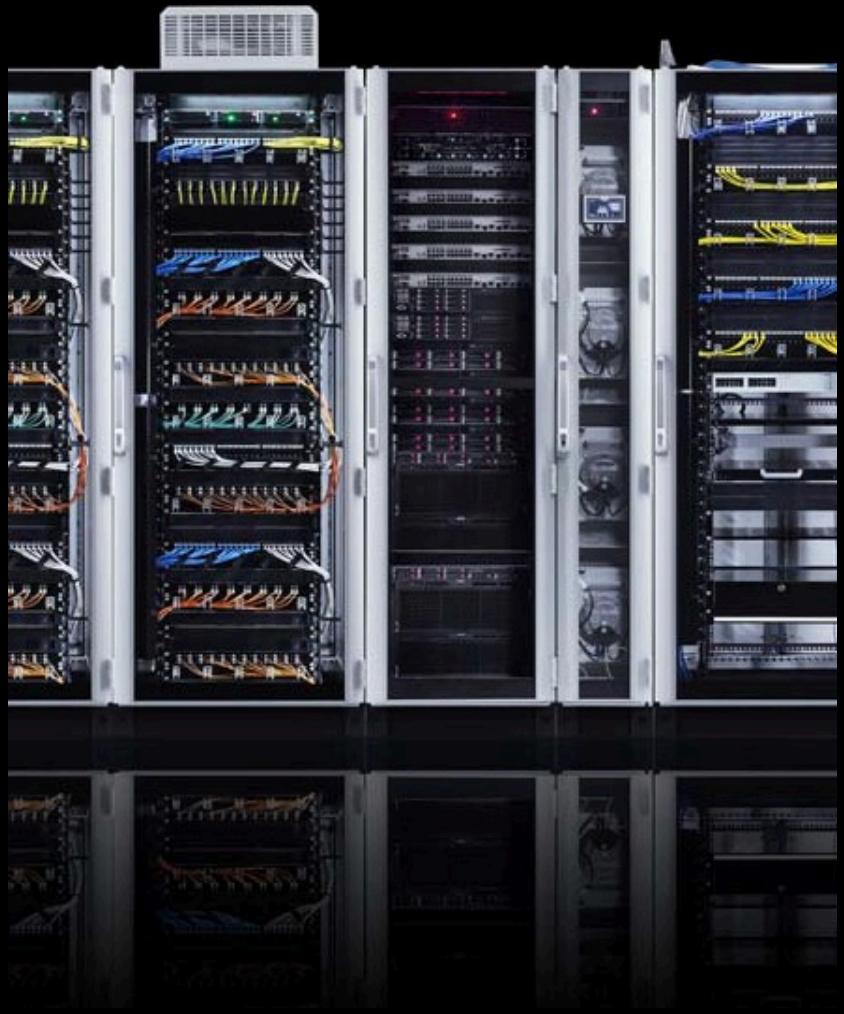
Energy in data center



Marko Ratosa, ICTP

Trieste 2015

- Efficiency
- Uninterruptible Power Supply
- Power Distribution Units
- Cooling
- ICTP Solution/Monitoring

Theory

The overall energy demand in data center can be divided as follows:

- IT server (~ 50%)
- Cooling (~ 35%)
- power distribution (~ 12%)
- lighting (~ 3%)

Theory

Because it is important not only to consider the investment costs, but also to analyse the expected operating costs. In addition to personnel costs, priority must also be given to checking and evaluating the energy costs. For that reason we must talk about the EFFICIENCY.

Efficiency

- Data Centre Infrastructure Efficiency (DCIE)

$$DCIE = \frac{\text{Energy consumption of IT system}}{\text{Total energy consumption of data centre}} \times 100\%$$

- Power Usage Effectiveness (PUE)

$$PUE = \frac{\text{Total energy consumption of data centre}}{\text{Energy consumption of IT system}}$$

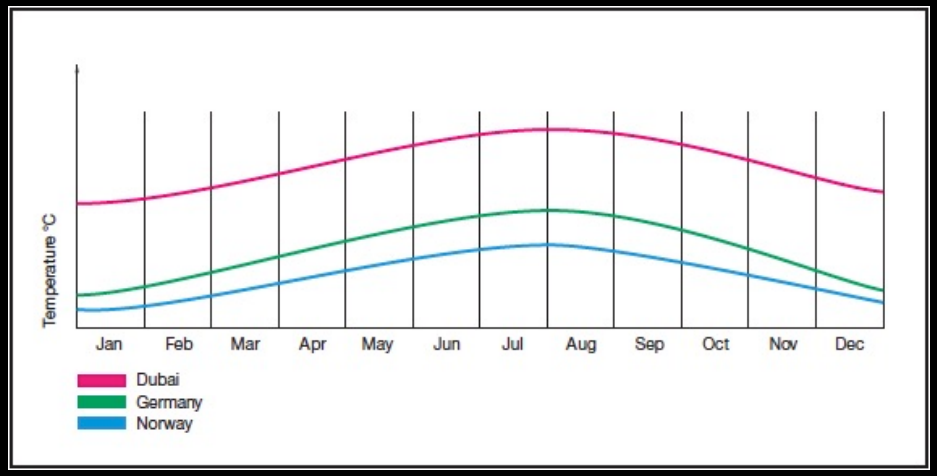
How to increase the efficiency of a data center

- Replace old servers with new
- Use of free cooling systems (using the ambient air for cooling)
- Aisle containment and thereby separating the warm and cold sides in the IT infrastructure
- Cooling using groundwater or geothermal system

Location

Location factors

- Climate and energy costs

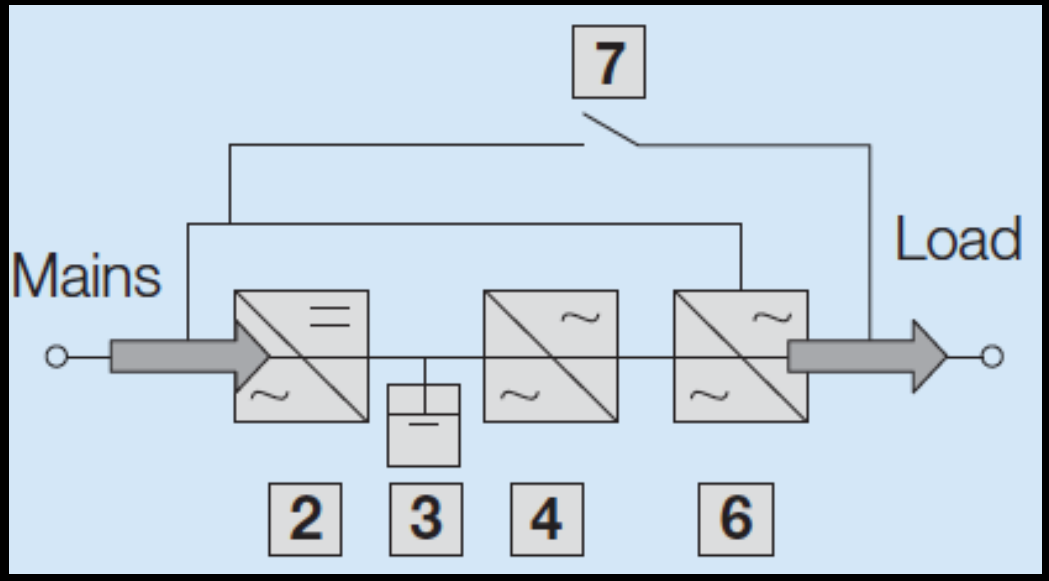


- Buildings, accessibility, skilled workers
- Network connection, taxation and Security

Uninterruptible Power Supply

- Offline UPS system
- Online UPS system

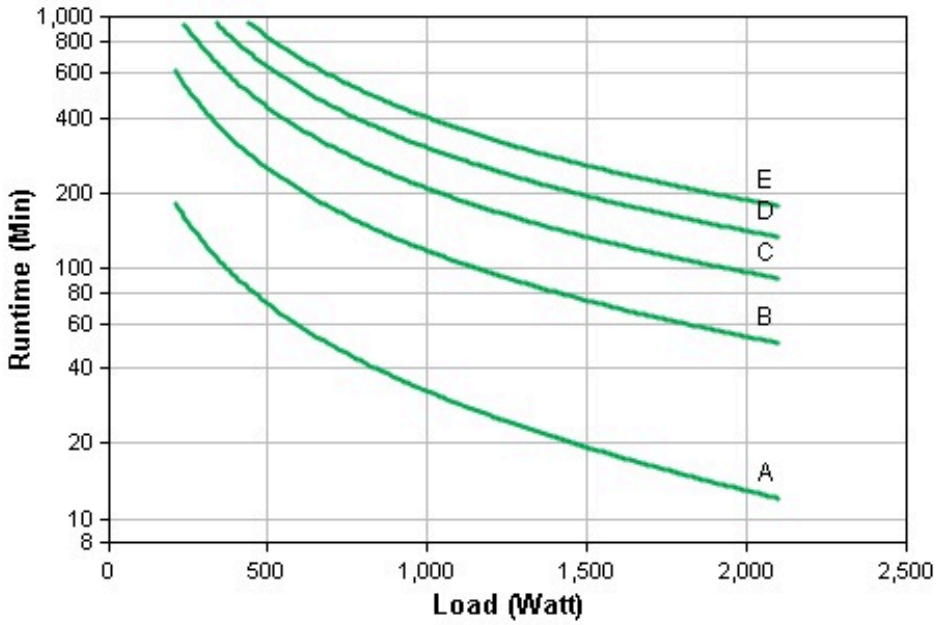
2 … rectifier
3 … batteries
4 … inverter
5 … static bypass switch
7 … manual bypass switch



UPS Batteries

- Dimension

Curve	Part Number(s)
A	SURTA3000RMXL3U
B	SURTA3000RMXL3U + (1)SURT192RMXLBP3U
C	SURTA3000RMXL3U + (2)SURT192RMXLBP3U
D	SURTA3000RMXL3U + (3)SURT192RMXLBP3U
E	SURTA3000RMXL3U + (4)SURT192RMXLBP3U



- Position
- Circuit

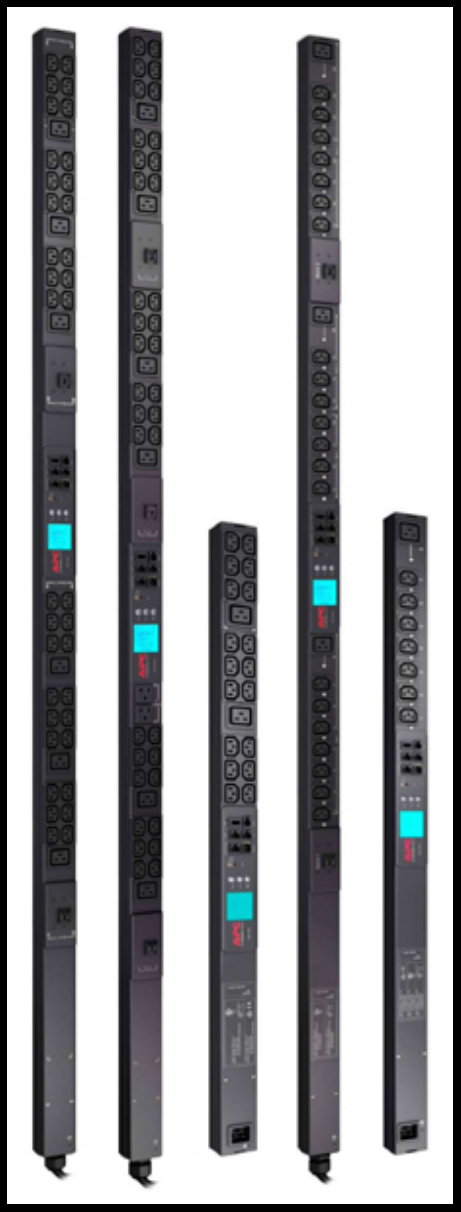
Power management system components

In this group we can put all components that are in the meddle between UPS and IT servers

- Electric conductors
- Line switchers
- Circuit breakers
- Power Distribution Units (PDU's)

PDU

- Un-managed
  - Monitoring
- Managed
  - Monitoring
  - Outlet managing

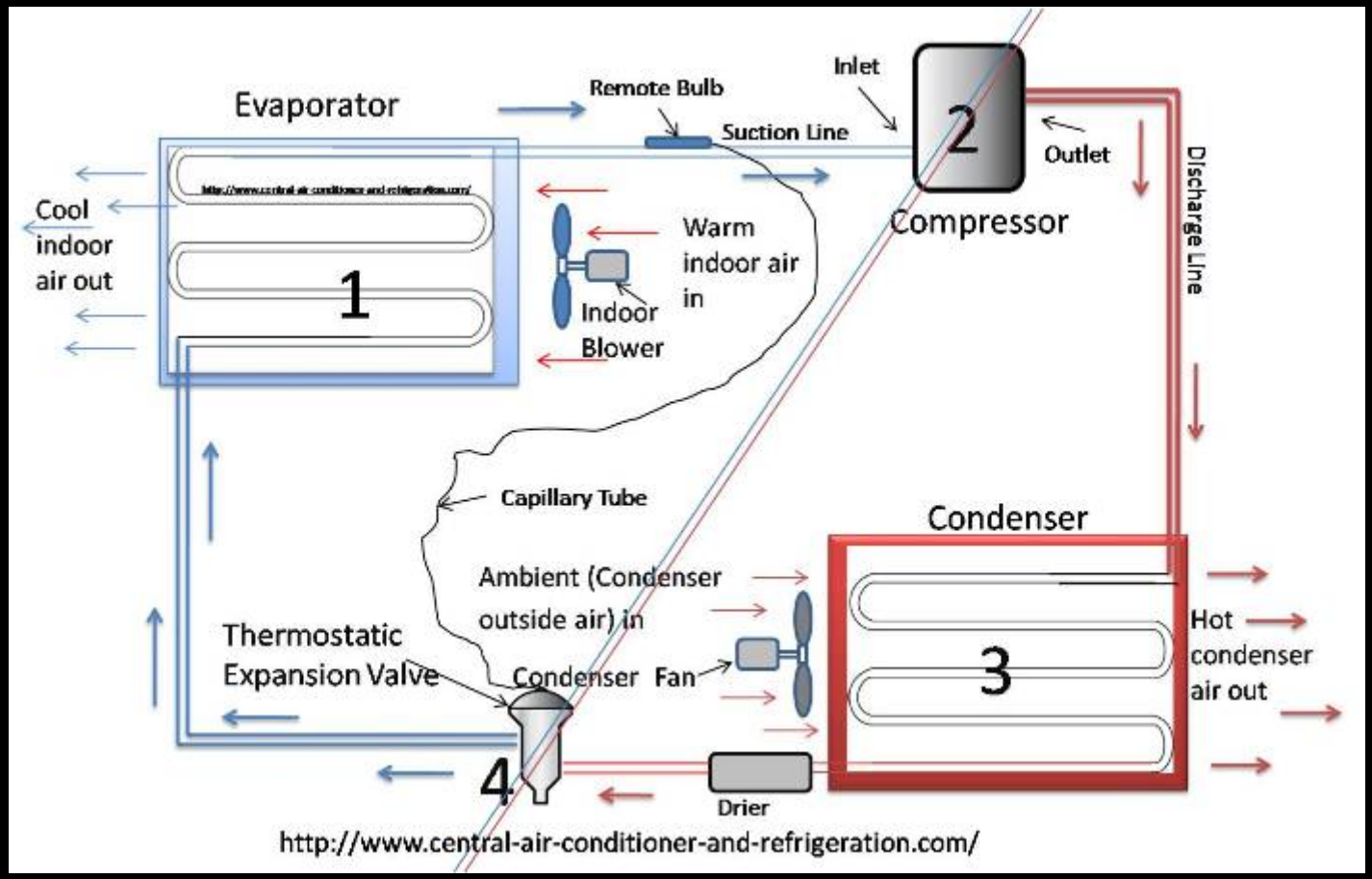


Cooling

- The main operational problem of server rooms is removing of heat produced by servers and other IT equipment
- We can subdivide the cooling in:
  - ventilation systems (climate suitable for humans)
  - air-conditioning systems for heat dissipation (IT cooling)

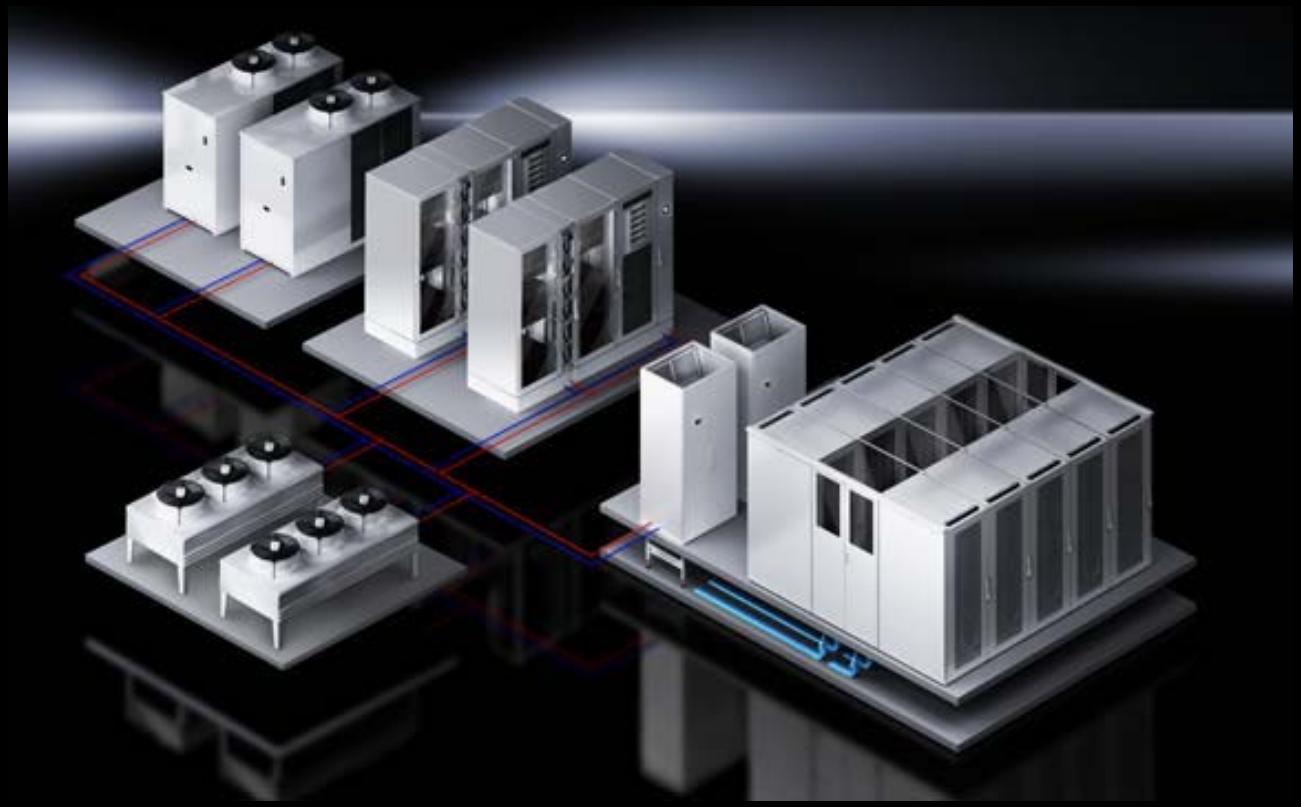
IT cooling

Refrigerator cycle



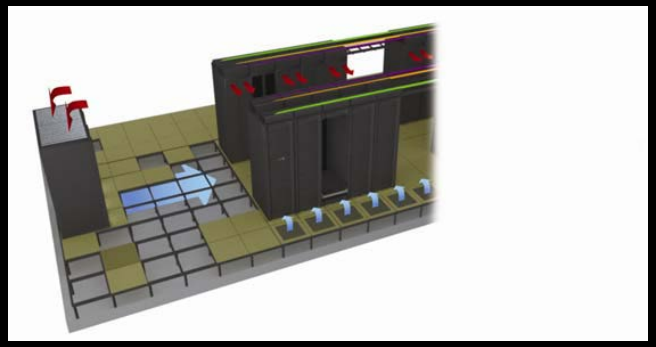
IT cooling

Entire system

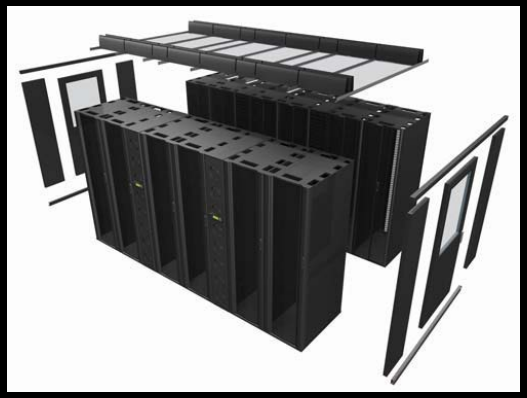


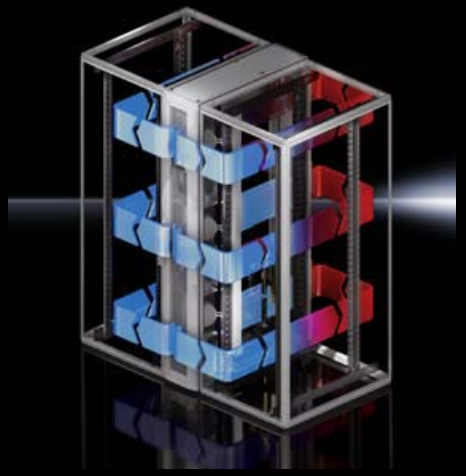
IT cooling

Internal devices



room cooling
row (hot/cold aisle) cooling





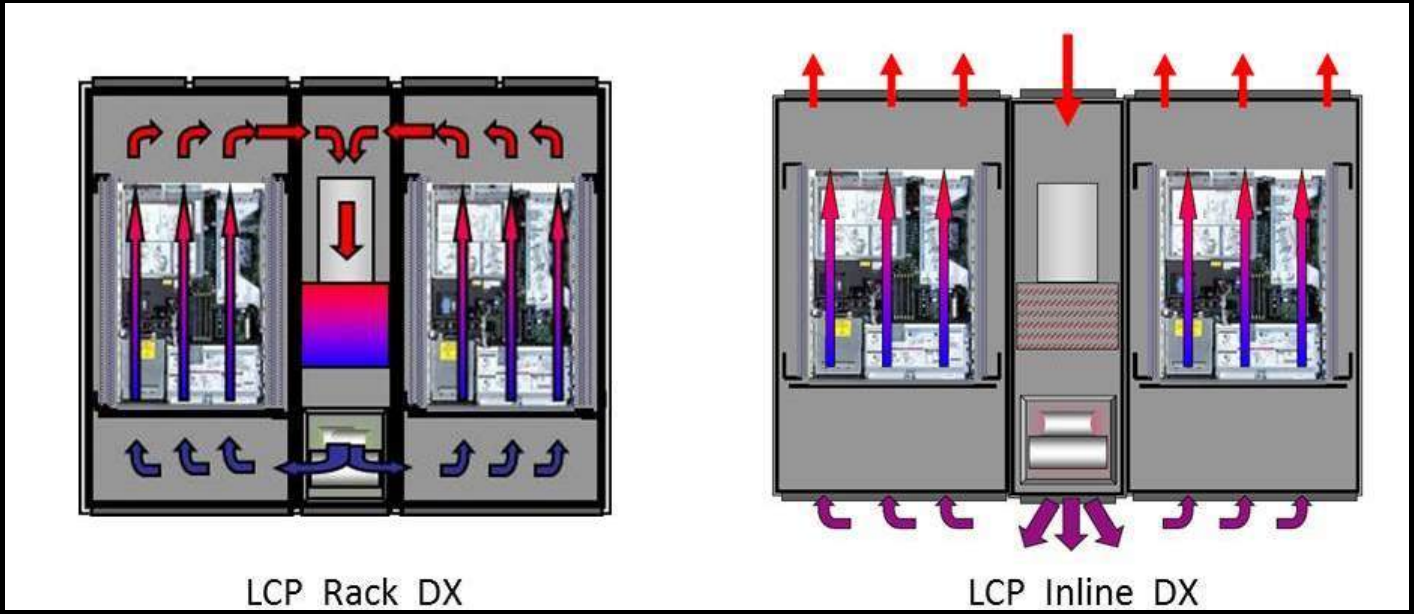
rack cooling

IT cooling

Row/rack cooling

Row Cooling Products						
InRow® Chilled Water Close-coupled, chilled water cooling for medium to large data centers			**InRow® Direct Expansion** Close-coupled, air-, water, and glycol cooling for closets, server rooms, and data centers			
						
InRow RC		**InRow RP**	**InRow SC**	**InRow RD**		**InRow RP**
300mm	600mm		300 mm		600mm	
Up to 30kW	Up to 60kW		Up to 5kW	Up to 10kW	Up to 36kW	
Chilled water			Self-contained	Air-cooled/fluid-cooled	Air-cooled	
Hot Swappable Fans		Humidity Control	Hot Swappable Fans			Humidity Control
Active Response Controls						
Network Manageable						
Real-time Capacity Monitoring						
Variable Speed Fans						

IT cooling



IT cooling

External devices

Chillers Water chilling plants for row and room cooling products	**Fluid Coolers** Heat removal designed to use water or glycol for row and room cooling products	**Condensers** Specifically engineered heat rejection for row and room cooling products
		
50-220kW	**10-86kW**	**10-86kW**
Works with Multiple Cooling Units		One to One Unit Configuration
Microprocessor Controller		
Direct Drive Motors		
Variable Speed Fans	Fixed or Variable Speed Fans	
Scroll Compressor		Flooded Head Pressure Controls
Optional Storage Tank		
Dual Power Input for Pumps		

IT cooling

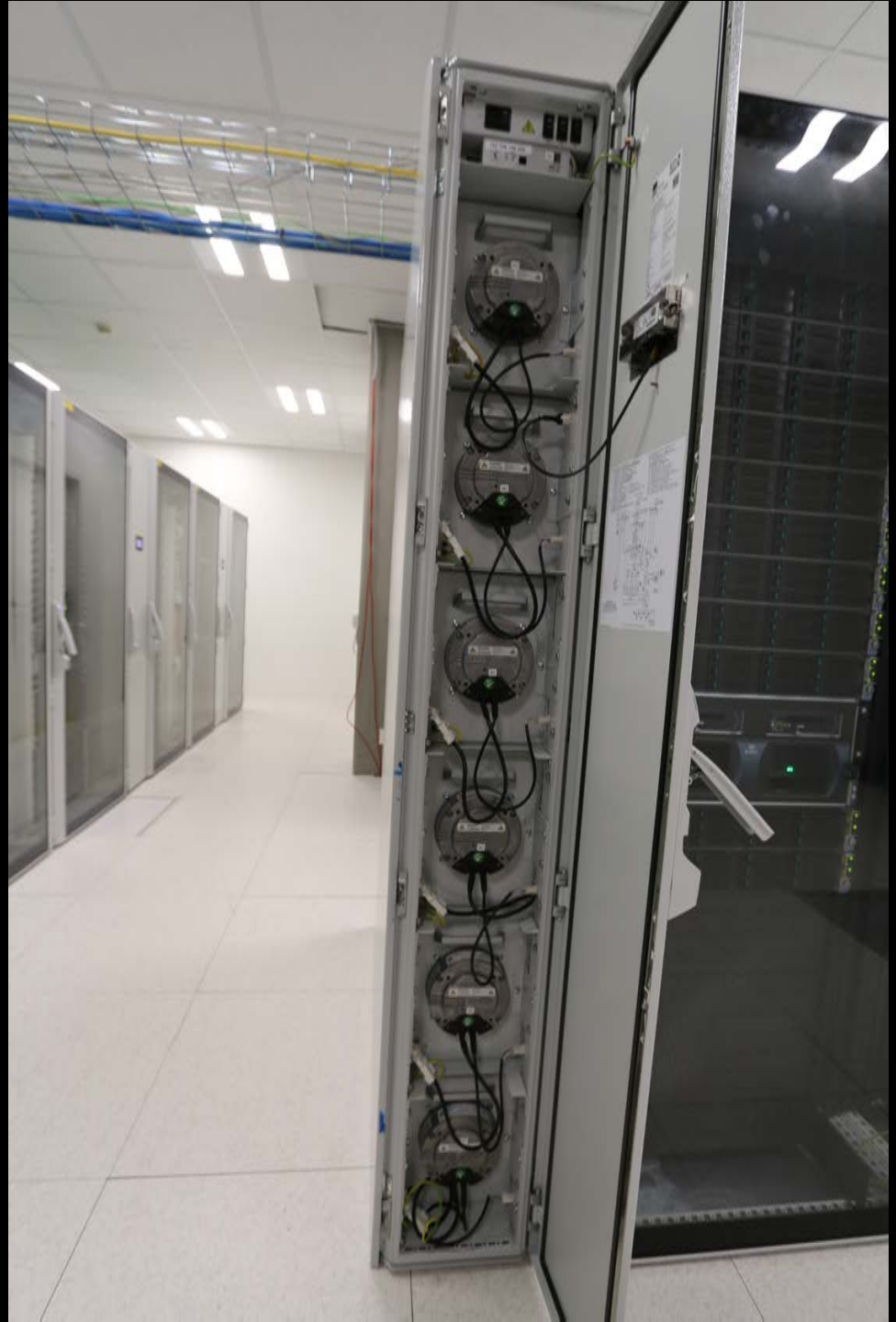
- Pipes
- Pumps
- Transmission Medium
- Reservoir
- Insulation

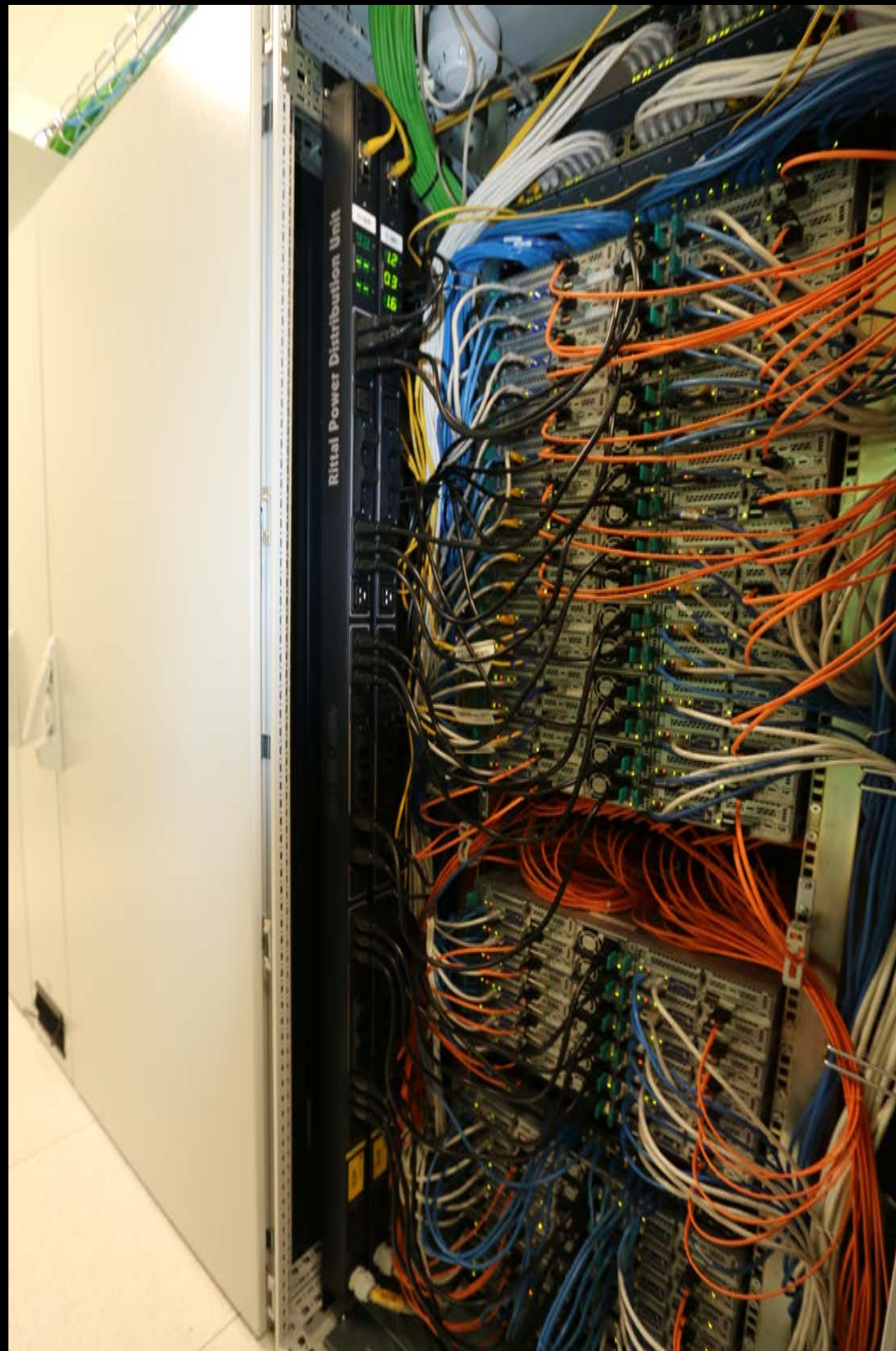
ICTP Solution

- Modernization/upgrade in 2011
- 12 racks for IT devices
- 8 LCP
- 3 chillers
- UPS (100 kVA)
- Each rack at least 2 PDU
- 2 generators (one for IT devices, one for cooling)

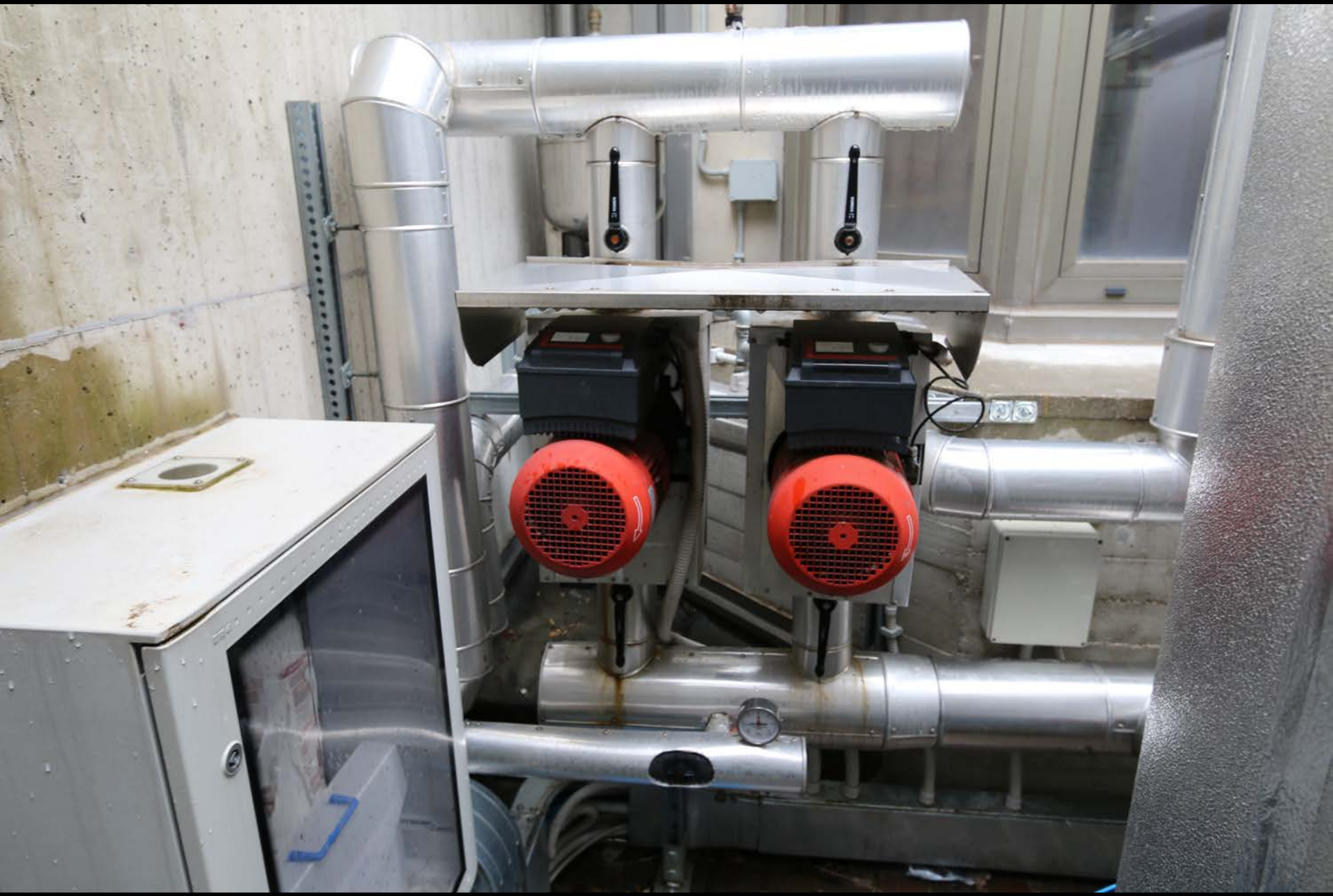

A02


lcp6
RITTAL
System OK
Home
22°C
Temperature
Server-In
15.8 kW
Cooling capacity




Rittal Power Distribution Unit


HIMOINSA




HIMOINSA

Conclusions

- Spend enough time to think also about this systems and non only about CPU, RAM,…
- Usually better systems cost more money but be aware in this case this is not a rule

Literature

- APC: Highly efficient cooling products for any IT application
- Rittal: The world of IT infrastructures
- Internet

END