential: it is the real key to success!

Choosing the Legrand Group gives you the assurance of global expertise thanks to:

- innovative applications and a huge range of products enabling you to build solutions then configure systems which incorporate the latest technological advances
- generalist (Legrand, Bticino...) and specialized (Raritan, Minkels, SJ Manufacturing, Zucchini, Cablofil, Valrack) brands who will help you set up your project, from its design through to its final implementation

90 subsidiaries and offices, sales in close to 180 countries

36,000 staff members throughout the world

€ 5 billion net sales in 2016

INTERNATIONAL INDUSTRIAL IMPLEMENTATIONS FOR DATA CENTER SOLUTIONS

LEGRAND
Complete global solutions for digital and electrical infrastructures solutions.
Headquarters in France.

RARITAN
Proven innovator of intelligent PDUs, transfer switches, environmental sensors, serial consoles and KVM-over-IP switches.
Headquarters in the USA.

MINKELS
Complete solutions (hot and cold aisle containment, racks, monitoring...) for corporate/SME environments and commercial data center infrastructures.
Headquarters in the Netherlands.

BTICINO
Secure access solutions expert: door entry phones, access control, video protection systems...
Headquarters in Italy.

SJ MANUFACTURING
Frontrunner in racks, Voice-Data-Image racks and related products for data centers. 3 plants: Singapore, Malaysia and Vietnam.
Headquarters in Singapore.

CABLOFIL
Global benchmark for cable management systems.
Headquarters in France.

LEGRAND DATACOM US
Complete global solutions for network infrastructure.
Headquarters in the USA.

ZUCCHINI
Specialist in low, medium and high power prefabricated busbar trunking systems.
Headquarters in Italy.

VALRACK
Specialized in racks, Voice-Data-Image racks and related products for data centers. 3 plants: Singapore, Malaysia and Vietnam).
Headquarters in India.

A fast-evolving market

The growing of the digital infrastructures' market is powered by the ever-increasing data flows in buildings. Driven by the Internet of Things (IoT), the cloud and the increased focus on security and energy efficiency topics within standards, the role of data centers is quickly changing.

The IoT's impact on the data landscape

In 2014, there were about 14 billion devices connected worldwide. By 2020, there will be 50 billion (source: Cisco). The Internet of Things affects not only the design and implementation of data centers but also their availability and scalability.

The IoT requires that data is handled locally, for example using micro data centers. This will mean a boost for the micro data center market, globally: from 1.7 billion dollars in 2015 to 6.3 billion dollars by 2020.

From cloud to colocation

Another trend that affects the data center market is the adoption of the cloud. Cloud providers are going to move up in the supply chain and be empowered to implement data center infrastructure that best suits their very own needs.

The strong increase in the demand for colocation comes from the desire of companies to reduce IT costs. By opting for colocation data centers, they choose high quality technology, scalability and availability, while managing the IT environment themselves.

New European guidelines

Under the influence of the cloud, there is a growing demand for data center security and safety solutions.

That demand is amplified by an increased focus on security topics within the European EN 50600 data center standard: the renewed security approach combines optimum security with an accessible working environment.

THE LEGRAND GROUP

Your reliable partner

Benefit from the data center skills and the digital infrastructure expertise of an innovation-driven leading company to reach high performance levels!

Constantly innovating to answer all market developments

The Legrand Group has always demonstrated its ability to adapt to changes in the market. World leader in communication networks for data transmission, the Group keeps elaborating innovative solutions that enable it to develop its offer and achieve the highest performance level. These solutions are ideal for today's multimedia networks, technologies and applications, and are a perfect answer to the greatest challenges in the data center market.

Setting up a future-proof data center

This challenge requires expert knowledge and a clear vision of the data center market. To strengthen still more its positions in digital infrastructures for data centers and to expand its dedicated offer, the Group keeps acquiring specialist brands that hold leading positions or have specialized technological expertise. These acquisitions ideally round out the Group's offer in data center solutions.

With the modular and integrated products of the Legrand Group, you are assured of a future-proof data center. Only then can the right level of performance be offered, powered by experts!

LEGRAND & SUSTAINABLE DEVELOPMENT

For many years, Legrand has been committed, with its customers and partners, to a process of continuous improvement to ensure profitable, long-term and responsible growth for its business. In this way, the Group intends to respond to the environmental, economic and social issues of today and the future via a global approach of sustainable development, the reduction of the Group's sites' environmental impact, the control of the use of chemical substances, and the creation of eco-friendly products.

LEGRAND & CORPORATE SOCIAL RESPONSIBILITY

- **4 core values for sustainable and profitable growth**
  - Innovation
  - Ethical behavior
  - Customer focus
  - Resource optimization
- **4 focus points for a sustainable use of electricity**
  - Offering sustainable solutions for users
  - Acting ethically towards society
  - Committing to the Group's employees
  - Limiting the Group's impact on the environment
- **Voluntary initiatives illustrating the Group's spirit**

Signing up to the Global Compact or meeting the stringent social and environmental criteria of the FTSE4Good, MSCI Global Sustainability and the DJSI World* indexes form part of an overall policy of transparency highlighting Legrand's determined commitment to CSR.

To find out more, visit www.legrand.com

* Based on 2015 evaluation and subject to annual re-evaluation

Answers... to specific

Data centers are sensitive areas which consume a huge amount of energy and have changing requirements. They house servers containing large amounts of data. Ensuring they are flexible, efficient and reliable thus means implementing a durable infrastructure which provides high performance under all circumstances.
There are four main objectives for providing an optimum response to the specific issues and requirements of data centers.

requirements

EFFICIENCY
AVAILABILITY
SCALABILITY
SAFETY AND
SECURITY

Optimize energy efficiency

Data centers consume a great deal of energy. The aim will therefore be to reduce their carbon footprint. How? By improving the PUE (Power Usage Effectiveness). This is an indicator which defines the energy efficiency of a data center by calculating the ratio of the total energy consumed by the data center as a whole to that actually consumed by the IT systems which the data center operates.

→ DISCOVER OUR SOLUTIONS IN THE « EFFICIENCY » SECTION

Ensure continuity of service

Maintaining an electrical and digital supply throughout the year as well as cooling the servers ensures availability of reliable energy. There are several availability levels. Depending on the level of availability required by the data center owner for all the equipment and infrastructures, the building will be assigned a Tier, from 1 to 4, which guarantees a certain continuity of supply and service.

→ DISCOVER OUR SOLUTIONS IN THE « AVAILABILITY » SECTION

Incorporate the need for scalability

It may be necessary to add a UPS or a cooling module, server or switch - a data center has to be able to change, and the infrastructures must do the same in order to support the durability of the data center. This involves in particular using solutions which combine optimization of space and modularity.

→ DISCOVER OUR SOLUTIONS IN THE « SCALABILITY » SECTION

Ensure the safety and security of equipment and data

A data center hosts strategic data that are essential for the operation of the companies they belong to. It is therefore absolutely necessary to protect equipment against any intrusions or internal/external events, and to ensure the safety of the people who work on-site.

→ DISCOVER OUR SOLUTIONS IN THE « SAFETY AND SECURITY » SECTION

1 EFFICIENCY

OBJECTIVES:

1 EFFICIENCY

Context & issues

Data centers consume a great deal of energy: 259 TWh in the EU in 2020, i.e. 1.7% of world energy consumption*

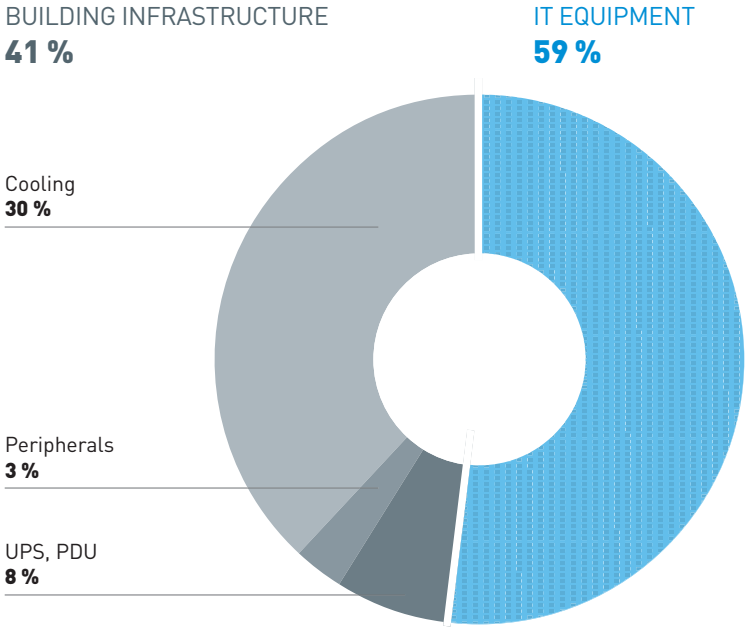
ENERGY-INTENSIVE BUILDINGS

For example:
- a typical data center consumes 10 to 100 times more energy per m² than a standard office building
- the consumption of a 10,000 m² data center is the same as that of a town with 50,000 inhabitants
- over 10 years, the operating cost of a data center is the same as its installation cost
- the electricity bill represents 10 to 15% of the operating cost

The building infrastructure currently represents close to half of the total energy consumption.

AN INCREASINGLY LARGE ECOLOGICAL FOOTPRINT

The environmental footprint of data centers continues to increase: over the 10 coming years, it is estimated that there will be 30 times more data (including 90% unstructured data) and 1000 times more servers. At this pace, energy needs could double within five years. It is therefore essential to reduce the carbon footprint of data centers and improve their energy efficiency, in order to reduce consumption and costs.



* Source: European Commission

Legrand Group's response

OBJECTIVE: REDUCE THE PUE

The PUE (Power Usage Effectiveness) is an indicator for measuring the energy efficiency of a data center by working out the ratio of the total consumption of the data center to that of the computer and telecoms (IT) equipment. The ISO/IEC 30134-2:2016 "Information technology -- Data centres -- Key performance indicators -- Part 2: Power usage effectiveness (PUE)" standard defines several PUE categories:

- **Basic PUE (Category 1)**

This measurement stipulates the conversion of all measurements into kilowatt-hour (kWh). It is a precise method including energy sources other than mains electricity. PUE1 is calculated over a 12-month period.

- **Intermediate PUE (Category 2)**

This measurement includes the category 1 requirements. However the IT consumption is measured at the PDUs (Power Distribution Units). A clear distinction is therefore made between the infrastructure and the IT equipment and it is easier to measure a pPUE (partial PUE).

- **Advanced PUE (Category 3)**

This measurement includes the category 2 requirements. It refines them by requiring the IT consumption to be measured at device level. A data center with optimum efficiency will be PUE 1, whereas the average global PUE of a data center is between 1.8 and 1.89 (source: Uptime Institute survey 2012). Reducing this is therefore a priority in order to ensure that the infrastructure provides ever-higher performance.

THREE POSSIBLE ACTIONS TO REDUCE THE PUE:

OPTIMIZING THE COOLING SOLUTIONS
→ SEE P. 12

REDUCING POWER LOSSES
→ SEE P. 16

MAKE USE OF PERFORMANCE INDICATORS
→ SEE P. 20

1.8 < AVERAGE GLOBAL PUE < 1.92

NOTE

ISO/IEC standardised additional indicators to refine the assessment of the ecological footprint of a data center:
- The Renewable Energy Factor was standardised as the ISO/IEC 30134-3:2016 Information technology -- Data centres -- Key performance indicators -- Part 3: Renewable energy factor (REF)
- The Energy Reuse Factor (ERF): this measure of the amount of energy reused outside the data center is in the process of being standardised
- The Carbon Usage Effectiveness (CUE): this extrapolates a greenhouse gas emission volume based on the electricity consumption of the data center
- The Water Usage Effectiveness (WUE): it measures the amount of water used in the data center.

These last two KPI are on the list for future standardization.

Optimize the cooling solutions

The cooling systems are the main item of consumption in a data center.
To reduce the energy consumption, the consumption by the server cooling systems must above all be reduced.
This involves:
- an optimized design of the white room (IT room, the heart of the data center)
- selecting the right cooling solutions

Data centers are increasingly using energy efficient cooling techniques such as free cooling. We offer a variety of active cooling products both DX and H_2O:

- **Separation of hot and cold airflows**

By separating hot and cold air using aisle containment solutions, this step leads to an optimum reduction of air leakage and increases the energy efficiency.

- **Optimization of the cold air circuit**

Though the airflow optimization in the rack is often not fully or effectively implemented, it is the next step in energy-efficient data centers. Objective: minimize the air leakage. Airflow optimization is also important for the proper functioning of the server, network and storage equipment, for temperature stability and for the general reliability of a data center.

THE LEGRAND ADVANTAGE

Thanks to its worldwide network of partners, Legrand supports you during the decisive stages of your project:

- selection of the right solutions when defining the white room's design
- sizing of the cooling solution in relation to the power of the servers

"MINKELS' FREE STANDING CORRIDOR"

The Free Standing Corridor is a fully self-supporting aisle containment system thanks to which closed-off aisles can be created independently from the IT racks, which is not usual in the data center market. Its modular design consists of a self-supporting construction, wall panels, roof panels and sliding doors. Immediately after implementation, the energy efficiency reached is the same as that of a regular aisle containment system supported by IT racks. The Free Standing Corridor offers corporate and commercial data centers a cost-efficient "pay-as-you-grow" solution in order to create energy efficiency at low initial investments (CAPEX).

SEPARATION OF HOT AND COLD AIR

In addition to simply separating the hot/cold air flows by creating dedicated aisles, the cold aisle containment enables the aisles to be contained for optimized cooling.

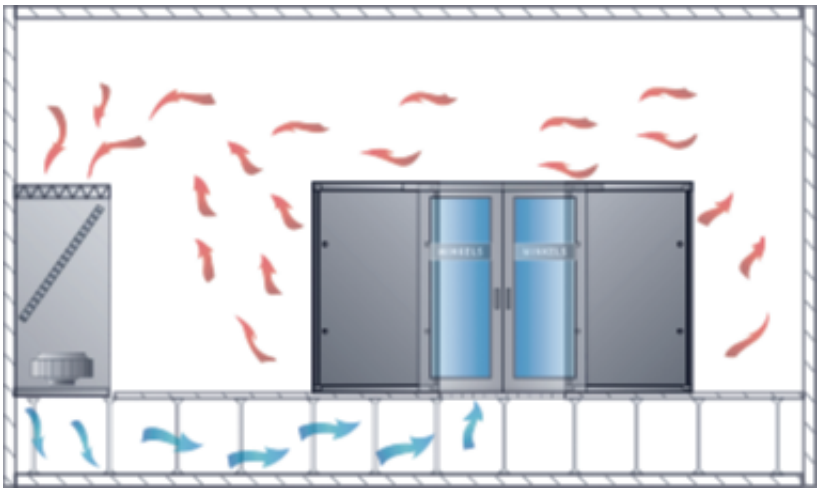
The hot air and cold air are separated when the room is designed, using roofs, panels and doors (at the entrance and exit). This very effectively reduces the energy consumption of the air conditioning units (visible reduction via the air conditioning unit consumption reports). The cold aisle containment provides an average of 30% energy savings.

OPTIMIZATION OF THE COLD AIR CIRCUIT

■ **Cooling the room**

This is done using CRAC (Computer Room Air Conditioning) units.

Traditionally, the cold air is sent into the false floor at a slightly higher pressure and exits via perforated tiles in the contained cold aisle. The hot air is evacuated in the hot aisle and reprocessed by the unit.



Principle of the room cooling system

AISLE CONTAINMENT
AN AVERAGE OF **30 %** ENERGY SAVINGS

STANDARDS

The class (A1 to A4) of a data center, defined by the ASHRAE standard, is assigned according to the equipment in the data center and its specific environmental features.

Equipment (ASHRAE - 2015 Thermal Guidelines)

2015 classes	2008 classes	Applications	IT Equipment	Environmental Control
A1	1	DATA CENTERS	Enterprise servers, storage products	Tightly controlled
A2	2		Volume servers, storage products, personal computers, workstations	Some control
A3	NA			
A4	NA			

Class A1:
typically a data center with tightly controlled environmental parameters (dew point, temperature, and relative humidity) and mission critical operations.
Classes A2/A3/A4:
typically an information technology space or office or lab environment with some control of environmental parameters (dew point, temperature, and relative humidity).

Specific environmental features (ASHRAE - 2015 Thermal Guidelines)

	Product Operations					Product Power Off	
	Dry-Bulb Temperature (°C)	Humidity Range, non-Condensing	Maximum Dew Pont (°C)	Maximum Elevation (m)	Maximum Rate of Change (°C/hr)	Dry-Bulb Temperature (°C)	Relative Humidity (%)
Classes	Recommended (Suitable for all 4 classes; explore data center metrics for conditions outside this range)						
A1 to A4	18 to 27	-9°C DP to 15°C DP and 60% RH					
Classes	Allowable						
A1	15 to 32	-12°C DP & 8% RH to 17°C DP & 80% RH	17	3050	5/20	5 to 45	8 to 80
A2	10 to 35	-12°C DP & 8% RH to 21°C DP & 80% RH	21				
A3	5 to 40	-12°C DP & 8% RH to 24°C DP & 85% RH	24				
A4	5 to 45	-12°C DP & 8% RH to 24°C DP & 90% RH					
B	5 to 35	8% to 28°C DP & 80% RH	28		N/A		
C	5 to 40						

For more information, check the ASHRAE 2015 Thermal Guidelines

OPTIMIZATION OF THE COLD AIR CIRCUIT (continued)

■ **Row-based cooling solutions**
These cooling solutions integrated in the aisle (in or between the racks) reduce the complexity of the installation and provide cooling as close as possible to the server. Particularly suitable for high density solutions or rooms without false floors, these solutions optimize the air flow so that it is as short as possible, which results in lower losses.

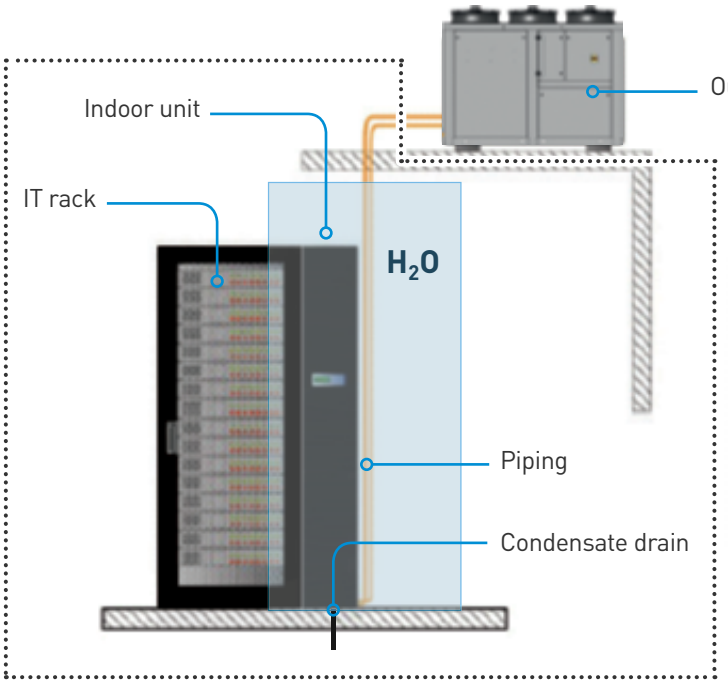
Example: the H_20 cooling system
Commonly called a chilled water system, it uses water for exchanging thermal energy between the secondary system and the primary outdoor system. When the system is running outside a water/glycol mixture is used as a coolant to prevent freezing. The system can be designed as a single loop system avoiding an extra heat exchanger and therefore maximizing the capability of free cooling. The water infrastructure is commonly managed as a circuit for a whole room or is part of a complete building.

Example of H_20 cooling system in cold aisle containment

NOTE

The right airflow optimization accessories ensure an energy efficient solution!
A research carried out by Minkels shows that the use of the correct airflow optimization accessories leads to an enormous reduction in power usage. Based on this research, Minkels has developed accessories which provide concrete products for specific airflow optimization needs.

To find out more, consult Minkels' Whitepaper 04: 'Rack Airflow Optimization', available for download on https://www.minkels.com/whitepapers/rack-airflow-optimisation



H_2O installation diagram

Minkels' expertise

Integration of H_2O cooling to obtain the most energy-efficient performance

Reduce power losses

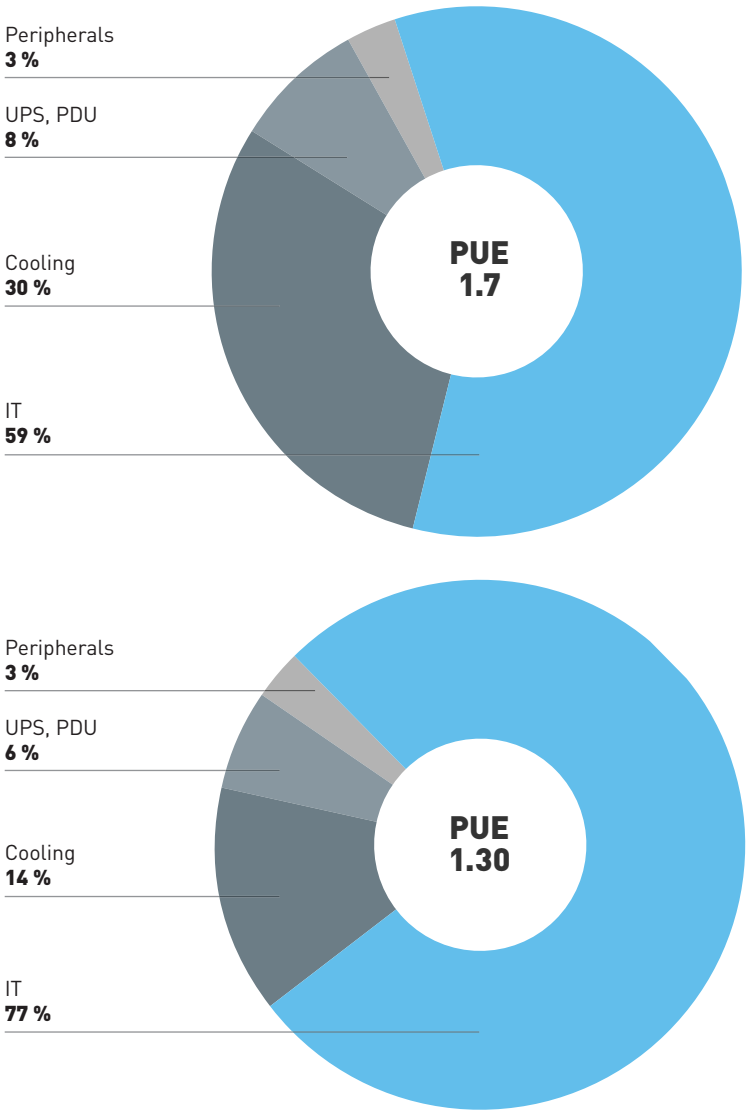
The objective is to reduce power losses so as to increase the efficiency of the electrical infrastructure. Power losses connected with energy conversion and UPSs currently represent around 10% of the total energy consumption of a data center, where the cooling alone represents 32%.
Given the efforts made with regard to cooling, particularly through designs enabling the use of free cooling, these power losses will account for a large part of the data center's energy bill.

In order to increase the efficiency of the electrical infrastructure, it is therefore necessary to look into solutions that will reduce this percentage, in particular via the power supply and distribution systems.

Various products, providing high performance installations, improve the quality of the energy and limit power losses, thus reducing the environmental footprint:

- **Uninterruptible power supplies (UPS)**
  These enable the power demand to be as close as possible to the actual requirements
- **Green T.HE HV/LV transformers**
  (Green Transformer High Efficiency)
  These high efficiency transformers ensure effective energy efficiency.
- **Intelligent PDUs**
  Outlet monitored rack Power Distribution Units accurately measure power consumption for efficient capacity planning and power usage effectiveness improvements.
- **Environmental Sensors**
  Optimize the data center ecosystem to ensure that guidelines and set points are met, reducing operational costs, and improving power usage effectiveness.

PROJECTION OF LOSSES BY IMPROVING THE PUE



STANDARDS

Various normative documents and certifications guarantee the quality of the supply and distribution systems, thus limiting power losses.

- **Standard EN 62040 & European Code of Conduct on the efficiency and quality of UPS**

For uninterruptible power supply (UPS) systems

- **Standard IEC 60076**

For power transformers. Refer more specifically to standards EN 60076-1 to 60776-5 and EN 60076-11 version 2004 (for dry-type power transformers)

- **Standard EN 50588-1**

This standard, in accordance with EU Regulation 548/2014, replaces and supersedes the previous EN 50541-1. It has been applicable since 2015 and applies to the medium power transformers 50 Hz, with highest voltage for equipment not exceeding 36 kV.

- **Standards IEC 60831-1 and 60831-2**

These define the electrical characteristics and robustness tests for capacitors.

- **Standards IEC CEI 61439-1 and IEC CEI 61439-2**

For low-voltage switchgear and controlgear assemblies.

NOTE

The reduction of power losses must be worked at on a daily basis, via careful management of the energy requirements. Those responsible for operating a data center must therefore pay attention to the flow and quality of the incoming energy in order to adapt the power demand to the actual requirements of the data center and ensure optimum use of the power received. As the various power devices operate efficiently at low load conditions (a transformer used at 10% of its capacity is 3 times less efficient than at 60% of it capacity, likewise for inverters and air conditioning units.), their energy management will be optimized and power losses limited.

UNINTERRUPTIBLE POWER SUPPLIES (UPS)

There are 3 types of UPS, depending on the technology of their design:
- single UPS
- distributed (or centralised) parallel UPS
- modular UPS

UPS, with optimized energy efficiency, ensure the power demand is as close as possible to the actual requirements and reduce power losses. In fact, if the efficiency of the UPS is increased, it will give off less heat, which will reduce cooling and consumption losses. Legrand offers UPS solutions that can achieve efficiency levels of up to 96% mode Online (VFI - Voltage Frequency Independent double conversion).

Archimod UPS

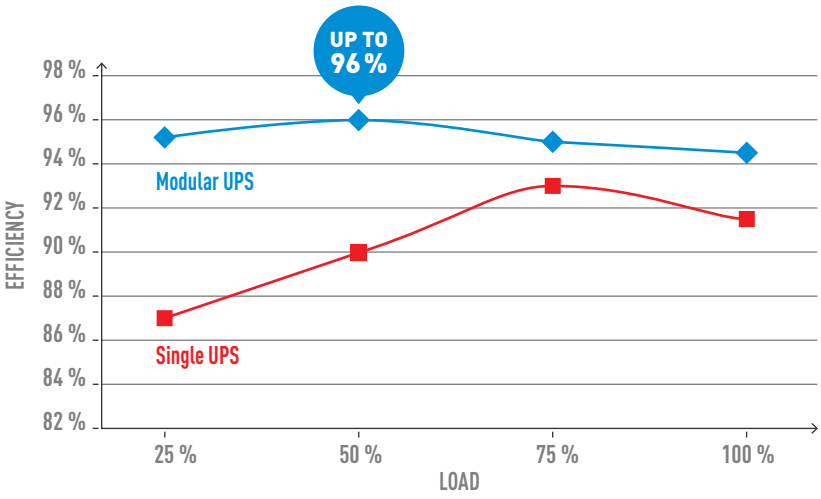
EFFICIENCY LEVELS UP TO 96%* WITH LEGRAND'S UPS!

NOTE

The power of a UPS is usually described in kVA, but a data center is sized in kW because it is necessary to know the actual active power to be supplied.

The power factor of the UPS, i.e. the ratio between the active power (in W) and the apparent power (in VA), is therefore a very important indicator of its performance. It often reaches 0.8, while high performance UPS have a power factor of 0.9 or even 1 (which is the case with Legrand UPS). This means that when 80 kW is required, an 80 kVA UPS with a power factor of 1 will be adequate, whereas a UPS with a power factor of 0.8 at the output must be sized at 100 kVA.

The electrical infrastructure (rating of the circuit breakers) will therefore be better sized.



* Mode Online (VFI - Voltage Frequency Independent double conversion).

GREEN T.HE HV/LV TRANSFORMERS

These provide high energy efficiency and a lower environmental footprint (fewer pollutants).

An average of 3 times fewer losses is observed with these high efficiency transformers than with a standard transformer.

The Legrand Green T.HE offer gives you access to classes AoBk, AoAk and AAoAk solutions. The classification according to standard EN 50588-1 stipulates that the transformer with the lowest losses will be class AAoAk.

Legrand Green T.HE transformers

PX® INTELLIGENT PDUs

Raritan's offer comprises 230V and 415V models, in hundreds of different configurations, including per socket monitoring that help to improve power usage effectiveness of data centers. Remote and "at-the-rack" data collection of current (amps), voltage, power (kVA, kW), and energy consumption (kWh) allows you to:

- benchmark entire racks and individual IT equipment as to identify inefficient IT devices and ghost servers,
- identify when more power is going to a rack than needed and deploy "stranded power" elsewhere,
- drive energy-efficient behavior and support sustainability initiatives.

Power data obtained from PDUs can help you calculate PUE at a granular level, allowing for Category 3 PUE reporting. Intelligent PDUs send power-usage data over the network to a DCIM solution such as Power IQ® to automatically calculate PUE. Total power used in each rack can be compared to the building's overall power usage to create the foundation for PUE calculation.

ENVIRONMENTAL SENSORS

Raritan's plug-and-play server rack sensors for PX PDUs, transfer switches and EMX environmental rack controllers enable you to:

- achieve optimal data center temperatures and minimal HVAC power consumption requirements,
- identify air pressure differences that could indicate hot/cold aisle partition leaks,
- monitor flow rates of cooling and hot air returns to ensure cooling and containment systems are functioning optimally.

REAL WORLD RESULTS

When Cisco sought to reduce its energy consumption and costs, its labs were an obvious target as they accounted for 60% of the company's total power usage, yet occupied only about 10% of its real-estate space. The largest savings came from deploying smart PDUs in all new labs and in major lab retrofits, as well as in existing labs. These PDUs were compatible with Cisco's EnergyWise infrastructure, which Cisco said removed barriers to adoption. The amount of power that the smart PDUs have saved varies from 5 to 60%, depending on the lab. At least $ 8.6M in annual electricity bill savings is being achieved according to in-depth calculations by Cisco!

A comprehensive range of environmental sensors

PX PDU

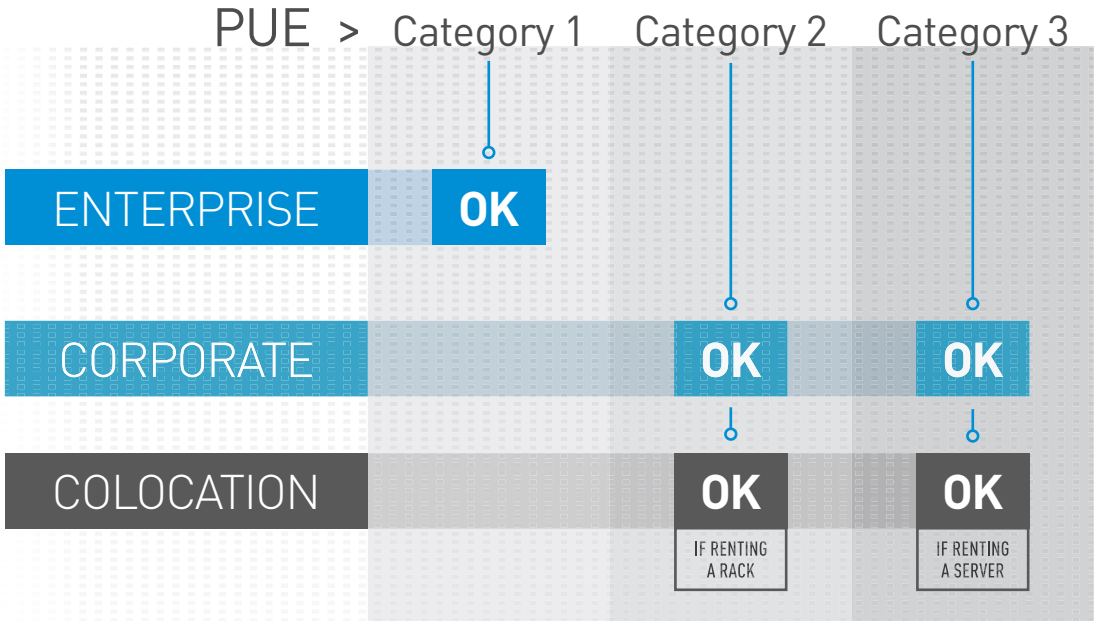
Make use of performance indicators

For greater efficiency, solutions for optimizing the cooling systems and those to reduce power losses can be combined with measurement and supervision systems. These systems provide real-time information on consumption per application, the overall consumption of the installations and the power consumed by the equipment. Energy expenditure can then be reduced by implementing corrective actions.

There are three possible measurement points:

- **overall consumption of the data center**
- **consumption downstream of the UPS**
- **overall consumption of a rack and/or a server**

RECOMMENDED PUE CATEGORIES ACCORDING TO THE TYPE OF DATA CENTER:



OVERALL CONSUMPTION OF THE DATA CENTER, FOR ALL PUE CATEGORIES

This involves measuring the total energy consumed by the data center (in the equipment room). Measurement of consumption must be included in the main LV distribution board, thus enabling the losses of the UPS, the power consumed by cooling and the consumption of the IT equipment to be consolidated.

CONSUMPTION DOWNSTREAM OF THE UPS, FOR PUE CATEGORY 0 OR PUE CATEGORY 1

■ In the secondary distribution boards

The energy consumed per phase is measured. For computer rooms which are heterogeneous in terms of equipment, it should be noted that the consumption varies from one phase to another. To enable maintenance to re-balance the phases, it is useful to include measurement modules in the secondary distribution boards in the rooms, with direct display of the currents per phase.

■ Via the UPS

It is possible to feed back consumption data using electronic cards inside the UPS.

OVERALL CONSUMPTION OF A RACK (FOR PUE CATEGORY 2) AND/OR A SERVER (FOR PUE CATEGORY 3)

This involves measuring the energy consumed by the IT systems. This is done using Power Distribution Units (PDU), intelligent rack transfer switches and monitoring solutions.

■ Power Distribution Units

Rack PDU metering allows data center managers to monitor power in real-time to avoid downtime brought on by overloaded circuits, and to efficiently utilize power resources.

Legrand's PDUs are equipped with an ammeter. The 1-U PDU ammeter can be rotated 90° to ensure easy reading regardless of mounting position (horizontal or vertical).

Raritan's PX Intelligent PDUs are fitted with monitoring features that detect hidden problems in your power chain, test for true redundancy and implement more efficient load balancing with detailed measurements from each server's power supply.

Hybrid Transfer Switch

■ Hybrid Transfer Switches

Raritan's hybrid rack transfer switch system is the first in the world to offer inlet, outlet, and branch circuit level power metering as well as outlet level switching for better remote power control!

■ Branch Circuit Monitor (BCM)

Raritan's Branch Circuit Monitor series provides data center managers with real-time and historical views of electrical capacity and power usage at the panelboard, floor PDU, RPP or overhead busway.

■ DCIM monitoring

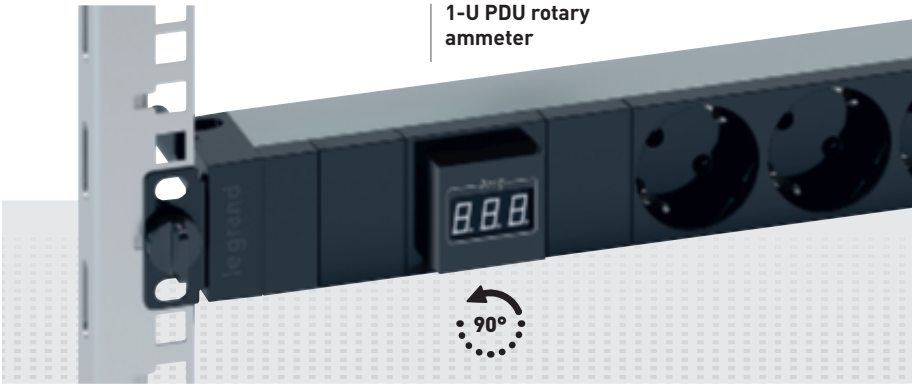
Associated with PX and PXE PDUs, Raritan's Power IQ® DCIM Monitoring Software enables you to closely monitor and efficiently utilize your existing data center power infrastructure. A configurable dashboard provides vendor agnostic views of power capacity, environmental health, and energy consumption.

Power IQ® DCIM: user-configurable dashboards provide information on power and consumption, health and environmental data, and more.

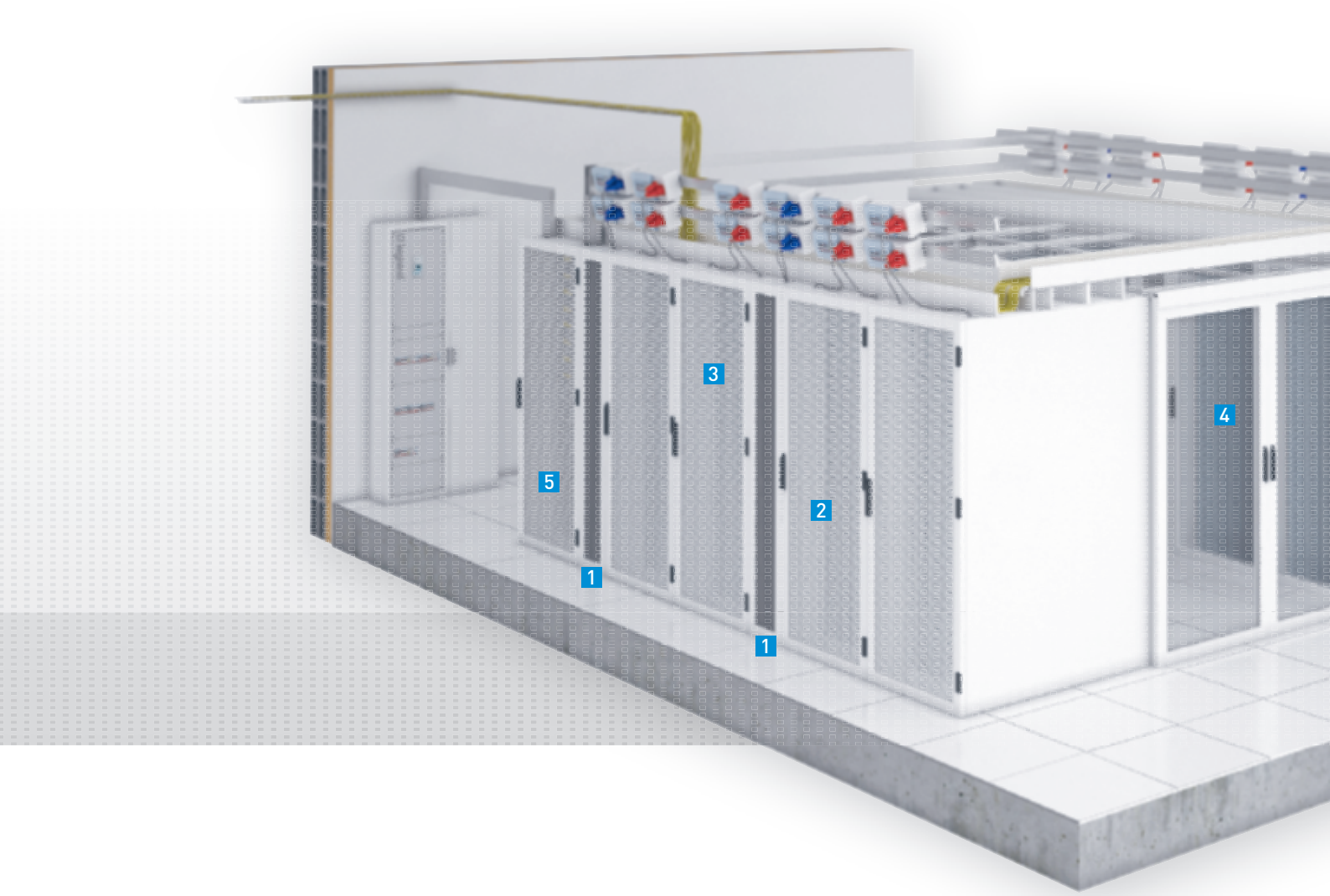
NOTE

For a PUE category 2, it is possible to:

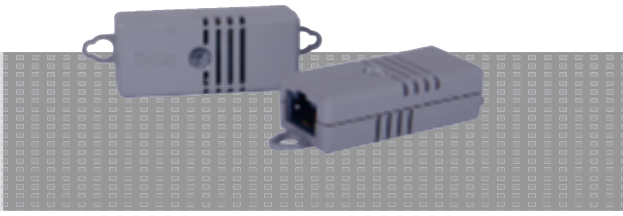
- locate the measurement remotely from a PDU for the consumption of a rack at its upstream protection device, thus enabling a basic PDU to be used.
- integrate measurement in the tap-off boxes connected to the prefabricated busbar trunking .



1-U PDU rotary ammeter



1 Row-based cooling
→ SEE P. 14



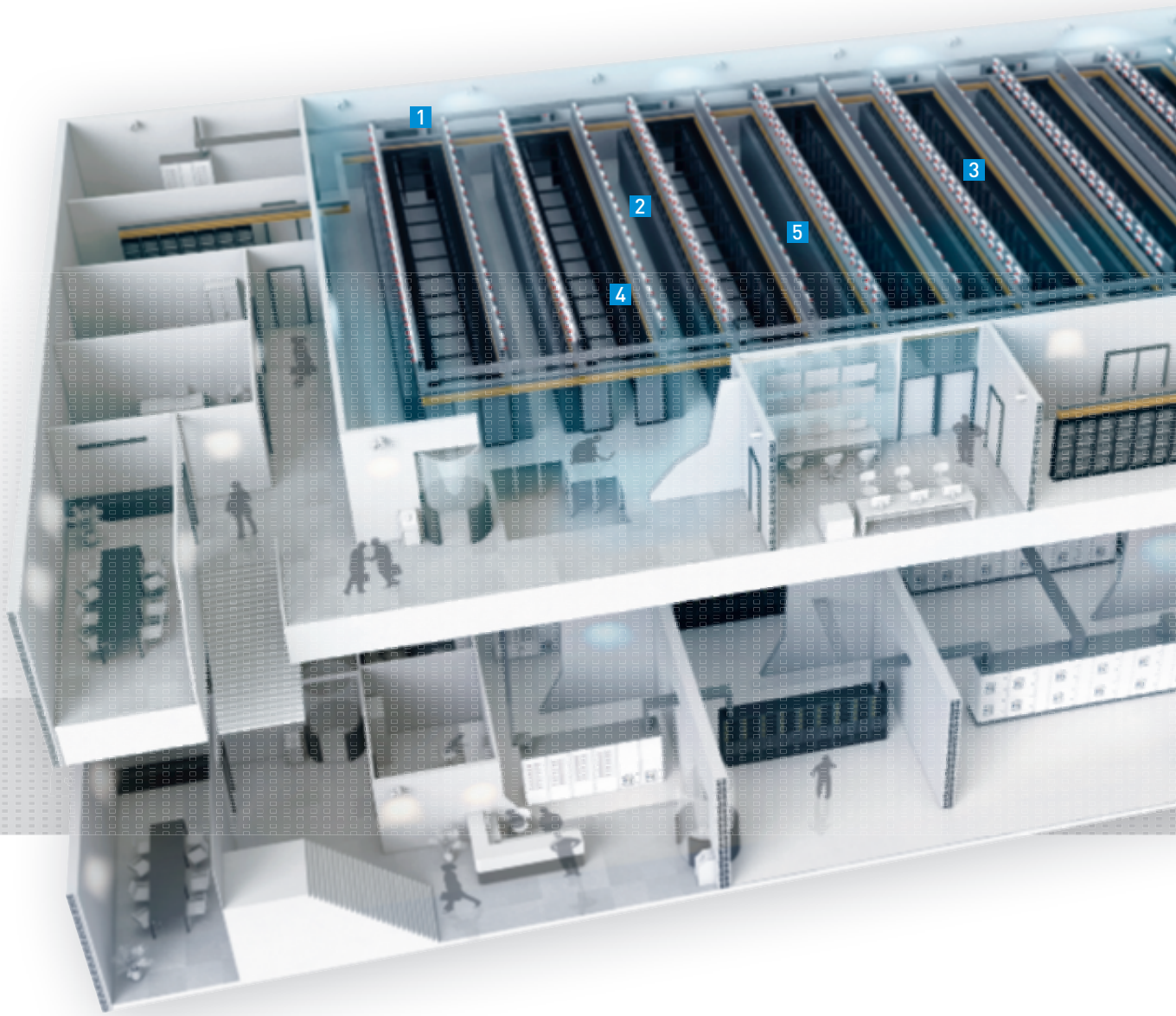
2 Environmental sensors
→ SEE P.19

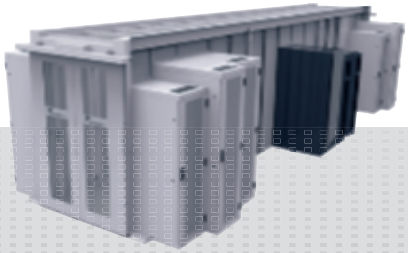
ENTERPRISE
PRODUCTS
SOLUTIONS

3 PXE metered rack PDUs
→ SEE P.21

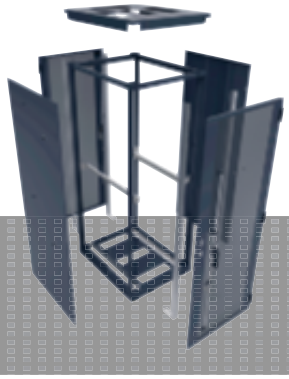
4 Branch Circuit Monitor
→ SEE P.21

5 Archimod UPS
→ SEE P. 18



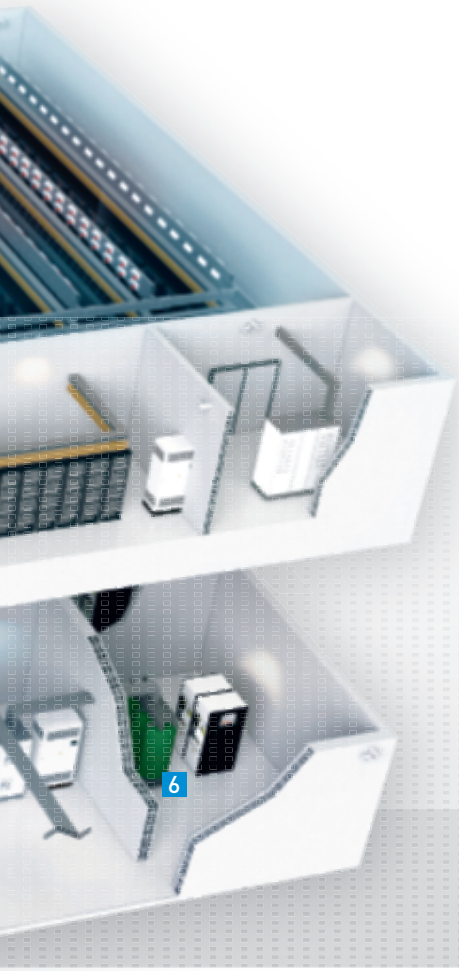


1 Aisle containment
→ SEE P. 12



2 Server rack
→ SEE P. 12

3 Intelligent PDUs
→ SEE P. 19



CORPORATE & COLOCATION

PRODUCTS SOLUTIONS

4 Environmental sensors
→ SEE P. 19

5 Power metering and monitoring
→ SEE P.21

6 HV/LV Green T.HE transformers
→ SEE P. 19


Available

2 AVAILABILITY

OBJECTIVES:

2 AVAILABILITY

Context & issues

A 1 hour outage of a trading room can represent a loss of up to 6 M€.

Providing available power, data and cooling is vital to the core business of any data center.

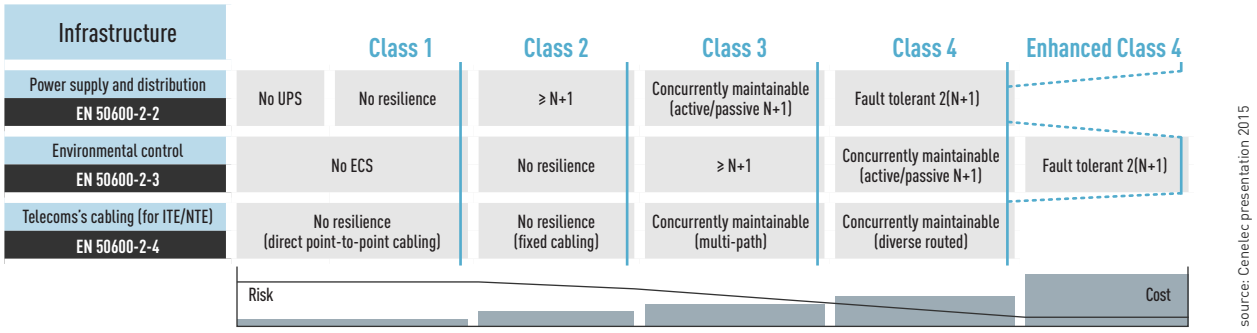
Availability being impacted by the maintenance or failure of critical components making up the delivery path, investing in a highly efficient infrastructure is essential to ensure reliable availability of energy and data in all circumstances!

DETERMINING THE REQUIRED AVAILABILITY

Currently the best reference standard, the EN 50600 series fittingly connects the different availability classes with a corresponding classification related to security and energy efficiency enablement.

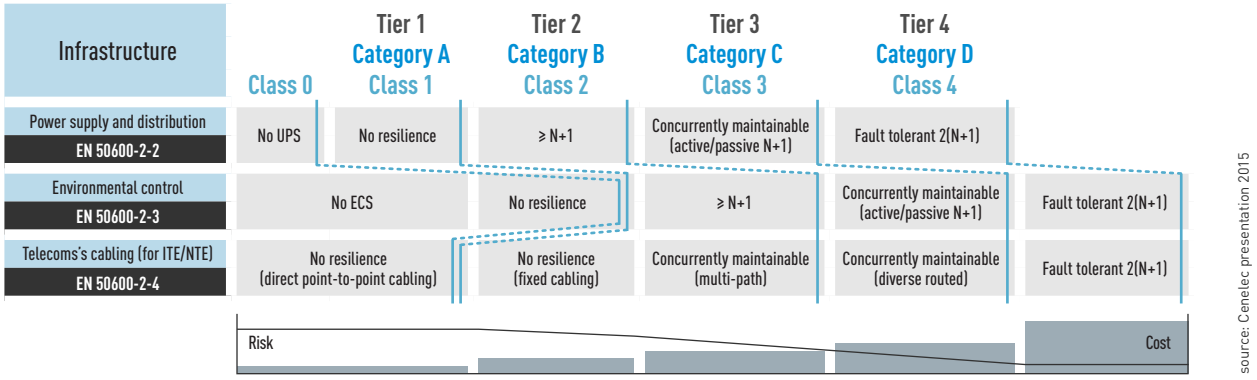
In order to determine which availability class is needed, one must assess the consequences a failure induces in parallel with the investment made and the level of risk mitigation achieved.

EN 50600-1 CLASSIFICATION[1]



source: Cenelec presentation 2015

OTHER CLASSIFICATIONS[1]



source: Cenelec presentation 2015

[1] The requirements and recommendations giving the required protection classes (to ensure availability of equipment and infrastructures) appear in:
- Standard EN 50600-2-1, for the construction of a data center.
- Standard prEN 50600-2-5, for the physical protection of the data center.

Tier - Uptime Institute **Category** - Bitkom **Class** - ANSI/BICSI

Legrand Group's response

AVAILABILITY CONSIDERED CAREFULLY AT EVERY STAGE

■ **When designing the data center**
Legrand can work with you on the entire design of the data center's infrastructure. Objective: to help you identify critical items which could reduce the level of service (and thus lead to a loss of continuity) and to suggest solutions to avoid too high a level of redundancy in order to optimize costs, while maintaining service. Example of a solution: synchronisation of two main LV distribution boards.

■ **When developing the systems**
It is essential to design distribution, power supply and equipment supervision systems etc. using innovative systems that enable not only constant access to a high-performance electrical/digital network, but also the performance of work on the installation (upgrades, maintenance, etc.) without interrupting service.

THE RIGHT TIER/CLASS FOR A GIVEN DATA CENTER

For optimum availability of energy, cooling and data meeting your exact needs, it is important to determine the most appropriate Tier/Class.

To do so, it is necessary to perform a business risk analysis.

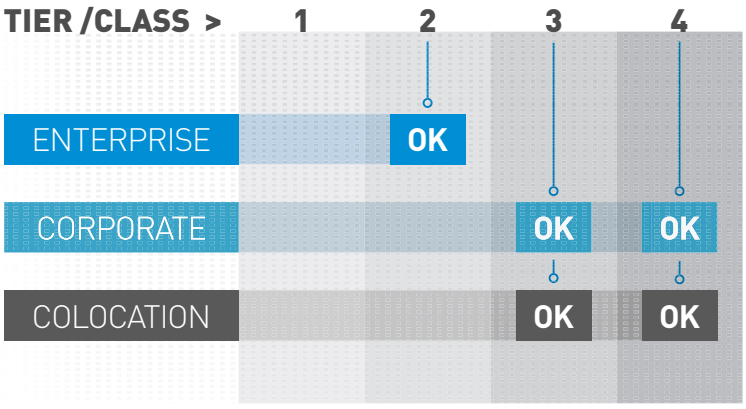
The Legrand Group gives you some recommendations ensuring you to subsequently implement optimum solutions.

DESIGN INNOVATIVE SYSTEMS WHICH ENABLE:

CONSTANT ACCESS TO A HIGH PERFORMANCE ELECTRICAL/DIGITAL NETWORK
→ SEE P. 30

ANY WORK TO BE CARRIED OUT ON THE INSTALLATION WITH NO BREAK IN SERVICE
→ SEE P. 36

MINIMUM RECOMMENDED TIER/CLASS ACCORDING TO THE SIZE OF THE DATA CENTER



THE LEGRAND ADVANTAGE

Legrand has a centralised expert department which can provide you with expertise in its various competitive areas, working with you to define technical solutions by looking at the project as a whole, over and above single products.

Constant access to a high performance network

The availability of data, and therefore the servers, is assured if the cooling, its power supply and its connectivity are always assured if a component in the infrastructure fails or if maintenance has to be carried out.

Constant accessibility to a high performance network is based on 3 main factors.

- **Continuity of service**
  This involves above all providing a clean power supply with no electrical disturbance (micro-breaks, overvoltages, undervoltages, etc.) and choosing solutions that enable components to be changed with no break in service.
- **Performance and reliability of solutions**
  This involves selecting products which are reliable, due to both their design and their integration, whose connectivity performance levels ensure an optimum rate.
- **Access to network**
  This involves implementing comprehensive productivity solutions enabling a reduction of time taken to perform work via network identification solutions and via systems designed so as to give better access in case of interventions.

CONTINUITY OF SERVICE

- **Uninterruptible Power Supplies (UPS)**
  Legrand has a range of UPS (modular, synchronizable, etc.) with various performance levels (from 10 to 4800 kVA), thus able to meet all requirements. The guarantee of optimum continuity of service!
- **Electrical distribution racks**
  Discover our increased safety solutions on page 37!

PERFORMANCE AND RELIABILITY OF SOLUTIONS

Ensuring a data center is constantly available involves selecting solutions that ensure correct operation over time. For this, the Legrand Group develops and designs its high performance products and systems with safety margins well beyond those in the standards, to ensure they operate correctly irrespective of the environment in which the systems are installed and used.

- **Dry type transformer**
  This is one of the most reliable products in the electrical infrastructure:
  - once it has been commissioned, it requires very little maintenance in comparison with an oil-immersed transformer, which has to be inspected regularly
  - it does not contain any moving parts, or any insulating fluids: there is therefore no risk of leaks or any need for regular maintenance.

STANDARDS

The reference standards for availability mainly concern structured cabling. They include the project and the installation of the system as a whole, and also the technical characteristics of each component. Although the standards are structured differently for each continent, they all cover all the important topics and contain in particular the requirements for performance, safety and conformity of installations.

EUROPE

- **EN 50173 standards**
- **EN 50174 standards**
- **TC215WG3 and EN 50600 standards**

UNITED STATES

- **EIA/TIA 568-C standards**
- **EIA/TIA 942 standards**

- **Capacitor banks**

The design of these is completely dry. They incorporate capacitors:
- designed to last and to withstand the stresses of the electricity supplies: overvoltages, harmonic pollution, etc.
- with a tolerance significantly higher than in the standards (U max = 1.18 Un constantly)

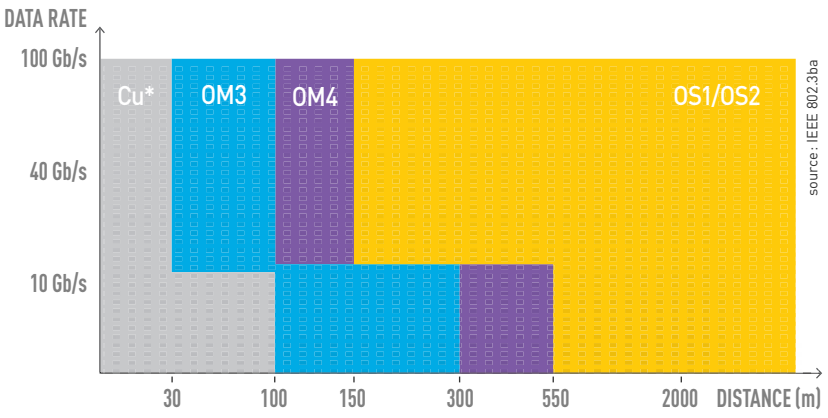
The service life of the compensation system is therefore increased.

- **Structured cabling systems**

When describing the performance of a structured cabling system, independently of the technology used for the conductor whether it is copper or optical fiber, the transmission speed is the reference point.

LCS³, the new Legrand structured cabling system, ensures high performance and reliability for the installation via zero fault solutions and routing systems that are ideal for copper and optical fiber cables.

SELECT THE IDEAL OPTICAL FIBER SOLUTION!



*Draft versions ISO/IEC and EIA/TIA, standards in process

PERFORMANCE AND RELIABILITY OF SOLUTIONS (continued)

ZERO FAULT SYSTEM

The innovative Legrand LCS³ offer provides you with:
• 25 Gbps and 40 Gbps BASE-T Ethernet solutions with the copper system.
• 40 Gbps and 100 Gbps Ethernet solutions with the optical fiber system.

To ensure the 40/100 Gbps and Fiber Channel protocols are supported, hence opt for LCS³ high speed optical fiber solutions, among which our newest MTP connectors and cassettes! They make for a perfect connection in just a few seconds, giving a link providing excellent performance levels, from the patch panel through to the workstation!

These solutions can be used to create wiring architectures for the LAN and SAN infrastructures of data centers with OM3 and OM4 performance levels, in multimode and OS1/OS2 in single-mode.

As for LCS³ Cat. 8 copper solutions, they provide performance levels meeting the "ISO/IEC 11801 standards - third edition" requirements.

All the LCS³ components are tested individually at the end of production and their excellent performance levels over short links (less than 15 m) ensure availability of the bandwidth at the highest frequencies. As for the Legrand RJ 45 and optical fiber connectors, their design ensures they comply with the installation regulations: correct installation is thus assured!

NEW CAT. 8 CONNECTOR

The new toolless connector in Cat. 8 STP, with transmission speed (BIT rate) from 25 Gb/s to 40 Gb/s, is at the heart of the performance of the new LCS³ system.

Tested up to 2500 connection/disconnection cycles and in accordance with ISO/IEC 11801 standard - third edition, this new connector ensures a perfect connection in just a few seconds, giving a link providing excellent performance levels!

CAT. 8 BANDWITH PERFORMANCE IS **4 TIMES BETTER** THAN THAT OF CAT. 6A

NOTE

▪ Optical fiber

This is a transmission medium that enables a larger bandwidth to be used than copper cables. Optical fiber cables have major advantages over copper cables: total immunity to electromagnetic interference, high transmission capacity, low attenuation, much smaller cable sizes (10 times smaller than a copper cable)...

▪ PoE certification

With PoE technology, devices (Wi-Fi access points, cameras, etc.) can be supplied directly with the Ethernet data cable. In a single cable one has the passage of data and voltage to supply the peripherals.
There are three types of PoE in relation to the power supplied:
- PoE standard IEEE 802.3af (2003),
- PoE + standard IEEE 802.3at (2007),
- PoE ++ standard IEEE 802.3bt (2018).

For PoE++, the choice of connectors is fundamental because the powers in play begin to be considerable. The wiring standards must be respected because, when a live RJ 45 connector is disconnected, an electrical arc can be created, which damages the connector's contacts.
All the LCS³ connectors are certified PoE + and guaranteed for PoE++.

▪ High Density (HD)

The main advantage of HD optical fiber solutions (panels, racks, optical fiber drawers, cassettes, etc.) is a large number of physical connections in a minimum amount of space.
Another advantage is that they can be used for a scalable 40 or 100 Gigabit installation.

ROUTING SOLUTIONS

Given the number of digital links in a data center, it is important to ensure the durability of the existing installations and avoid collateral damage which could lead to wiring changes. For this reason the Legrand Group, world leader in cable routing, has developed dedicated data center solutions which ensure:

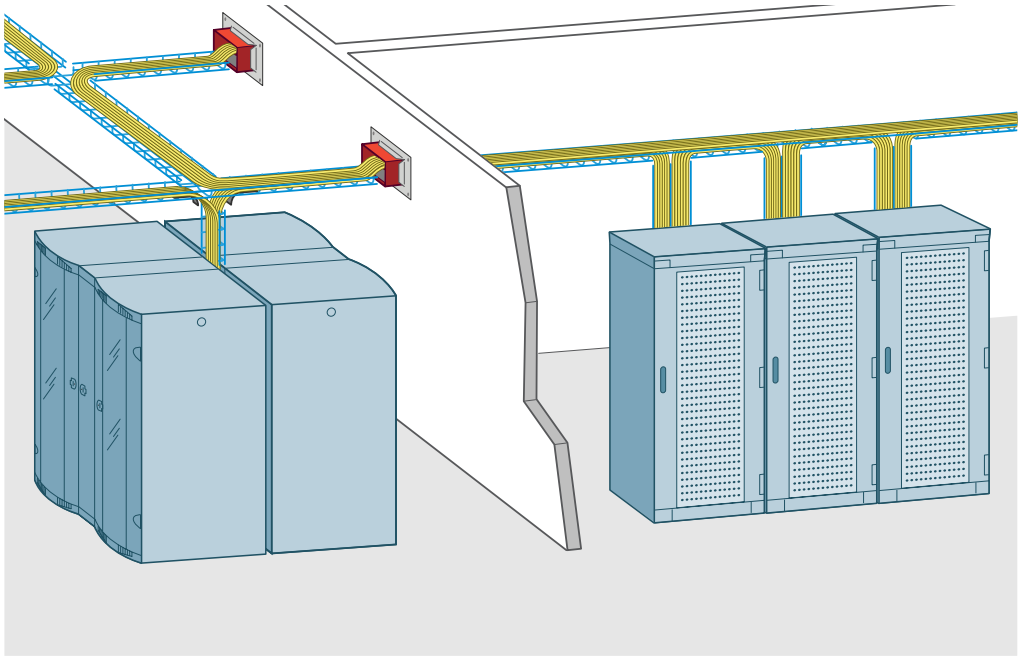
• compliance with the permitted bending radiuses for copper and optical fiber data transmission cables, with:
- the Cablofil range
- a wide range of accessories for server racks and HD racks
- firestop partition feedthroughs with the EZ Path system

Cablofil cable tray: patented T-joint system

• protection of the cables when they are installed or replaced, with:
- Cablofil cable trays and their patented T-joint system
- the automatic cable fixing system on LCS³ patch panels without cable ties

• compliance of the hot and cold air flows with the ranges of short (< 1 m) LCS³ cords and the vertical fixing system for the panels at the rear of the server racks.

COMPLETE LEGRAND CABLE MANAGEMENT SOLUTION



NOTE

The complete Legrand solution (racks for the wiring, server racks and routing) enables LCS³ solutions preterminated with connectors to be added!

ACCESSIBILITY TO THE NETWORK

■ Network identification systems

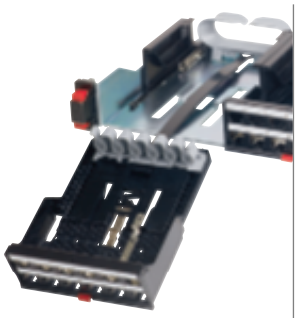
In its LCS³ solutions, the Legrand Group still gives more space than average to the alpha-numeric means of identifying the connections on copper and optical fiber patch panels, in both standard and high density solutions. All patch panels can, thus, be equipped with labels available in numerous colors!

As for all 19"uprights used for fixing in wiring racks and server racks, they incorporate marking of the units that can be read from the top or the bottom.

It is also important to identify the various flows (copper, optical fiber, technical network, etc.). Legrand therefore offers you solutions with cable trays, cords and connectors available in various colors for optimum identification!

Marking of the units on 19'' uprights

Various colors for cords, patch panel labels and connectors



Copper system: simple extraction of connector blocks

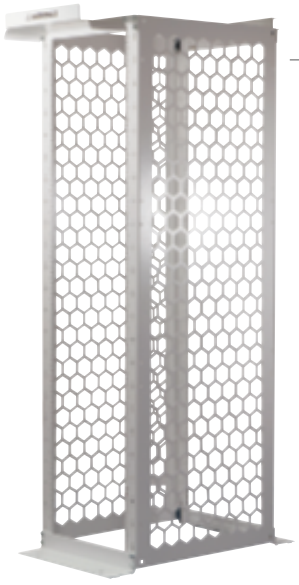
■ Accessibility

LCS³ panels are accessed and connectors attached via the front, and have a quick fixing system on 19'' uprights.

The new copper system panels have been designed and produced to make maintenance and future upgrades easier. Available in flat and angled versions, they have a quick system for extraction of the connector blocks and an innovative cable guiding system for tidy and easy management of the cables.

Equipped with sliding cassettes (from front and rear) and a fast button system, the LCS³ High Density optical fiber panel can take up to 96 LC connectors in 1 U. As for the innovative Ultra High Density panel, it can house 144 LC connectors in 1 U. All panels allow the connection and disconnection of the cords without the need for any special tools due to their unique optical fiber feedthroughs.

As for LCS³ Mighty Mo 20 4-post connectivity racks, they provide an economical mounting platform for switches and servers, and the adjustable racks allow all 4 mounting rails to be adjusted even after the rack has been fastened to the floor. Front and rear waterfalls allow for equipment patching and server patching.



Mighty Mo 20

NOTE

As servers consume increasing amounts of energy, thermal undersizing must be avoided as it could lead to faults (due to overheating of the infrastructure) and a break in continuity of service. A data center therefore requires solutions that provide continuous cooling of the equipment, for a building that provides even better performance!

It is therefore important to choose products that provide high thermal density, such as air conditioning units, the cold aisle containment, etc.

This high thermal density ensures:

- internal modularity of the fans that can be hot-swapped for ease of maintenance, and an optimum power supply
- absolutely no contact between the connections of the water inlets (lower part of the units) and the electrical inlets (upper part)
- simple, effective visual feedback for quick identification of alarms

For further information, see p. 12 to 15 (Efficiency)

Easy maintenance for even more efficient buildings

Carry out work with no break in service

Critical applications such as data centers require a high degree of availability at all times and under all circumstances.

It is therefore essential to ensure this high availability and optimize it in order to mitigate any possibility of faults or need for maintenance without having to interrupt service. Various highly efficient systems and functionalities allow this:

- **"Hot plug" system**
  Products can be connected/disconnected while energized, thus providing a great deal of flexibility for carrying out work.
- **"Hot swap" system**
  Components can be replaced while energized, thus ensuring optimum continuity of service under all circumstances.
- **Modular architecture**
  A scalable installation with no loss of performance.
- **Reliable network**
  Highly efficient solutions, from power distribution to supervision, for a reliable network.
- **Remote control and management**
  Optimum and secure solutions to access and remotely control servers and storage/network devices in order to identify potential failure points and prevent service disruptions.
- **Secure locking**
  Innovative and exclusive locking systems ensuring a perfect connection at all times.
- **Advanced functionalities**
  Solutions are architected with components, features and fail-safes that ensure the most reliable infrastructure possible.

"HOT PLUG" SYSTEM

This system enables components to be connected and disconnected in an installation while energized, without any interruption to the system and with no risk of damaging the rest of the installation. Even when high currents are interrupted, continuity of service is assured.

The Hot Plug system can be applied to various components in an installation, such as the low voltage electrical panel, energy distribution solutions in the computer room, IT equipment, etc.

NOTE

The Hot Plug system is also used for managing maintenance and the scalability of the installation, enabling the time taken for work to be reduced considerably and therefore increasing the availability of data centers.

■ Low voltage electrical panel

In the context of the IEC 61439 standards, which govern low voltage electrical panels, the concepts of connection/disconnection associated with requirements for upgrading the panel are essential. To meet these requirements, the Legrand Group uses two indexes which provide information on the level of continuity of service of an electrical panel, which are assigned to the panel according to its characteristics and its components: the Service Index and the Mobility Index.

SERVICE INDEX (IS)
French reference index, its aim is to define the service level provided by any type of low voltage distribution panel when undergoing all types of work, during the three phases of its life (operation, maintenance, upgrading). It takes the form of a 3-number code. The IS, through the choice it offers, helps to augment the continuity of service and the safety and security of the installation.
Although this index is not mentioned in the IEC 61439 series of standards, there is certainly some correlation, in particular with regard to the."Mobility index".

MOBILITY INDEX
International reference index determining the design of the functional units in the panel, it takes the form of a 3 letter code (see page 38).

SOLUTIONS RECOMMENDED BY LEGRAND

You want to be able to perform maintenance with no break in service?

YES

RESTART POSSIBLE AFTER 15 mins NO DOWN TIME

FORM OF THE FUNCTIONAL UNIT	3		4	
Minimum IS required for the LV panel – MOBILITY INDEX	DDD	WWW	DDD	WWW
Minimum IS required for the LV panel – IS INDEX	231	331	232 233	332 333

YES

RESTART POSSIBLE AFTER 1 hour NO DOWN TIME

FORM OF THE FUNCTIONAL UNIT	3	4	
Minimum IS required for the LV panel – MOBILITY INDEX	WWW	DFF	WWW
Minimum IS required for the LV panel – IS INDEX	321	221 222 223	322 323

NO

Implies complete power shutdown during maintenance operations

FORM OF THE FUNCTIONAL UNIT	1	1*
Minimum IS required for the LV panel – MOBILITY INDEX	FFF	WWW
Minimum IS required for the LV panel – IS INDEX	111 211	311

*No protection of live parts

"HOT PLUG" SYSTEM (continued)

STANDARDS

The main preliminary step for sizing the energy source(s) is to carry out a "power analysis", to ensure there is an optimum power supply for all the consuming receivers in the data center: lighting, heating, air conditioning and utilities... and of course the racks and IT systems. This power analysis must take the conditions of use, possible degraded modes (no power) and even electromagnetic interference (harmonics) into account in the dual interests of continuity of service and energy saving. The quality of the energy (standard EN 50160) and the distribution conditions (supplier, operators, proportion from renewable sources, etc.) are parameters which must also be managed in this operation.

Standard EN 50600-1 gives general design recommendations for data center installations and infrastructures.

Standards EIA/TIA 942-A (US version) and EN 50600-2-2 (EU version) give recommendations on energy distribution, in particular for the Service index/Mobility index.

The Green Grid, an international reference system, also provides advice on configuring energy distribution systems.

In addition to specific standards, it is also essential to comply with safety standards for electrical installations (IEC 60364-X set of standards) regarding equipment choice and implementation, protection of people, and installation safety. Similarly, all active products (servers, switches, etc.) integrated in racks must comply with the IEC 60950 standard regarding information technology equipment safety, to which they must refer.

For further information, see p. 60 to 65 (Safety and Security)

SI and Mobility index: the codes

Service Index

SIXXX

OPERATION

Determines the consequences of a mechanical or electrical lockout operation on the panel to allow work on the installation

1. Complete shutdown of the panel
2. Complete shutdown of the functional unit concerned only
3. Shutdown of the power to the functional unit concerned, but control system tests authorised in order to test the installation

MAINTENANCE

Determines the capacity of the panel to respond to a maintenance requirement

1. Complete shutdown of the panel
2. Interruption limited to the functional unit concerned only, for a limited time (e.g. UTE: 1 hour). Replacement will require work on the connections
3. Interruption limited to the functional unit concerned only, for a limited time (e.g. UTE: 15 mins). Replacement will not require any work on the connections

UPGRADING

Determines the capacity of the panel to respond to a future upgrade

1. Complete shutdown of the panel
2. Interruption limited to the functional unit concerned only. Spare functional units are provided
3. Addition of any type of functional unit in an unequipped location, without powering off the panel

Mobility index

XXX

UPSTREAM POWER

F: fixed
D: disconnectable
W: draw-out

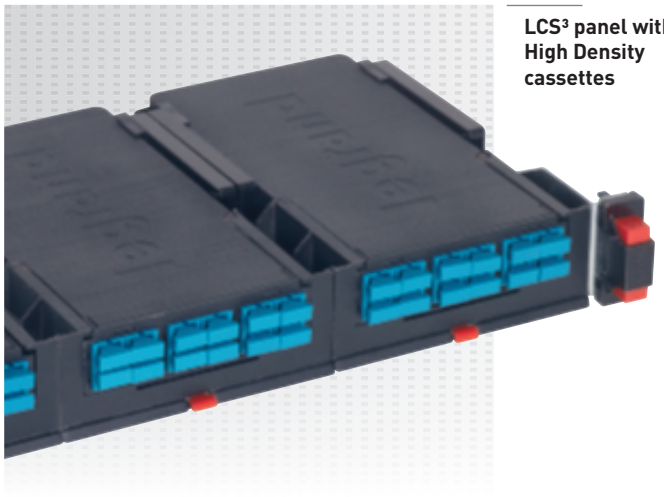
DOWNSTREAM POWER

F: fixed
D: disconnectable
W: draw-out

AUXILIARIES

F: fixed
D: disconnectable
W: draw-out

MR busbar solution with tap-off box



LCS³ panel with High Density cassettes

- **Energy distribution solutions in the computer room**

The MR busbar range solution, with tap-off outlets, can be used to connect and disconnect tap-off boxes supplying a PDU while energized.
(see solution p. 52 - Scalability section)

- **IT equipment**

Essential for relaying data, the patch panels, racks and other optical fiber drawers must allow constant data transmission. To do this, hot connection/disconnection is essential. This means making the installation scalable with no risk of damage to existing equipment and connections.

NOTE

For a cost-effective solution, the Legrand solutions enable the service indexes in a set of racks to be mixed. Example: a rack already equipped as IS 231 or 331 and an IS 223, 233 or 333 reserve rack.

To find out more, consult our Product Guide « Distribution system » available on www.legrand.com

"HOT SWAP" SYSTEM

This system enables components to be added or replaced in an installation while energized, without any interruption to the system and with no risk of damaging the rest of the installation.

- **UPS**

Uninterruptible Power Supplies, which switch the supply to a backup battery for a short while if there is an electrical problem, can consist of hot-swappable components such as the batteries.

As the ability to change a UPS module is essential for the scalability of an installation, Legrand "On-line double conversion" modular UPS all incorporate a hot swap system. This ensures optimum continuity and quality of the electricity supply.

With their innovative design, Legrand three-phase modular UPS can adapt to all installation types and allow to achieve various levels of redundancy. Their highly compact and easy-to-handle power modules are fitted with the hot swap system. Their highly standardised components guarantee the greatest upgrade flexibility on the market.

- **PDUs**

Legrand PDUs' surge protection module incorporates hot swap technology. It can be used to replace a used module without interrupting the power supply to the other equipment connected to the PDU. This is an essential accessory for business servers which need continuous protection. The module is equipped with a warning LED which indicates when it needs replacing.

MODULAR ARCHITECTURE

Making an installation scalable without any loss of capacity involves above all choosing solutions that provide a modular architecture which guarantees optimum performance in all circumstances.

- **At UPS level, with modular solutions**

The integrated n+1 architecture of Legrand modular UPS makes it possible to work on a module while maintaining the capacity "n" necessary for the installation, or even "n+1" if a module is available in stock. Upgrading or repair work can therefore be carried out while maintaining optimum operation of the UPS. Moreover, the return to an n+1 situation is much quicker with modular UPS, as the mean time to repair is less than 10 min.

- **At system level, with parallelable solutions**

The n+1 architecture of the Legrand parallelable UPS enables work to be carried out on a module while maintaining capacity "n".

MODULAR UPS
MEAN TIME TO REPAIR
< than 10 min

NOTE

- **On-line double conversion technology**

It consists of converting the current supplied via the raw mains supply twice before supplying the installation: once to DC via the rectifier, and once to AC via the inverter. This provides increased protection against power cuts and micro-cuts, interference, frequency variations, voltage dips, overvoltages, lightning, etc.

- **Energy efficiency**

All Legrand UPS are optimized so that they provide maximum energy efficiency between 45 and 80% load, which ensures optimum efficiency in the various types of architecture (n+1 or 2n).

RELIABLE NETWORK

Disturbance-free power distribution solutions, robust cable management systems, innovative structured cabling components, secure control and supervision solutions... The Legrand Group's global offer allows the creation of coherent and efficient systems which ensure a reliable network at all times and in all circumstances.

REMOTE CONTROL AND MANAGEMENT

An inability to quickly identify asset dependencies and potential failure points can lead to inoperable servers, when an ability to locate the root causes of failure and to mitigate power issues quickly can help restore service interruptions with fewer disruptions.

Raritan's KVM-Over-IP solutions precisely provide the ability to access and control servers from anywhere and over a secure IP connection, hence guaranteeing an optimum supervision.

With industry leading video performance, security, and enhanced reliability, the Dominion® KX III enterprise-class KVM-Over-IP switch is ideal for server rooms and the largest enterprise data centers. It offers high performance, Java-free, remote management of servers, storage, and network devices, and virtually any application.

What's more, the Dominion Serial Access Modules (DSAM) provide "true serial access" with copy and paste capability for up to 8 simultaneous connections to serial devices like LAN switches, routers and Linux/Unix servers.

SECURE LOCKING

A major addition to the PDU range and exclusive to Legrand, C13 and C19 outlets have a power supply cord locking system which prevents unintended disconnection. Once the power supply cord is connected, it locks automatically and can only be removed by a secure pressing on the unlock button.

Raritan's intelligent rack PDUs are equipped with SecureLock outlets, preventing SecureLock power cords from coming unplugged due to vibration or human error.

ADVANCED FUNCTIONALITIES

From the ground up, Raritan's PX Intelligent PDUs are architected with components, features, and failsafes that ensure the most reliable infrastructure possible thanks to various highly efficient functionalities.

- **Built-in Failover Power**

Even if one power feed fails, both PDUs in the rack maintain network connectivity, and continue monitoring and alerting using the built-in power share capability of the iX7 generation controller.

- **Advanced Alerting and Intelligence**

Billing-grade accurate monitoring of user defined thresholds ensure that potential failures are identified far in advance. Real-time alarms notify you of potential risk conditions in the power chain.

- **Circuit Breaker Trip Alarming**

Immediately identify faulty power supplies and react to tripped breakers that would otherwise go undetected by building management systems, branch circuit monitoring, and other brand PDUs.

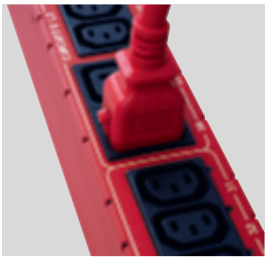
- **Bi-State Latching Relays**

Employing the most reliable components available, PX Intelligent PDUs with outlet switching consume less energy, protect against in-rush currents, and hold the critical power load even in the event of catastrophic failure.

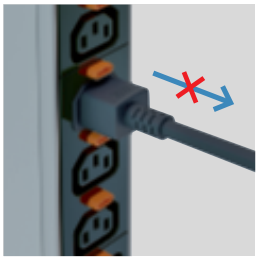
PX PDU

Dominion KX III

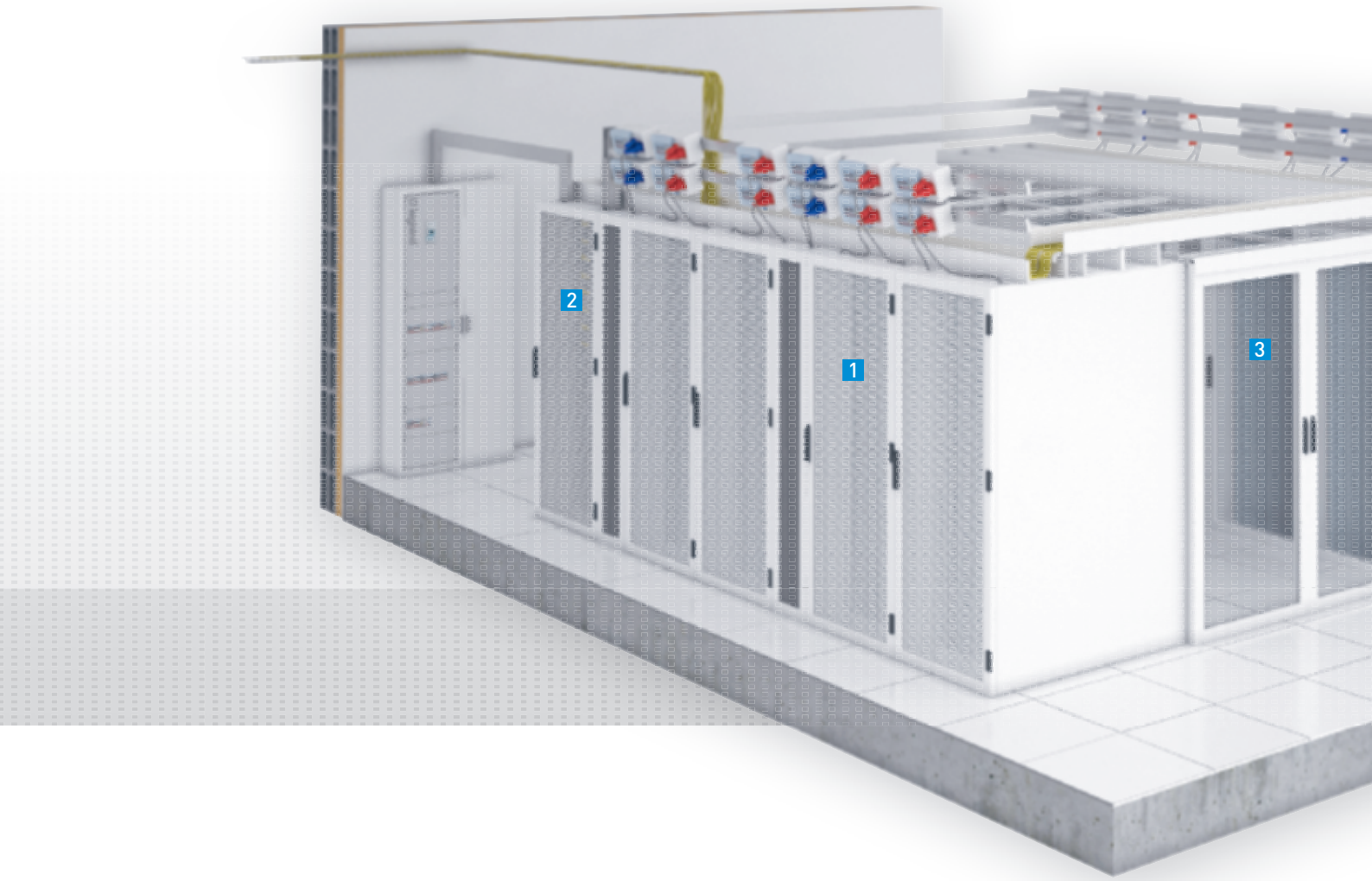
Dominion Serial Access Modules

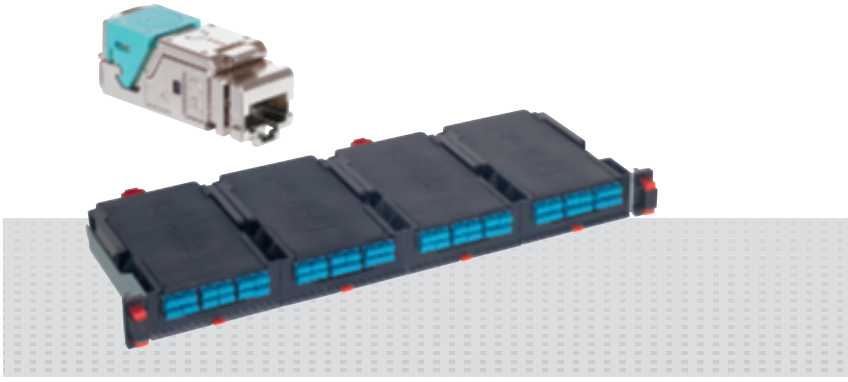


Raritan's Secure Lock system



Legrand's certified PDU cord locking system



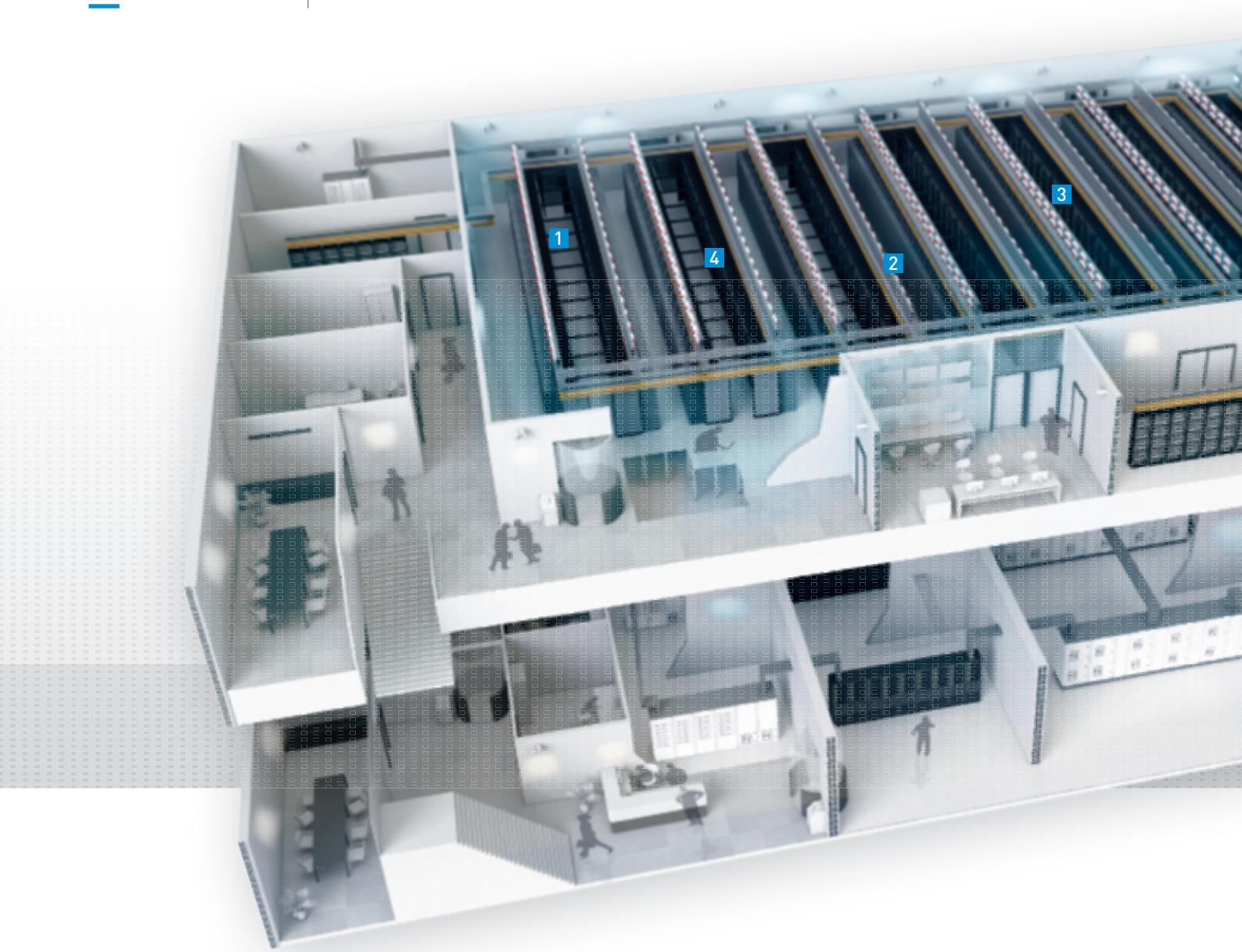


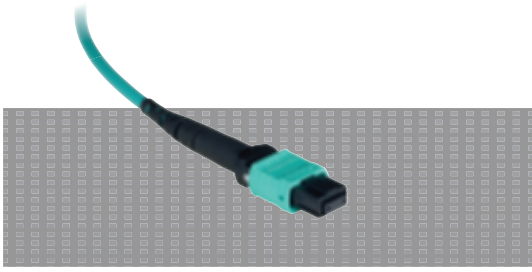
1 LCS³ solutions
→ SEE P. 32/39

ENTERPRISE
PRODUCTS
SOLUTIONS

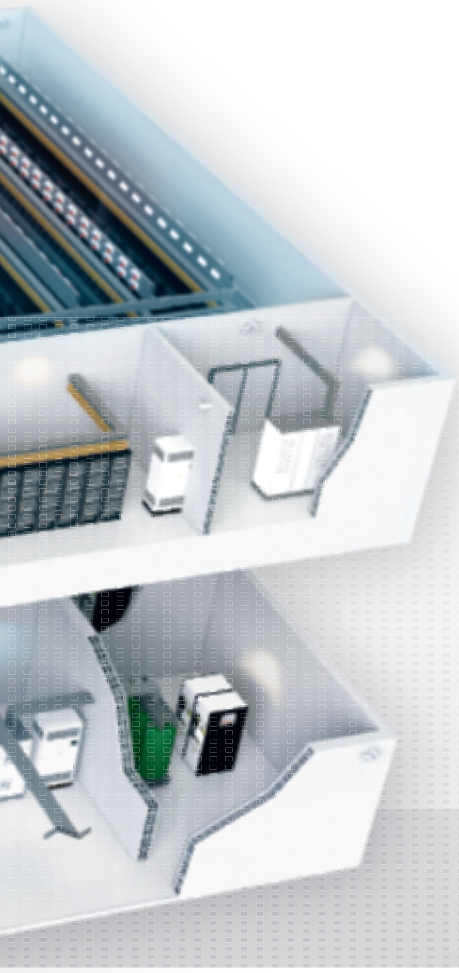
2 Modular UPS
→ SEE P. 40

3 KVM-over-IP Switches
→ SEE P. 41



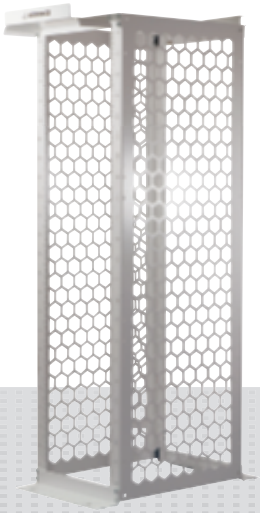


1 MTP/MPO optical fiber solutions
→ SEE P. 32

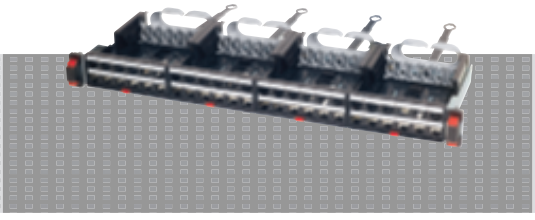


CORPORATE & COLOCATION

PRODUCTS SOLUTIONS



2 Mighty Mo 20 connectivity rack
→ SEE P. 34



3 HD LCS³ solutions
→ SEE P. 32

4 KVM-over-IP Switches
→ SEE P. 41

3 SCALABILITY

OBJECTIVES:

3 SCALABILITY

Context & issues

16% CAGR expected between now and 2026 regarding enterprise cloud spending

In the era of virtualization and cloud computing, enterprise cloud spending is expected to grow at a 16% compound annual growth rate (CAGR) between now and 2026 (source: Wikibon). This rapid growth will have a major impact on how we design our server rooms, with scalability becoming vital. In fact it will be essential for a server room to adapt to constantly changing requirements dictated by the growth in volumes of data.
Conversely, virtualization and cloud computing will have less and less impact on the physical sizing of server rooms. But this temporary phenomenon will be followed by a significant increase which will then necessitate the physical expansion of server rooms. The massive growth in data volumes forecast over the coming years will contribute to this considerably.

REQUIRED FLEXIBILITY OF THE SERVER ROOM

The temporary physical reduction in the size of server rooms will lead to increased energy density due to the use of servers with medium and high density power requirements. Due to the changing needs in terms of numbers of racks and power and the fluctuations that this involves in regard to cooling, it is essential for the design of server rooms to be flexible and scalable.

A MODULAR APPROACH

It must therefore be possible for the capacity of a modern server room to be increased or decreased quickly and easily. It is therefore clear: the building of server rooms requires a modular approach in order to provide an optimum response to current and future needs and to changes in the market.

A modular approach to building a server room involves a great deal more than simply making it easy to add or remove racks: modularity also applies to the energy distribution, the backup power supply, the cooling, the network, etc. This enables the need to constantly adapt the consumption of the server room to the needs of the computer installation.

THE LEGRAND ADVANTAGE

All Legrand Group's data center solutions are designed based on the concepts of scalability and flexibility.

Legrand Group's response

Legrand has therefore developed dedicated solutions for you, providing an infrastructure that is scalable at all levels: from energy distribution to data housing, and including cooling solutions.
These solutions enable you to anticipate needs, so as to make future upgrades possible, and to increase the capacity of the data center so that you can respond to your increasing requirements, in order to optimize the CAPEX/OPEX

SOLUTIONS ENABLING TO:

ANTICIPATE NEEDS FOR FUTURE UPGRADES
→ SEE P. 50

INCREASE THE DATA CENTER CAPACITY
→ SEE P. 52

Modular data center

Anticipate needs

The infrastructure requirements of all data centers have to change, all the more so with the increasing emergence of cloud computing. Anticipating future needs is therefore essential: adapting the physical space in the data center for the envisaged workload and the possible changes is therefore a real necessity.

Legrand recommends that you take the scalability of the infrastructures into account at every stage.

- **When designing the data center**
  Our teams are available to support you in considering this as a whole!
- **When selecting solutions to be implemented**
  This means choosing products that provide access to greater performance with minimum dimensions and which enable you to keep some space in reserve, providing an optimized and scalable area.

DESIGN

Legrand can work with you on the entire design of your infrastructure: the group has a centralised expert department which can provide you with expertise in its various competitive areas, working with you to define technical solutions by looking at the project as a whole, over and above single products.

Our expertise is your assurance of having a data center with optimum design, guaranteeing you reliable communication between the various interfaces.

Micro data center solution

CHOICE OF SOLUTIONS

There are two objectives: to optimize the space for optimum performance in minimum space, and to keep some space in reserve so that new devices can be added while the installation is energized.

- **Optimizing the space**

COMPACT PRODUCTS

The LCS³ range provides an infrastructure which supports today's most commonly used protocols on Ethernet and Fiber Channel. It has been designed and produced to optimize space and make future upgrades easier.
It gives you access to higher performance levels without requiring any additional space: the copper system now comprises HD panels that house 48 ports (4 blocks of 12 connectors) in the same amount of space as the 24-port panels, and the HD/UHD optical fiber system offers innovative panels that can house up to 144 connections in 1 U!

As for Legrand's small-sized protection solutions, such as the 4-module 4-pole RCBO, they guarantee space saving with no loss of efficiency!

MICRO DATA CENTER SOLUTIONS

To make you benefit from an efficient and scalable IT infrastructure in minimum space, Minkels and Legrand have developed micro data center solutions. Our experts have brought power distribution, cooling, housing and mechanical infrastructure together in an all-in-one solution. The micro data center solutions offer you a complete and compact server room on which specific modifications can be made to meet your exact needs. Numerous options and accessories are available to expand the infrastructure as your needs evolve!

■ Keeping some space in reserve

PHYSICAL SPACE
It is important to keep some space in reserve in the secondary distribution board to maintain the scalability of the data center. A rack that is large enough to provide sufficient reserve space must therefore be chosen from the outset. With pre-equipped space in reserve, there is no need to switch off the main supply when making modifications to the installation: scalability and continuity of service are assured.

ENERGY DISTRIBUTION
The use of modular UPS, with a chassis with a high enough rating for maximum capacity and equipped with modules for the current requirements, provides a high-performance response to scalability requirements.

The versatility of Legrand's PDU range, available in both standard and customized configurations, offers greater flexibility and responsiveness. The modular design of ZERO-U and 19'' 1-U customized solutions, with expandable outlet and function modules, allows new specific configurations as your needs evolve.

DISTRIBUTION SYSTEM
The scalability of an electrical panel, via its distribution system, is indicated by the 3rd number in the Service Index.

IS XXX

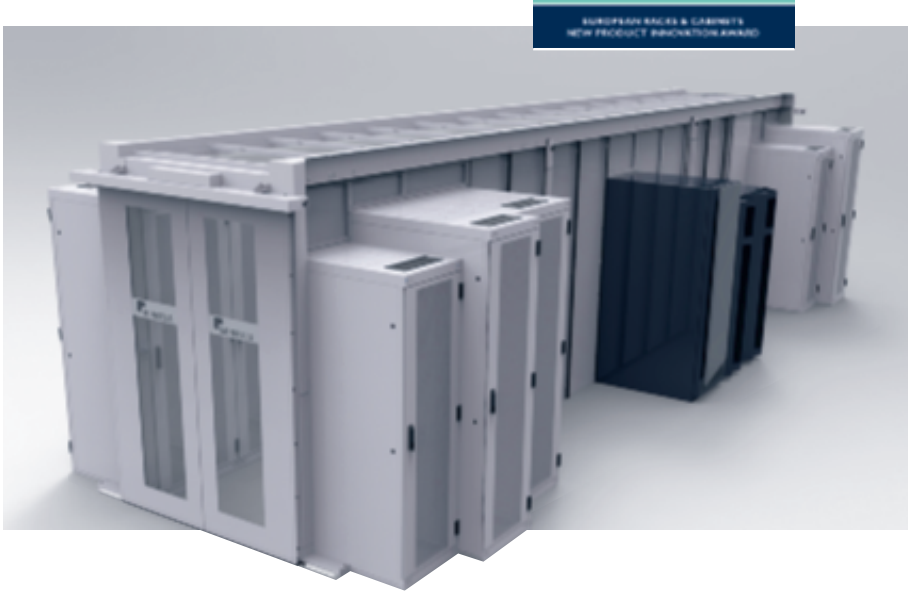
UPGRADING

Determines the capacity of the panel to respond to a future upgrade:

1. Complete shutdown of the panel
2. Interruption limited to the functional unit concerned only. Spare functional units are provided
3. Addition of any type of functional unit in an unequipped location, without powering off the panel

COOLING SOLUTIONS
Minkels' Free Standing Corridor offers you the ultimate freedom to add or switch racks, or integrate equipment and racks with abnormal dimensions during the product's life cycle.

The self-carrying character of the Free Standing Corridor offers a large number of advantages, among which:
- ultimate modularity: you can install, remove or change the racks quickly and easily,
- optimal flexibility: you can fit different types and sizes of racks, for example for storage and network equipment at a later time.
- optimal system integration from day 1: you can, for example, fit all integration parts for monitoring, security and the extinguishing system before placement, even for the racks which have not yet been installed.



MINKELS REWARDED AGAIN IN 2015!

With its strong overall performance, Minkels has earned Frost & Sullivan's 2015 European Racks New Product Innovation Award!

Increase capacity

Since IT equipment requirements change, the infrastructures must adapt to your requirements and allow upgrading without disturbing the operation of the existing installations.
Some systems incorporate this concept:
- using a particular technology (modular UPS system)
- by design (cold aisle containment, PDU and structured cabling, electrical distribution in the computer room)
- by means of standards (eg: IS standard for distribution panels).

Scalability requirements in regard to capacity, resulting in increasing numbers of servers, concern 3 main areas:

- **Connection**
  Various systems are necessary, from solutions pre-fitted with connectors to Hot Plug solutions for IT equipment, as well as high density solutions and flexible electrical distribution.
- **Power**
  Increasing the capacity of a data center involves the installation of power solutions which combine adaptability and high performance both in terms of the architecture and their technical characteristics.
- **Cooling**
  Thermal high density solutions provide continuous cooling of the equipment!

NOTE

When adapting an infrastructure in order to increase a data center's capacities, it is essential to control capital expenditures (CAPEX), which can be substantial.
This is possible by resorting to solutions which allow an evolution of capacities at the rate of the data center's real needs. Implemented in a modular design, these solutions will limit the engendered operating expenses (OPEX), all the while controlling scalability and availability.

CONNECTION

Digital infrastructure
The LCS³ system provides solutions with small copper and optical fiber cables prefitted with connectors.

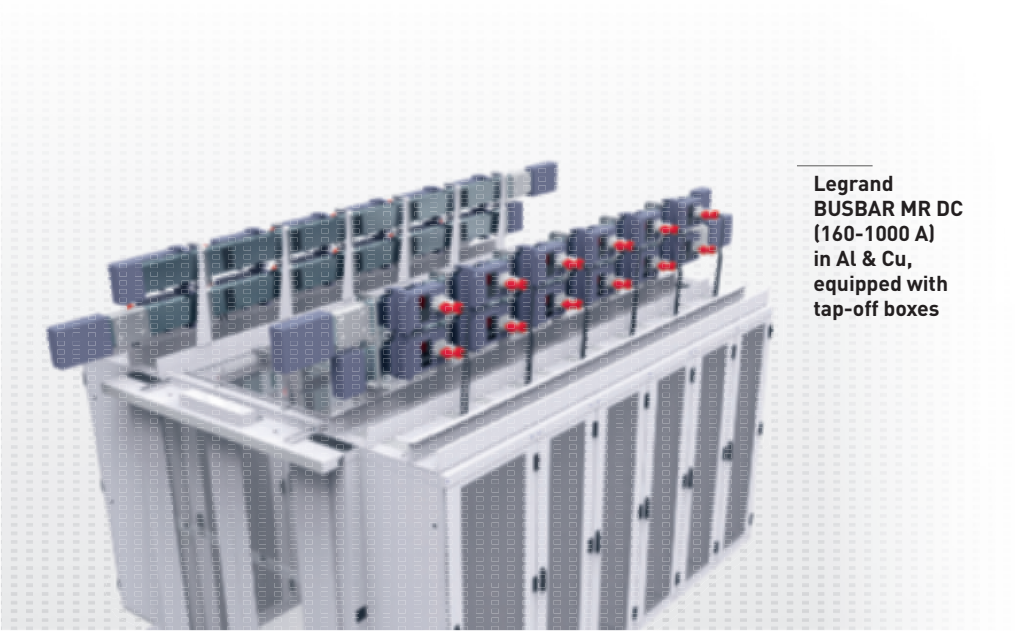
LCS³ solutions can be installed at the top of the rack, by fixing on cable trays, which increases the flexibility of the installation and the server rack capacity.

To be noted: LCS³ links, either with bare cables or cables pre-fitted with connectors, can perfectly be added in an installation equipped with the EZ-Path cable routing system. (for further information, see p. 65)

High Density (HD)
HD solutions allow upgrading because they are small. This ensures a high degree of availability of spaces for adding equipment in order to provide higher performance levels.

Electrical distribution for PDUs
This involves choosing the right electrical distribution mode for the PDUs.
For optimized distribution, Legrand recommends a Legrand BUSBAR solution MR DC with tap-off boxes, with or without metering. When it includes metering, this solution is ideal for colocation data centers. The complete unit, which can be connected to the power and to the metering bus while the installation is energized, provides maximum flexibility as its equipment is easy to adapt to the type of power supply required (three-phase/single phase, 32-63-125-160 A).

For small applications, Legrand offers Plug & Play solutions for cable routing and the IS 223 distribution panel. Offering good scalability at an optimum cost, this solution is ideal for enterprise data centers.



Legrand BUSBAR MR DC (160-1000 A) in Al & Cu, equipped with tap-off boxes

■ **"Hot plug"**
This system enables VDI equipment to be connected/disconnected while is energized, with no damage to the installation and with no break in service. (for further information, see p. 36)

POWER

■ **A modular architecture**
With the Legrand range of modular Uninterruptible Power Supplies it is possible to add power and battery modules, and thus to increase the capacity inside the UPS itself. Additional advantage: the connections upstream and downstream of the UPS are already made.
The Legrand range of parallelable UPS enables, together with IS optimized distribution solutions (HX³ range), an additional UPS to be added with no break in service, and provides for the necessary upstream and downstream connections.
With the KEOR HP solution, it is thus possible to connect up to six UPS in parallel to provide very high power capacities.
Note: the physical location of the UPS and some reserve space (unequipped space) must be provided in the electrical panel!

■ **"Hot swap" system**
Legrand UPS incorporate the Hot Swap function which enables UPS to be replaced/added while energized, with no damage to the installation and with no break in service. (for further information, see p. 40)

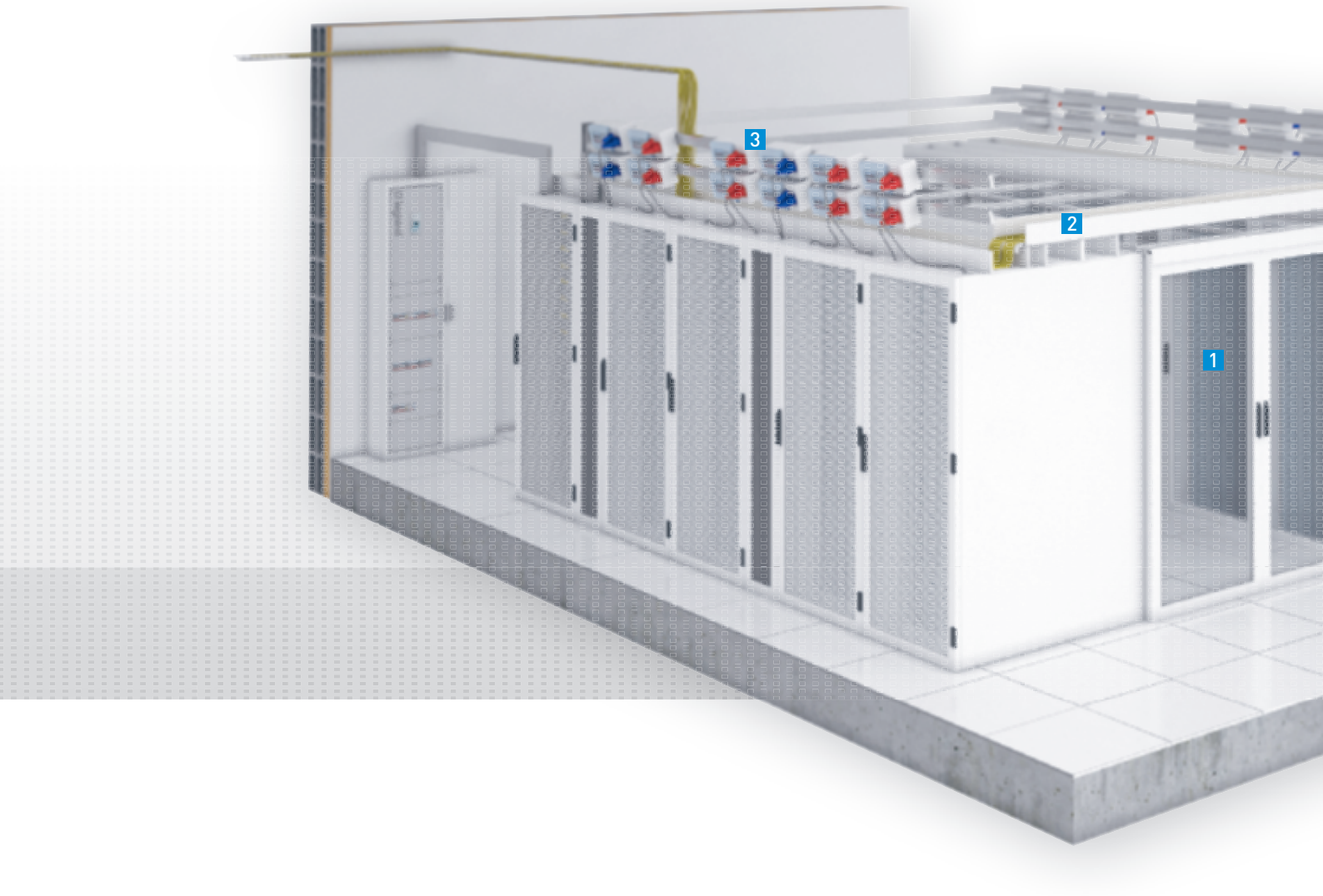
■ **USB and Ethernet Mix and Match Cascading**
Choose the best way to daisy chain up to 8 PDUs using one of the two USB ports of Raritan's iX7 controller. Or leverage the Gigabit Ethernet port for cascading and the free USB ports for other applications.
You can mix and match USB and Ethernet connections, and even include other PX and EMX products as part of the daisy chain.

Archimod UPS with "hot swap" system

■ **Physical upgrading of the white room**
Increasing the number of racks requires the addition of data and electrical connections. It also implies sufficient air conditioning power in the room.

COOLING

Thermal high density solutions provide continuous cooling of the equipment: the assurance of a high-performance building that can incorporate upgrades without any damage! (for further information, see p. 12)

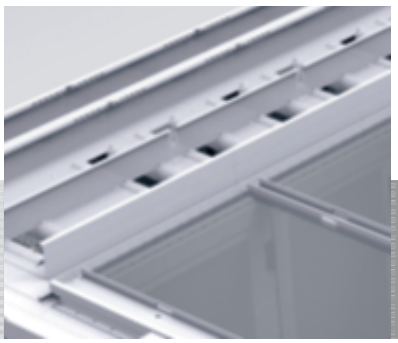


You can also opt for Micro Data Center solutions

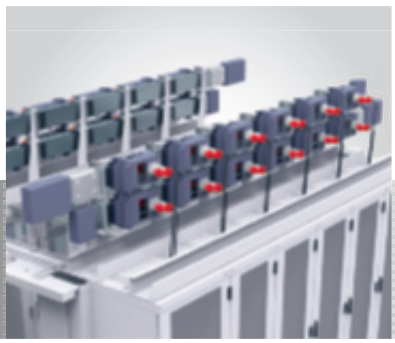
→ SEE CORPORATE/COLOCATION PRODUCTS SOLUTIONS

ENTERPRISE
PRODUCTS
SOLUTIONS

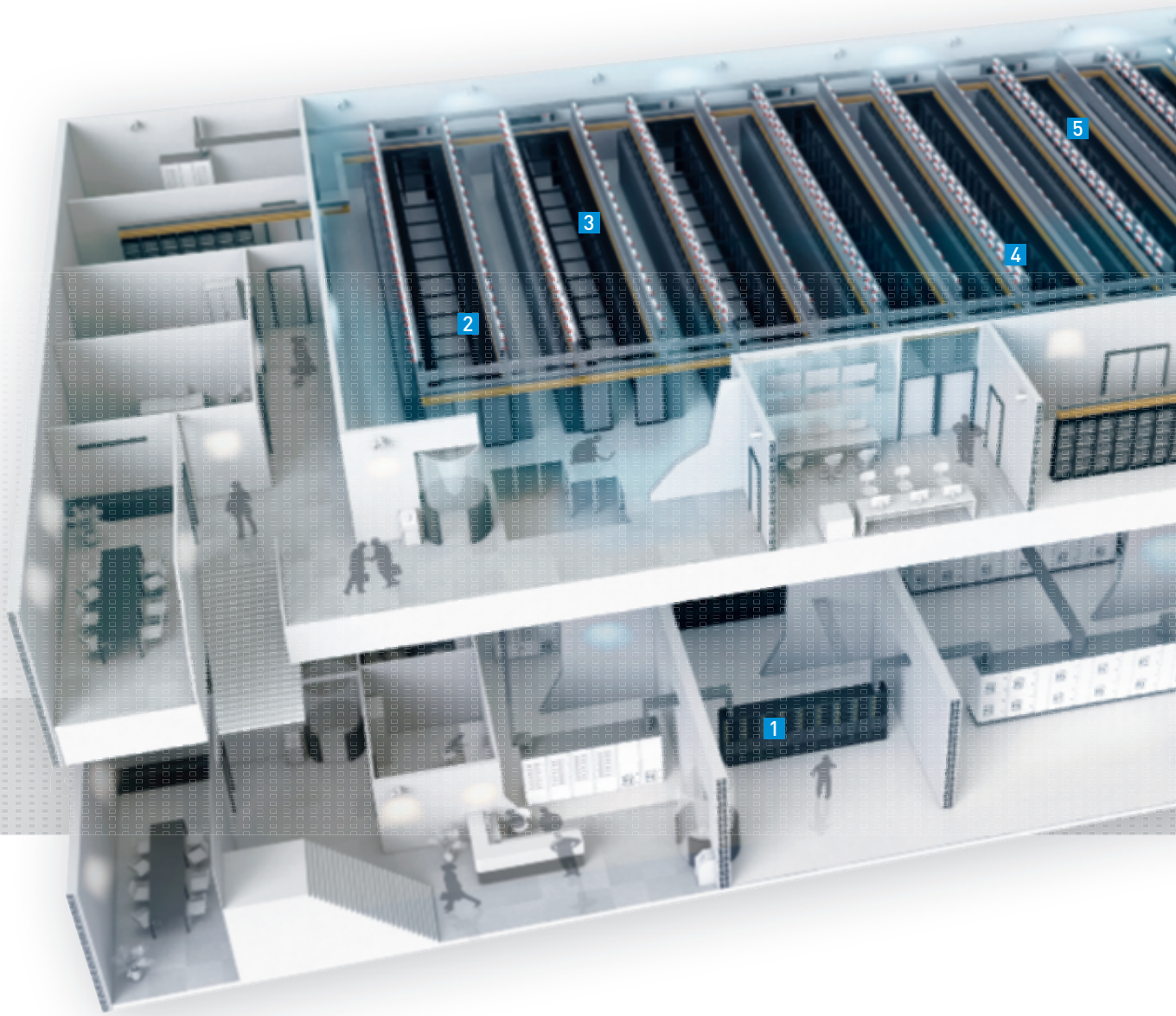
1 USB and Ethernet Mix and Match Cascading
→ SEE P. 53



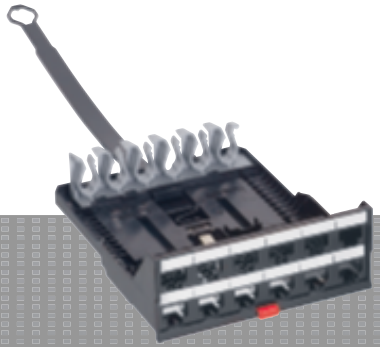
2 Cable management over aisle containment
→ SEE P. 51



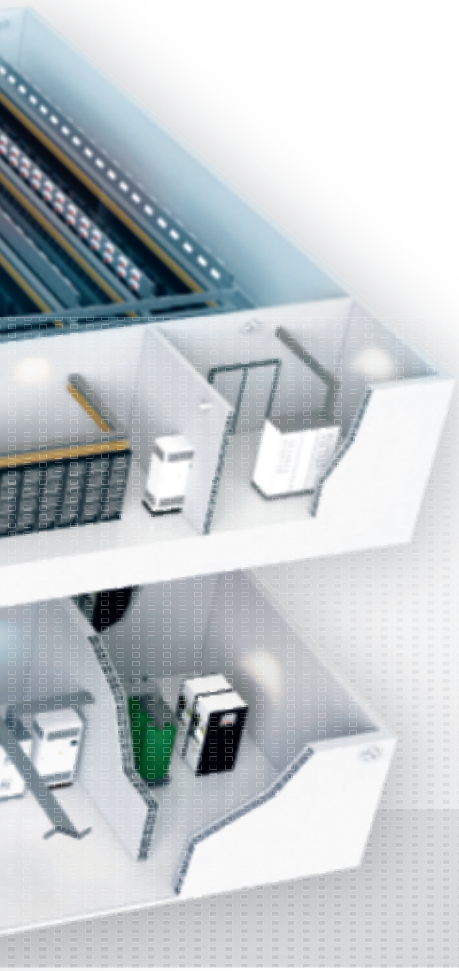
3 Tap-off box over aisle containment
→ SEE P. 52



1 Micro Data Center solutions
→ SEE P. 50



2 LCS³ range
→ SEE P. 50/52



CORPORATE & COLOCATION

PRODUCTS SOLUTIONS

3 Power Distribution Units
→ SEE P. 52

4 Tap-off box over aisle containment
→ SEE P. 53

5 USB and Ethernet Mix and Match Cascading
→ SEE P. 53


safety

4 SAFETY AND SECURITY

OBJECTIVES:

4 SAFETY AND SECURITY

Context & issues

As data centers house strategic data essential to the operation of the companies to which that data belongs, it is essential to ensure the data is protected. For this, two aspects must be considered.

EQUIPMENT

As data security is crucial for any data center owner (or for the owner's customers), increased protection of the equipment on which this data is located must be implemented.

PEOPLE

Since data centers cannot operate without human intervention, whether this is for maintenance or monitoring purposes, it is vital to ensure optimum safety and security for all workers/visitors who need to be on-site or in the data center.

NOTE

In 2015, approximately 10% of the budget for building a data center was allocated to safety and security of the building, with more than half of this being dedicated to fire detection and suppression.

Legrand Group's response

The protection requirements to ensure smooth operation of the data center and the safety and security of people working there are mainly connected with:
- physical intrusion: this involves preventing all unauthorized access, to ensure optimum protection of people and data.
- internal and external environmental events: whether these concern the internal infrastructure of the data center (overheating, fire, electrostatic discharge, water leaks, etc.) or its close proximity (fire, flood, lightning, earthquake, explosion, etc.), numerous risks must be prevented to ensure optimum safety and security of people and the building.

OFFER SOLUTIONS PROTECTING AGAINST:

PHYSICAL INTRUSION
→ SEE P. 62

INTERNAL AND EXTERNAL ENVIRONMENTAL EVENTS
→ SEE P. 64

Protect against physical intrusion

For optimum protection of people and property against any physical intrusion, it must be possible to manage access control at various levels: building, room, aisle, rack, etc.
To do so, Legrand can provide four main product families which ensure optimum safety and security of people and data.

CCTV

Legrand vandal-resistant IP cameras, which can be used both indoor and outdoor, provide optimum video surveillance due to their numerous advantages: compatibility with the ONVIF2 and PROFIL-S protocols enabling use with a global system, coverage of a large area, megapixel images, direct viewing/action, traceability, etc.

For further information, see www.datacenter.legrand.com

STANDARDS

Each data center is assigned a protection class according to its type, environment, the criticality of the data and the customers' requirements. This class defines the type of access that is authorised, as indicated in the following table:

TYPE OF PROTECTION	Class 1	Class 2	Class 3	Class 4
Protection against unauthorized access	Public or semi-public area	Area that is accessible to all authorized personnel (employees and visitors)	Area restricted to specified employees and visitors Other personnel with access to Protection Class 2 have to be accompanied by personnel authorized to access Protection Class 3 areas	Area restricted to specified employees Other personnel with access to Class 2 or 3 areas have to be accompanied by personnel authorized to access Class 4 areas

Source: standard EN 50600-1

NOTE

As the levels of requirements are very variable in colocation data centers, especially in a context in which the use of new technologies is playing an increasing important role, Legrand provides it expertise and support to help you select exactly the right solutions.

From badge and fingerprint readers for access control to supervision systems, Legrand offers you optimum solutions

Locking cap system

ACCESS CONTROL

■ Access to the location

Badge and/or coded keypad systems, possibility of installation per room, compatibility with the WIEGAND protocol enabling combination with a third-party system: the range of centralised Legrand readers provides numerous functions to ensure a location is totally secure.

■ Access to the rack

For critical situations, it is highly advisable to use a locking system on each rack.
Legrand racks with lockable doors provide the assurance of an electrical installation that is protected under all circumstances.
These solutions include RFID badges, coded keypad and fingerprint systems.

■ Access to the power supply

Legrand's PDU locking cap accessory allows you to control access to the power supply. The locking cap is used to lock the access to a socket: a special key is required to unlock it.

For further information,
see www.datacenter.legrand.com

SUPERVISION

Legrand CCTV and access control systems which have their own supervision tools can be integrated in third party software for overall management of the data center.

For further information, please consult us

ASSET MANAGEMENT

Raritan's Asset Management Tags (AMTs) and Asset Management Sensors (AMSs) provide data center operators an accurate, automated, real-time inventory of all IT assets and their locations, down to the 1U level. Alerts can be set to indicate the moment an asset leaves its physical location.

For further information,
see www.datacenter.legrand.com

Protect against Internal and external environmental events

The data center can be protected against internal environmental events (overheating, fire, electrostatic discharge, water leaks, etc.) and external environmental events (fire, flood, lightning, earthquake, explosion, etc.) both by installing detection solutions and by using products which ensure safety and reliability due to the way they operate or the way they have been manufactured.
This protection against internal and external environmental events can be managed at various levels: building, room, aisle, rack, etc.

STANDARDS

The class defines the level of protection applied:

TYPE OF PROTECTION	Class 1	Class 2	Class 3	Class 4
Protection against an internal fire	No special protection applied	Critical datacenter function is secured in case of events	Entire datacenter function is secured in case of events	Entire datacenter function is secured in case of events, even during the maintenance of the fire protection system
Protection against any other internal event or against an external event	No special protection applied	Mitigation applied	Mitigation applied	Mitigation applied

Source: standard EN 50600-1

In addition to the specific standards, it is also essential to comply with the safety standards for electrical installations (IEC 60364-X series of standards) for the selection and installation of equipment, the protection of people, and the safety and security of the installations.

Likewise, all live products (servers, switches, etc.) incorporated in the racks must comply with standard IEC 60950 on the safety of information technology equipment, to which reference must be made.

TECHNICAL DETECTION

Smoke, temperature rise, flood or water leak in air conditioning units, etc. are incidents which can have serious consequences on the operation of the data center.

The comprehensive range of Legrand technical detectors, which can be used with sensors (optionally integrated), enables alarms to be raised quickly and a fast response.

Raritan's environment sensors allow you to maintain proper humidity levels (thus avoiding electrostatic discharge problems), detect any water leak and secure your racks.

For further information, see www.datacenter.legrand.com

EMX Environmental Rack Controller

NOTE

With the Legrand solutions, you can use a gateway to collect all the data received!

ELECTRICAL PROTECTION

Short-circuits, overloads, voltage peaks, etc. are electrical events against which protection is provided by circuit breakers. It is important to provide total discrimination between the various levels of protection and a very high level of selectivity.

Compatible with all Legrand PDUs, a surge protection module protects equipment against overvoltages. As for ZERO-U PDUs, a power supply cord locking system (for C13 and C19 outlets) guarantees absolute safety.

For further information,
see www.datacenter.legrand.com

CABLE ROUTING

The EZ-PATH mechanical firestop caulking system provides optimum protection against fire spreading, whatever the load factor of the cables.

Because it enables cables to be added or removed without affecting its firestop performance, it is particularly suitable for infrastructures requiring modifications to the electric wiring, and ensures durable, flexible and sealed cable routing in installations.

For further information,
see www.datacenter.legrand.com

POWER

The power devices are key components in a data center, and particular attention must be paid to their safety and security. It is essential to manage the risks concerning these devices, using:

- **Optimum manufacturing techniques**

The manufacture of the insulating parts of Legrand transformers and capacitor banks using vacuum pressure moulding avoids any risk of fire breaking out, compared with manufacturing technologies using oil for cooling.

- **Capacitors in compensation systems**

These do not contain oil or gas and have a triple safety system, comprising fuses and pressure monitoring devices. The materials used comply with standard UL94V2. This helps to limit the risks of fire as much as possible. The capacitor banks can also optionally be equipped with smoke detectors.

- **Optimization of the electricity system**

Management of the harmonics in UPS will, for example, provide a better quality system, for greater durability of the electrical infrastructure.

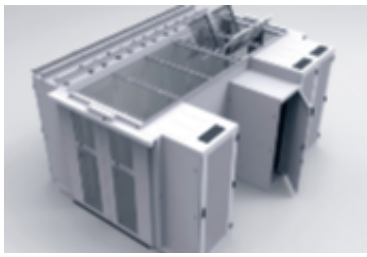
- **Residual current monitoring**

By measuring current flowing in the ground wire, the residual current monitoring option (available on several of Raritan's intelligent PX PDUs) reduces the risk of electric shock. Residual currents generate a system alert, keeping technicians safe!

For further information,
see www.datacenter.legrand.com

Surge protection module

Drop Away Panels



Pivoting roof active (remote activation)

FIRE SUPPRESSION

If a water fog or sprinkler fire suppression system is used in the white room in a containment situation, it is necessary to ensure suppression of the fire (in the event of an alarm) via an opening in the roof.

For this purpose, Minkels elaborated two highly efficient solutions incorporated in the cold aisle containment systems:

- an opening roof system, either automatic above 50°C or controlled electronically.

- Drop Away Panels FM APPROVED: they ensure the seamless integration of aisle containment solutions with sprinkler or water mist systems. In the case of a fire in the data center, the plastic Drop Away Panels automatically soften and fall down so that they do not form an obstruction when sprinklers are activated. The system is specifically designed for use with sprinkler installations.

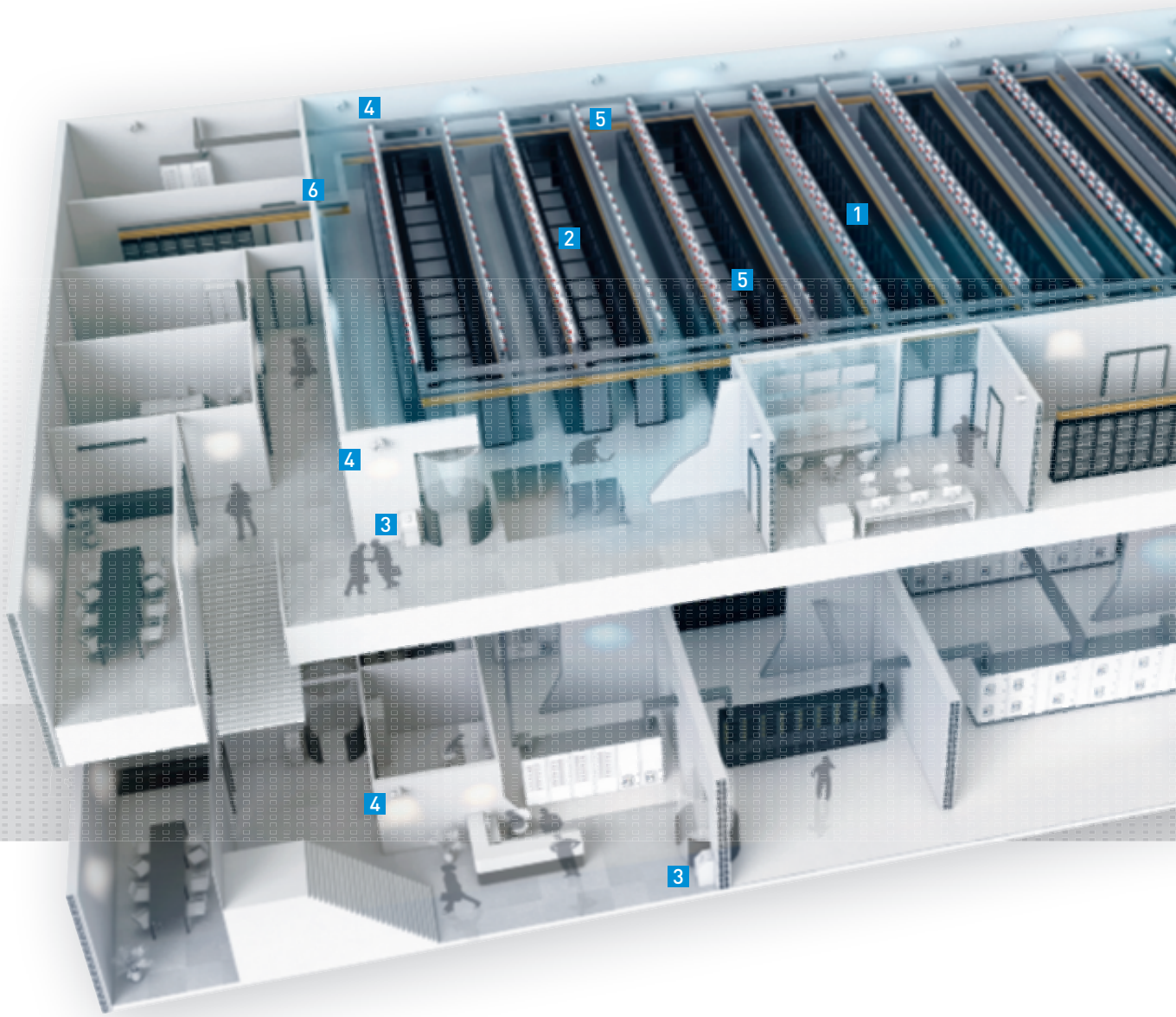
For further information,
see www.datacenter.legrand.com

LED LIGHTING

Minkels energy-efficient LED Tubes deliver improved visibility in data centers, providing a safer and healthier working environment. Safety certification to the highest level (IEC 62471:2006) offers the user a guarantee of exceptional eye protection.

For further information,
see www.datacenter.legrand.com

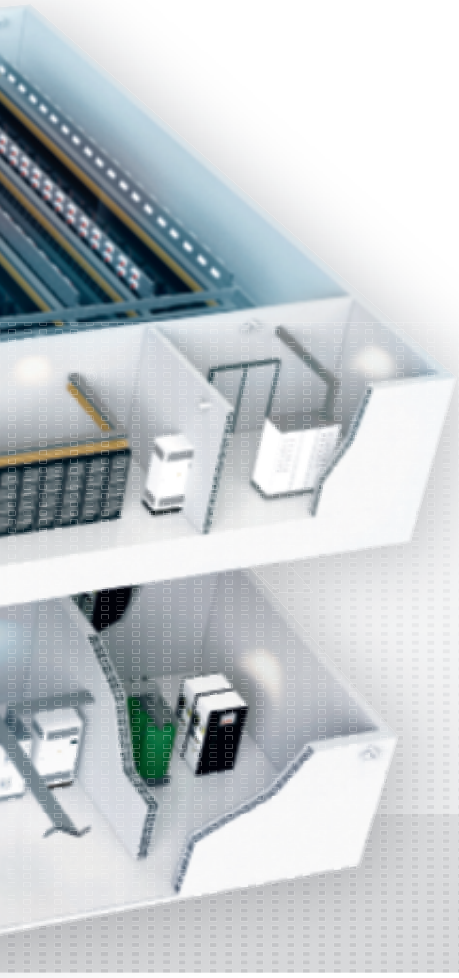
LED lighting



1 LED lighting
→ SEE P. 65

2 Drop Away Panels
→ SEE P. 65

3 Biometric readers
→ SEE P. 63

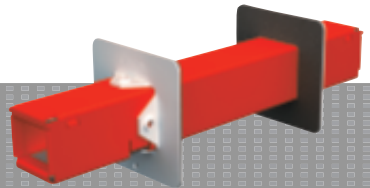


CORPORATE & COLOCATION

PRODUCTS SOLUTIONS

4 IP camera
→ SEE P. 62

5 Environment sensors
→ SEE P. 64



6 EZ-Path
→ SEE P. 65

BEFORE DEPLOYMENT OF YOUR PROJECT

- Design assistance / Tailored design studies
- Software
- Training
- Visits to reference sites / show-room
- Technical documents

DURING DEPLOYMENT OF YOUR PROJECT

- Assistance with implementation and commissioning according to products
- Training for operators
- Training and certification for installers
- Specific support for major projects

IN THE OPERATION OF YOUR PROJECT

- Diagnosis
- Invoicing
- Installation maintenance service
- Software updates
- Warranty extension
- Training for operators and/or service providers

SUPPORTING YOU EVERY STEP OF THE WAY

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