How to Increase Data Center Efficiency

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High cooling efficiency & and reduced power consumption

... enhances the balance between

operational reliability
and
cost-effectiveness!

DC CHALLENGES

The speed of technological change has created significant new challenges for the data center

– Higher demand for processing capacity

– Increase efficiency

– Reduce operational costs

– Higher processing power on smaller physical footprint

– Multivendor systems create complexity

– Security threats emerge daily

DESIGN
WITHOUT LIMITS

Pentair helps you with Schroff modular data center solutions to meet your goals with an systematic approach!

EFFECT of lower efficiency

Data Center challenges affect Efficiency …

- **AVAILABILITY**

- **REDUNDANCY**

- **SECURITY**

SUSTAINED
TEMPERATURES
ABOVE 93°F REDUCE
ELECTRONIC EQUIPMENT
FUNCTIONAL LIFE

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Measuring Data Center Efficiency:
PUE & DCiE

- **PUE – Power Usage Effectiveness**

  - Equals Total Utility Power / IT Power

  - The lower the number the better

- **DCiE – Data Center infrastructure Efficiency**

  - Equals IT Power / Total Utility Power

  - Shown as XX% -- high XX% = more efficient

- **DCiE is the inverse of PUE**

  - See chart

- **PUE and DCiE are measurements that help to easily understand how Data Center efficiency**

PUE = Total Facility Power / IT Equipment Power
DCiE = IT Equipment Power / Total Facility Power

PUE	DCiE	Level of Efficiency
3.0	33%	Very Inefficient
2.5	40%	Inefficient
2.0	50%	Average
1.5	67%	Efficient
1.2	83%	Very Efficient

Thermal failure is root cause for 55% of all equipment failures

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Looking at The Server cabinets First …

- **The main challenges are …**
  - air separation
  - blanking panels
  - cable management
  - static load
  - dimensions
  - accessories

- **Different IT equipment needs to be supported!**

# How to make your server cabinets efficient?

For every 18 degrees Fahrenheit (10 degrees Celsius) that internal cabinet temperatures rise above normal room temperature, the life expectancy of the enclosed electronics drops by 50 percent.

—Uptime Institute

- **The server cabinet must …**
  - support your cooling concept
  - adapt to your environment
  - host and protect several generations of IT equipment
  - contain the cable management

- **Example for a small change**
  - the installation of cabinets painted light grey, 75% less lamps had to be installed for room lighting!

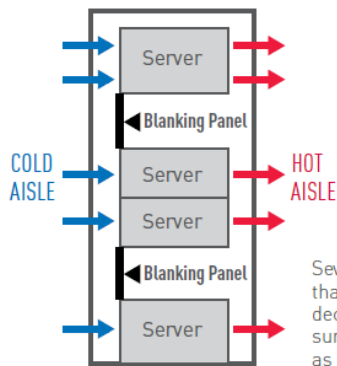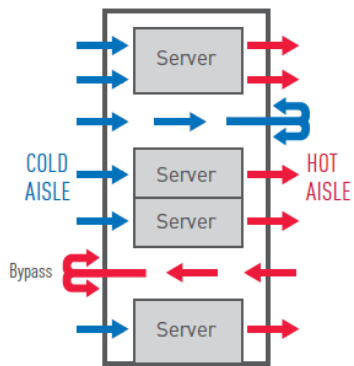# Sealing your server cabinets is basic ...
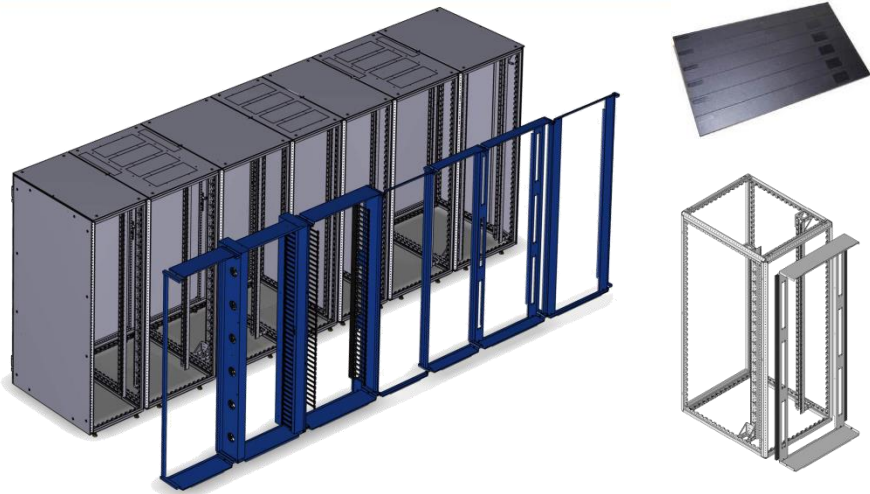
- **Little changes have big effects ...**
  - close every open space of the cabinet
  - use air baffles with cut outs and brush strips for front2rear cabling
  - use 19" blanking panels, they are available in many dimensions
  - **at any time!**

Airflow BEFORE installing blanking panels*

COLD AISLE — Server — HOT AISLE

Bypass

*Bypass air mixes with hot exhaust air.

Airflow AFTER installing blanking panels

COLD AISLE — Server — HOT AISLE

Blanking Panel

Several studies have shown that blanking panels can decrease the air temperature surrounding IT equipment by as much as 15° to 20° F.

- **Don´t let cold and hot air mix up ...**
  - the difference of cold and hot air is crucial for the efficiency of your cooling system!

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This leads to aisle containments ...

CONTAINMENT SYSTEMS CAN INCREASE ENERGY EFFICIENCY BY AS MUCH AS 70 PERCENT OVER TRADITIONAL HOT AISLE/COLD AISLE SYSTEMS

- **Containment is state of the art!**
  - preventing recirculation by separating cold and hot areas inside Data Centers
  - balancing temperatures inside the aisle in front of the cabinets

- **At least, cooling efficiency is to optimize "air management"!**
  - project example: due to the consequent separation of cold and hot areas we achieved **30% energy savings** in a customer data center!

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# Containment - What needs to be considered?

- **Automatic aisle sliding doors**
  - pay attention to emergency exits

- **High transparent aisle covers**
  - the room lightning is not effected

- **side2side cooling**
  - use vertical front blanking panels with air guides to the sides

- **Integration of OEM cabinets**
  - use flexible aisle cover systems with universal profiles on top of the cabinets
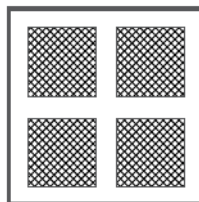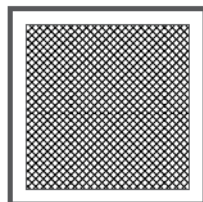
Data center Cooling is a Key Function!

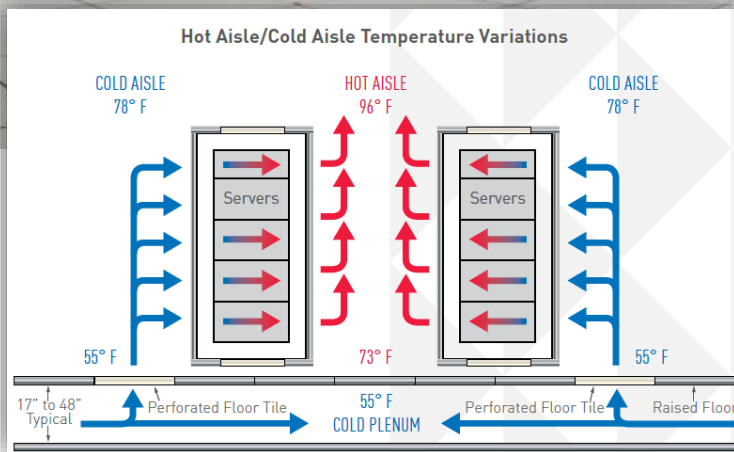Hot Aisle/Cold Aisle Temperature Variations

- **Statement**
  - 55% of equipment down time is caused by thermal failures, but
  - cooling is a significant part of the whole energy consumption of a data center!

- **So cooling must …**
  - be aligned with the used IT Equipment
  - be adapted to the different conditions on site
  - fulfil the requirements on availability and redundancy

But, How to choose the right cooling system?

- **Depending on heat load, inside and outside temperatures …**

	CLOSED CABINET	RAISED COVER, VENTILATION SLOTS	PERFORATED DOORS	19" FANS, TOP-COVER FANS	AIR FILTERED FANS	AIR/AIR HEAT EXCHANGER	AIR CONDITIONERS	AIR/WATER HEAT EXCHANGER (LHX)
	natural convection	free convection	free convection	forced air cooling	forced air cooling	forced air cooling	cooling with coolant	cooling with water
	0	0	55 … 65 dB (A)	34 … 67 dB (A)	39 … 71 dB (A)	55 … 75 dB (A)	50 … 81 dB (A)	50 … 60 dB (A)
	< 500 W	< 500 W to 800 W	< 500 W to 6000 W	< 2000 W	< 1500 W	< 2000 W	< 2600 W	< 40000 W

… various cooling solutions are available to ensure efficient cooling!

Data center cooling options

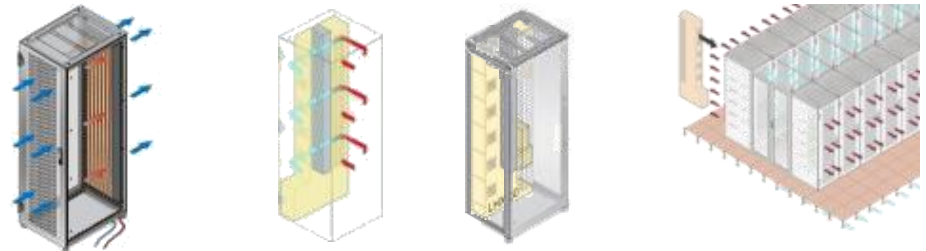| Air Cooling		
Cabinets		Cold Aisle Containment
Passive	Active	
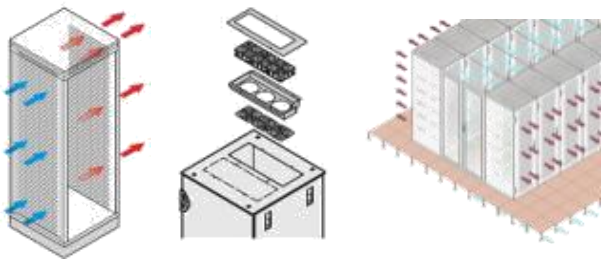
"traditional" ways of data center cooling

»Containment is state of the art!
Up to 30% energy savings are possible
»**However**:
Heat load per cabinet is limited!

Air / Water Heat Exchanger		
Cabinets		In Row Cooling
Rear Door Cooler	Side Cooler	Cold Aisle

Warm air is moved through a water register. The water takes away the heat.

»**Efficient cooling solutions**
»**Higher packing densities per rack possible**

You will reach the BEST cooling efficiency with ..

- **Air2water heat exchangers as InRow or InRackChillers!**

  InRow or InRackChillers increase cooling capacity inside the containment, because ...

  – they are _**where the heat is**_ and ...

  – chilled water has a _**4 times better heat transfer**_ than cold air

Cooling Unit

External Chiller

Front of the Cabinet
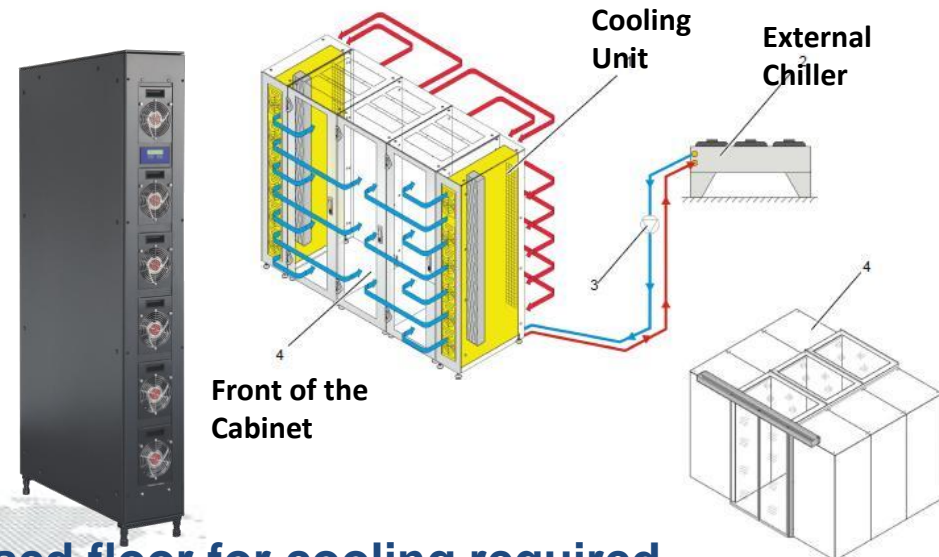
No CRAC unit required, no raised floor for cooling required

Water Cooling, what needs to be considered?

- **Redundancy / availability**

- **Efficient adjustment**

- **Monitoring of critical parameters and alerting**

- **Service and maintenance**

- **Emergency cases / leakage**

- **Scalability**

- **Future needs / prospective cooling capacity**

LIQUID COOLING REDUCES ENERGY COST BY 30-40% WHEN COMPARED TO TRADITIONAL RAISED FLOOR DATA CENTER COOLING
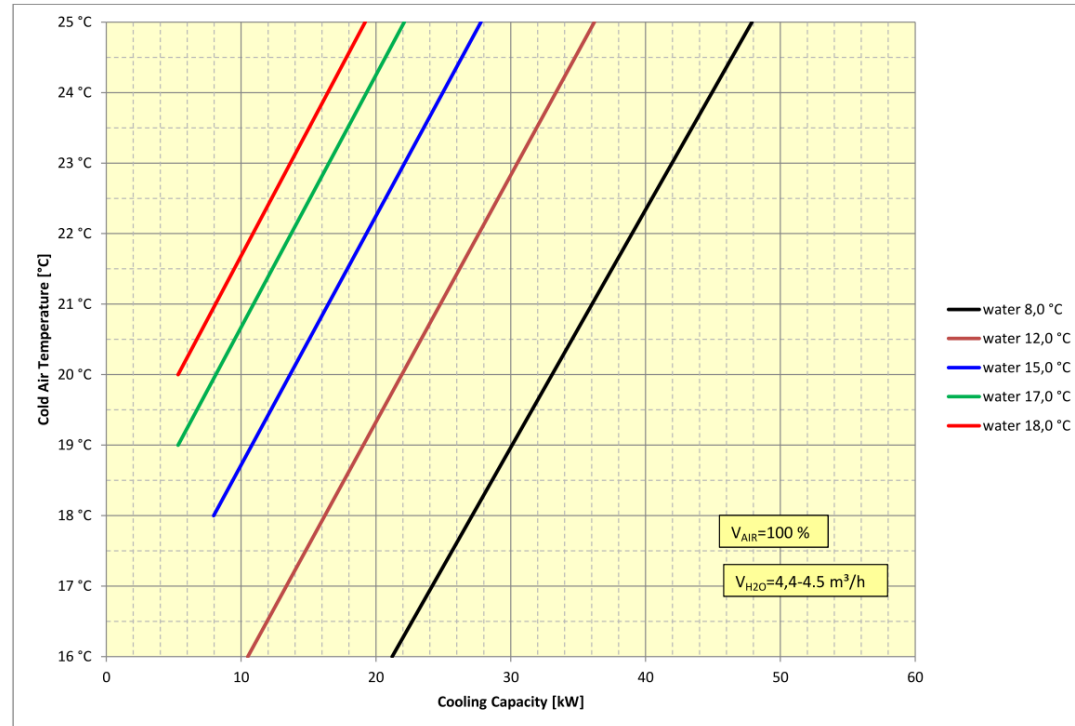
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Cooling Capacity calculation

- **Required data for a quick estimation ...**

    - water entry temperature

    - required cold air temperature inside the containment

    - type of redundancy

- **Real cooling capacity depends on ...**

    - air and water volume

    - temperature difference

    - heat load

    - layout of the DC

29 kW cooling capacity at 22° air temperature with 12° water temperature

PUE / DCiE Activities & Energy Costs

- **Hypothetical Data Center – Typical Hot Aisle / Cold Aisle**

  - 40 Cabinets each with 10 kW IT load

  - Base PUE 2.75 (Traditional non-optimized Data Center)

  - Energy Costs $0.10 / kW Hour

  - Guideline to potential costs for implementing various "Green Activities"
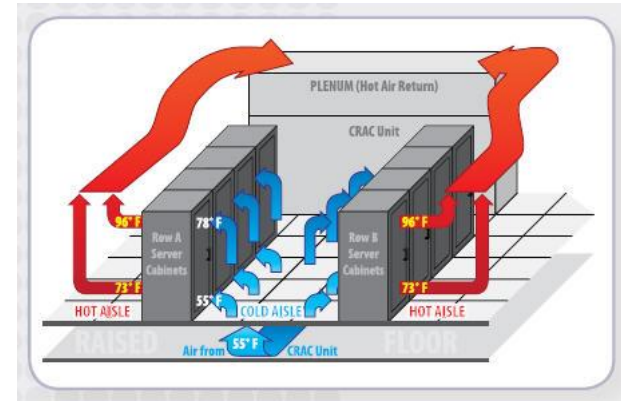
Activity	PUE Impact	Annual Power Usage	Annual Power Cost	Annual Power Savings
Base Hot Aisle / Cold Aisle	2.75	9,636,000	$963,600	
Blanking Panels	2.73	9,565,920	$956,592	$7,008
Floor Brushes	2.70	9,460,800	$946,080	$17,520
Optimized Floor Tile Placement	2.65	9,285,600	$928,560	$35,040
CRAC / CRAH -Duct work	2.62	9,180,480	$918,048	$45,552
Drop Ceiling Plenum	2.58	9,040,320	$904,032	$59,568
Cabinet Layout - Optimized	2.55	8,935,200	$893,520	$70,080
Raised Floor - Optimized	2.50	8,760,000	$876,000	$87,600
Containment Cold Aisle	2.20	7,708,800	$770,880	$192,720
Containment - Hot Aisle	2.00	7,008,000	$700,800	$262,800
Containment - Chimney	2.00	7,008,000	$700,800	$262,800
Liquid Cooling - Stand alone Cabinets	1.75	6,132,000	$613,200	$350,400
In Row Cooling	1.50	5,256,000	$525,600	$438,000

Data Center Cooling Strategies Comparison

- Containment solutions provide lower investment with less complexity for less than 10KW cooling per cabinet (Raised floor is already present)

- For higher number of cabinets in a room with higher heat loss per cabinet – Need added cooling

Strategy	Capital Costs	Raised Floor	Operating Costs/kW	Average Max kW per Cabinet	Reliability (Complexity)
Random (chaos)	$	Yes	Very High	2,500 kW	Very Low
Hot aisle / cold aisle	$	Yes	High	6 kW – 8 kW	Low
Chimney	$$	Yes or No	Moderate	10 kW – 20 kW	Medium
Containment (raised floor)	$$$	Yes	Moderate	15 kW – 20 kW	Medium / High
Closed-loop, ducting, hot and cold containment	$$$$	Yes or No	Low	10 kW – 20 kW	Medium
In-row cooling & containment (heat exchanger)	$$$$$	No	High	10 kW – 20 kW	High
Liquid cooling (heat exchanger)	$$$$	No	Low	20 kW – 40 kW	High
Chip-level liquid cooling	$$$$$$$	No	Very Low	+40 kW	Very High

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SOME NEW TECHNOLOGIES

Electronic Locking Handles

PHYSICAL ACCESS CONTROL

Challenges

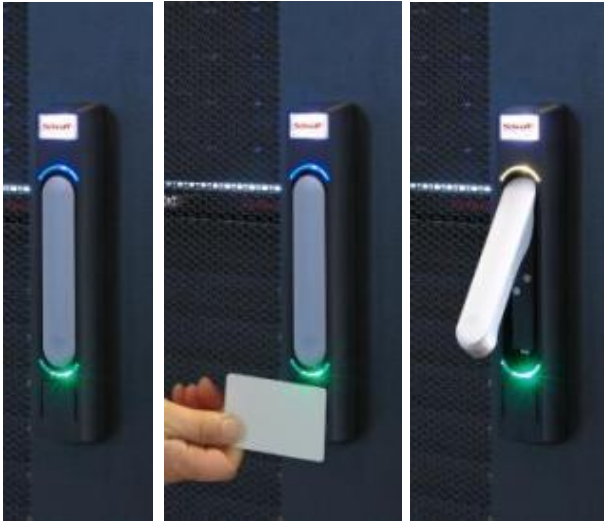– Sabotage protection

– Avoid „failures by accident"

The cabinet is the last protection of unauthorized access!

Access control have to …
– be always controllable
– manage control rights
– document access

Trend ~ High security cabinets within a Data Center

Electronic handles for SCHROFF Cabinets

- Integrated visualization of operating parameters and alerts over LED lights
- Standalone or IP addressable solutions
- Access documentation and control
- Sabotage and vandalism alerts
- HID or Mifare (optional) transponder technology

Short realization time as can be configured with the cabinet and delivered within 10 working days

OPERATIONAL STATUS INDICATION
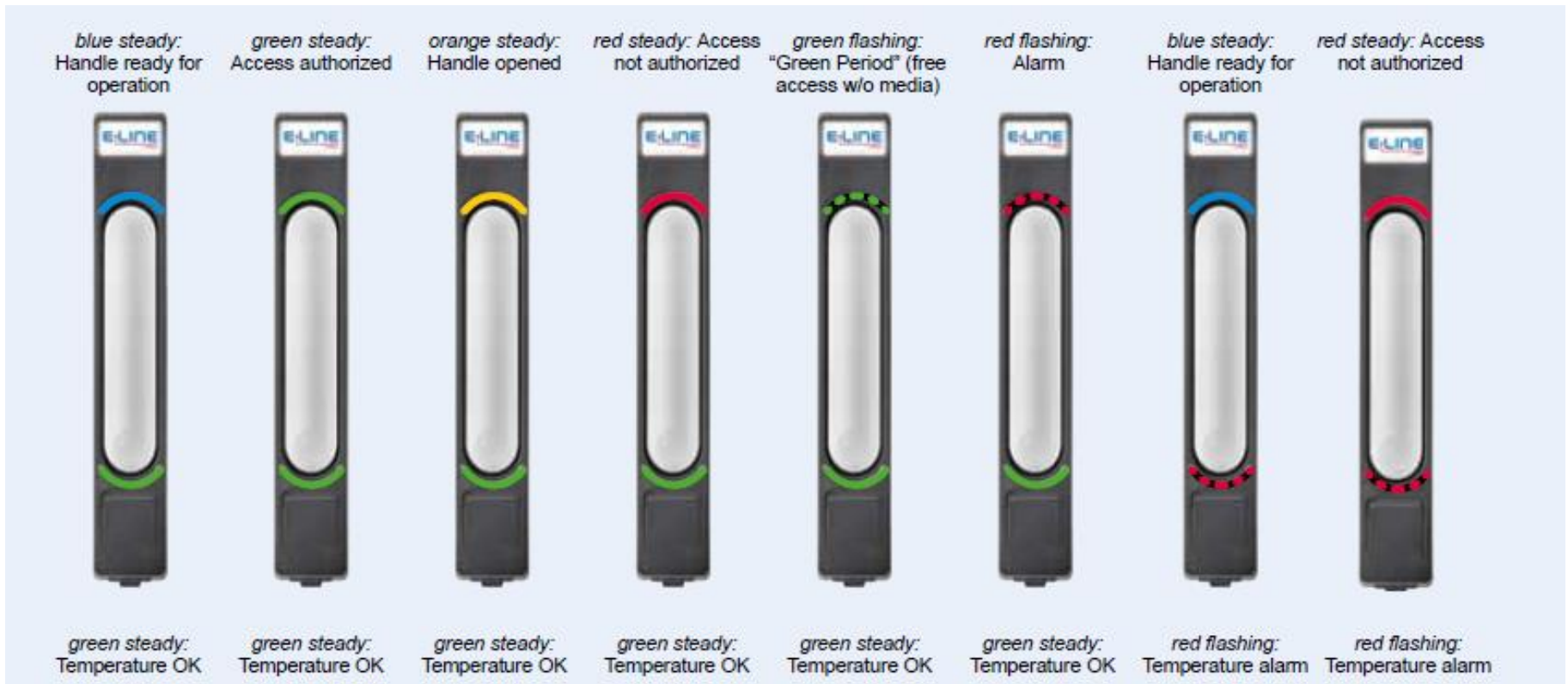
After access authorization handle does not swing out and change status after a defined time frame

The 19" cabinet is not just a Box!

- **Challenges**
  - Static Load
  - Structured Cable Management
  - Air Management
  - Dimensions
  - Security
  - Accessories

But we do not spend enough attention to the cabinet

Purpose of Cabinets

Protect and ensure uptime of the electronic equipment…

PROTECT

Pollution   IP   Temperat...
Salt spray
Vibrations   EMC   Van...   ...ismic   Pressure

SUPPORT

...ty   Usability   Power distribution
Cable Management
Noise pollution   Aesthetics   Thermal management

MANAGE

Temperature   Humidity   Cooling   Access
Condensation   Smoke   Air flow

A Cabinet is not Just a Metal

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CHALLENGES FACED TODAY

- **SALES / PROJECT MANAGER :**
  Why can I often not find a standard kit for my request?

- **END-USER / CONSULTANT:**
  Why I can not find the right solution fitting my requirements?

- **PURCHASE / PROCUREMENT:**
  Why cannot I have multiple choices to chose as per my budget?

SOLUTION :

➔ **Modular standard parts and modification capabilities**

- Standard offering for common products

- Project solutions for more specific specifications

- Quoted and realized project solutions are documented in our records
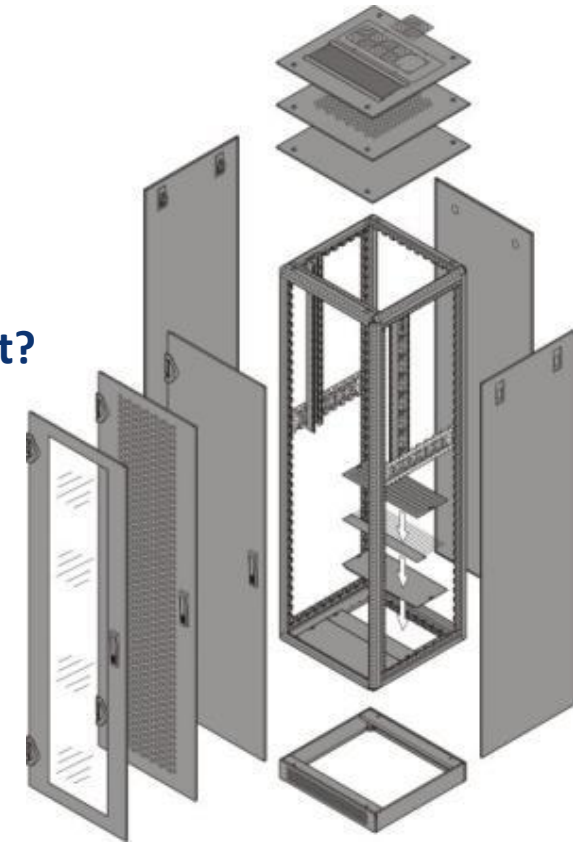
PROJECT REFERENCES

BANK in FRANCE

Project Size 1700k€

- **Brand/sales reputation and references**
  - Reference installations for cabinets and PDUs
- **Flexible standard platforms, that can be easily modified, therefore also best price performance**
- **Right cooperation partner to cover solutions besides the metal**
- **Sales, project management and operations capabilities and expertise**
  - Proactive on customer requests
  - Technically best prototypes
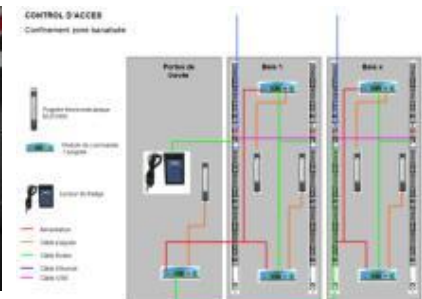
CAR MAKER IN GERMANY

- **Project Size 218k€**

- **Reference installations**

- **Flexible standard platforms, that can be easily modified, therefore also best price performance**

- **Sales, project management and operations capabilities and expertise**
  - Proactive on customer requests
  - Technically best solution
    → Competitor could not fulfill requirements
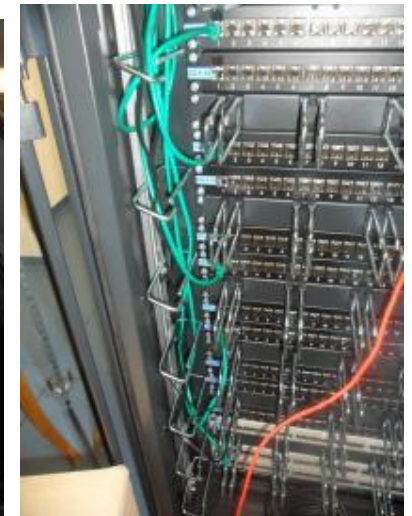

LHX20 footprint

ADVANCED PHYSICS DC

PROJECT DETAILS:

- **Products: Air to water Heat Exchangers**
- Date: 2013
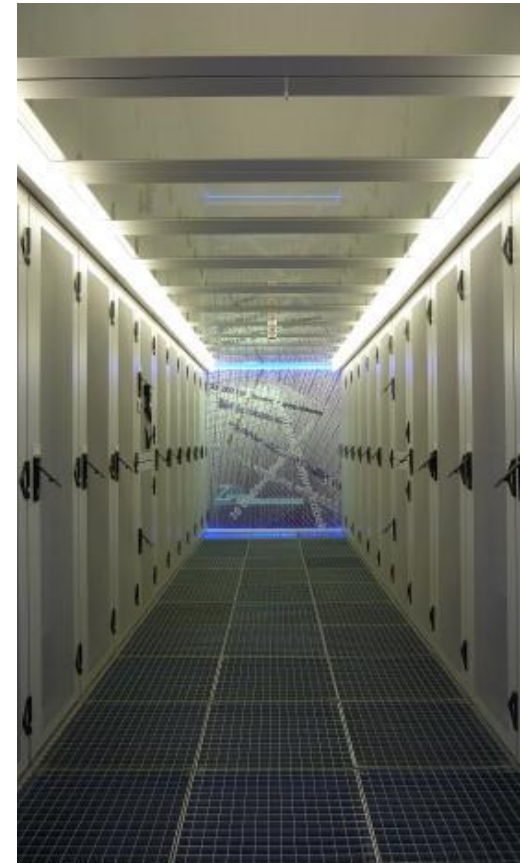- Industry: Seismic Measurements

CHALLENGES / PROJECT DESCRIPTION

- High Performance Computing (during measurements)
- Remote access required (No people onsite)
- Monitoring of cooling units, temperature, power, leakage

Cold Aisle Containment with White color cabinets

COLD AISLE CONTAINMENT IN NORWAY

- **92 Cabinets 47U 800x1000**
  - 60 Server Cabinets and 32 networking cabinets

- **3-phase iPDUs. 2 PDUs in each rack.**

- **7 cold aisle containments**
  - automatic doors and the other end of the aisles were permanently closed with frame + two sidepanels.
  - Prepared for overhead cabling.
  - Modified separating walls with 3 pcs Hoffman rubber grommet 3"
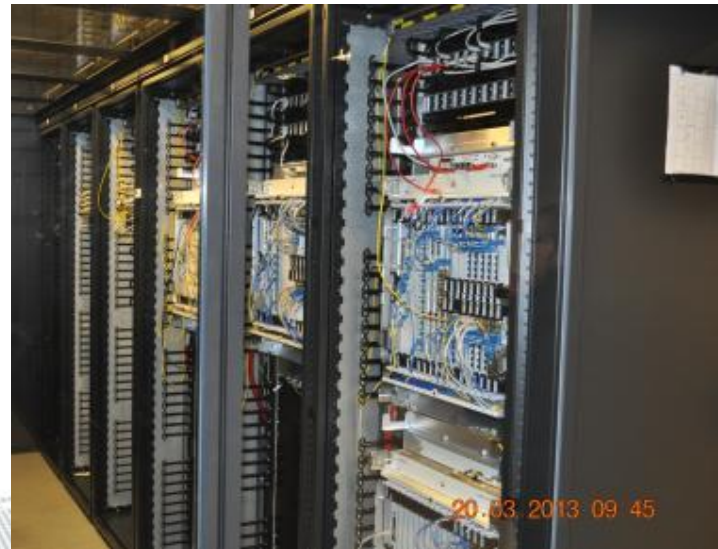 - Customer installed their own card readers for the automatic doors.

ENERGY PROVIDER

PROJECT DETAILS:

- **Products:**   **Cold aisle containment**
- Date: 2013
- Industry: Energy Provider

CHALLENGES / PROJECT DESCRIPTION

- Cold aisle containment cubes
- Defined server cabinet and networking cabinets, with special cable management

Put everything together ...

- Don´t let cold and hot air mix up!

- Use horizontal blanking panels!

- Use gaskets between cabinets and floor!

- Keep aisle doors closed!

- No cabinet doors inside the aisle!

- Use light-colored cabinets!

- Take everything out of the data center, which is not necessary, tables, chairs, packaging!

- Switch lights off automatically!

Some Results ...

- **The difference between cold and hot air is crucial for the efficiency of your cooling system ➔**

  less power usage on the cooling system!

- **The Heat transfer of water cooling is 4 times better than with air ➔**
  less power usage on the cooling system!

- **Containment balances temperatures inside the aisle ➔**

  less power usage on the servers!

- **Better cooling efficiency leads to less power consumption ➔**
  but you can´t manage what you don´t measure!

Questions

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