Planning a Green Datacenter

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Contribution to: **Green IT Crash Course**

Organisator: Green IT Special Interest Group
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Green Data Center (DC)? Why? Energy demand for ICT ?

- ICT consumes a lot of energy and hence is responsible for 2% of the global carbon dioxide (CO_2) emissions.
  - **This figure is equivalent to the output from the global aviation industry !**

  (Gartner, 2008)
- Round 50% of total energy use @ data centers is consumed by the auxiliary infrastructure i.e. air conditioning, cooling and UPS.
- Electricity price is rising -> energy costs could strongly charge IT budget in near future
- Green Datacenter focuses primarily on enhancing energy efficiency.
- Energy efficiency enables reduction of operating costs and sustainable ICT.

Corporate Responsibility Strategy @ Swisscom
-> energy efficient datacenter

By 2015, we intend to increase energy efficiency by 20% compared to 2010:

-> deployment of energy savings @ network and **data centers**

- Swisscom owns and operates 12 Datacenters (2 main and 10 mixed sites)
- Distribution between Hosting/Housing/Cloud for external customers and internal IT

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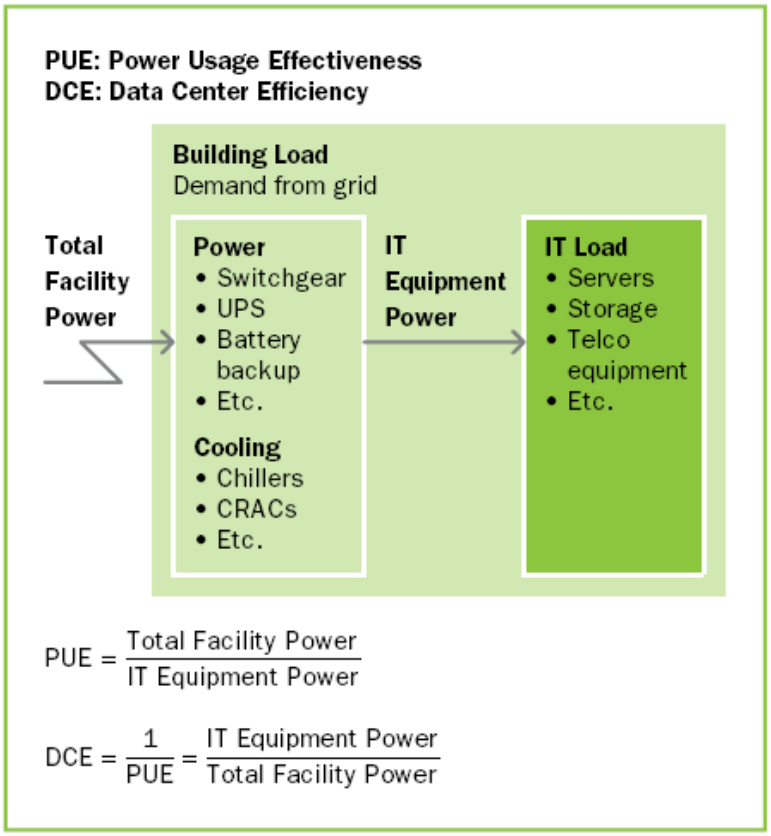
Datacenter metrics: PUE and DC(i)E according to *The Green Grid*



PUE (Power Usage Effectiveness)

$$= \frac{\text{Total Facility Power}}{\text{IT Equipment Power}}$$

- The closer the PUE value is to 1.0, the more energy efficient the infrastructure is.
- An ideal PUE value of 1.0 would imply 100% efficiency.
- According to US EPA study in 2009, average PUE of a sample of 121 DC by round 1.9.

- Other metrics also available, but PUE is currently the most widely used metric for data center infrastructure efficiency
- Measurement point of IT load usually set at UPS output
- Recommended to measure energy for the PUE, thus including time variation of power needs

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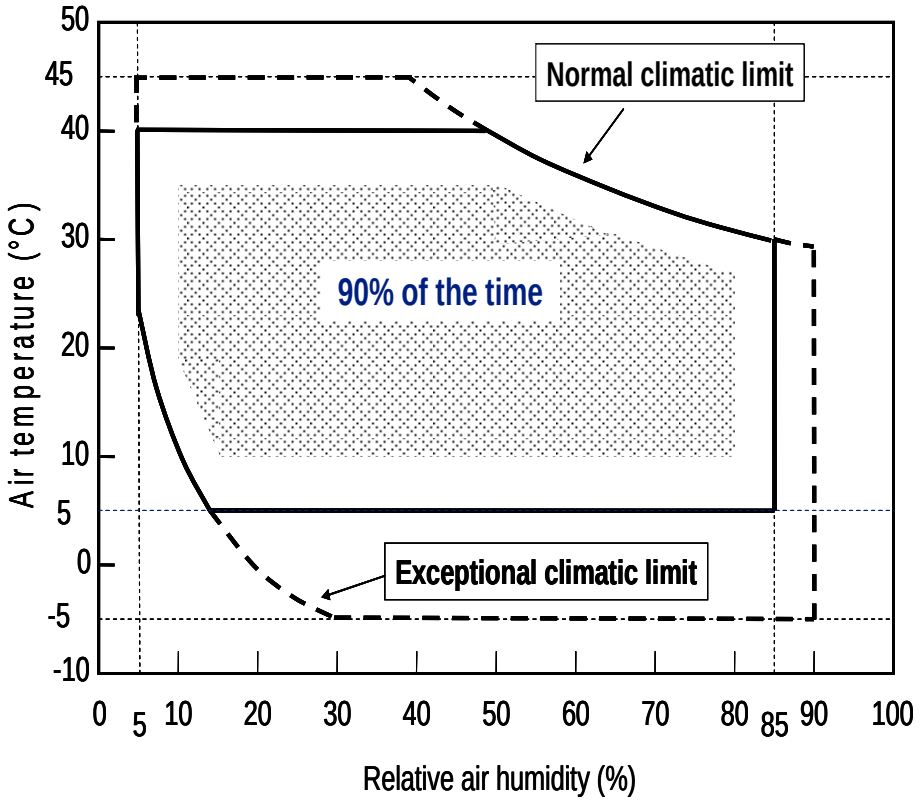
Datacenter: temperature specifications

- Mostly specifications are set according to ASHRAE thermal guidelines with restrictive recommended temperature area (up to 27°C).
- Since 2009 the telecommunication standard ETSI EN 300 019-1-3 (class 3.1) applies to data centres too. According to this standard the temperature may vary between 5 and 40 °C under normal conditions and even up to 45°C under abnormal conditions
- In 2011 ASHRAE has defined a new class A4 with upper temperature limit of 45°C which complies with the ETSI class 3.1.

ETSI EN 300 019-1-3, class 3.1



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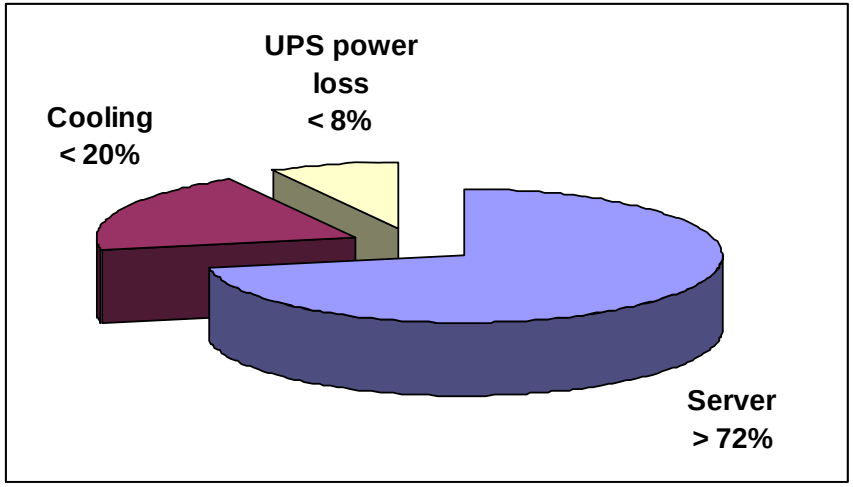
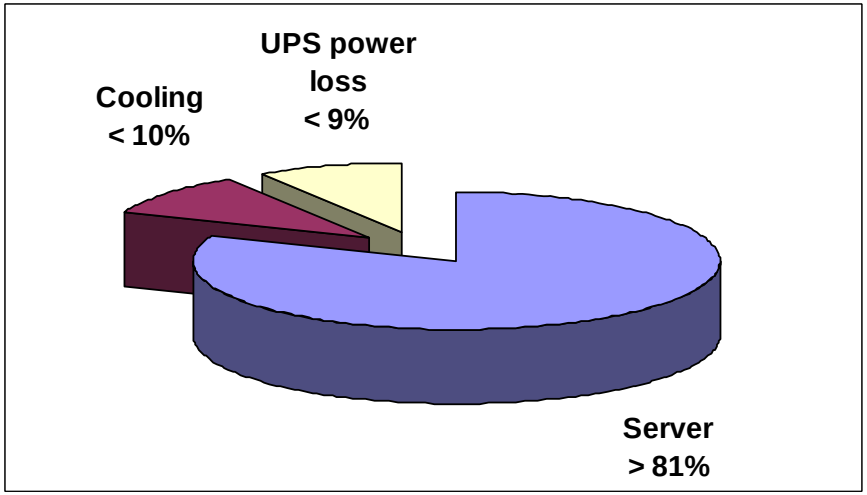
Energy efficiency targets for new Datacenter by Swisscom

2008 → 2011





@ load rate >25%

- Energy target for cooling <20% based on recommendation from the Swiss Federal Office for Energy
- The energy breakdown in the above chart corresponds to a PUE < 1.39 and a reciprocal DCiE > 72%
- These targets correspond to a PUE < 1.23 and a reciprocal DCiE > 81%

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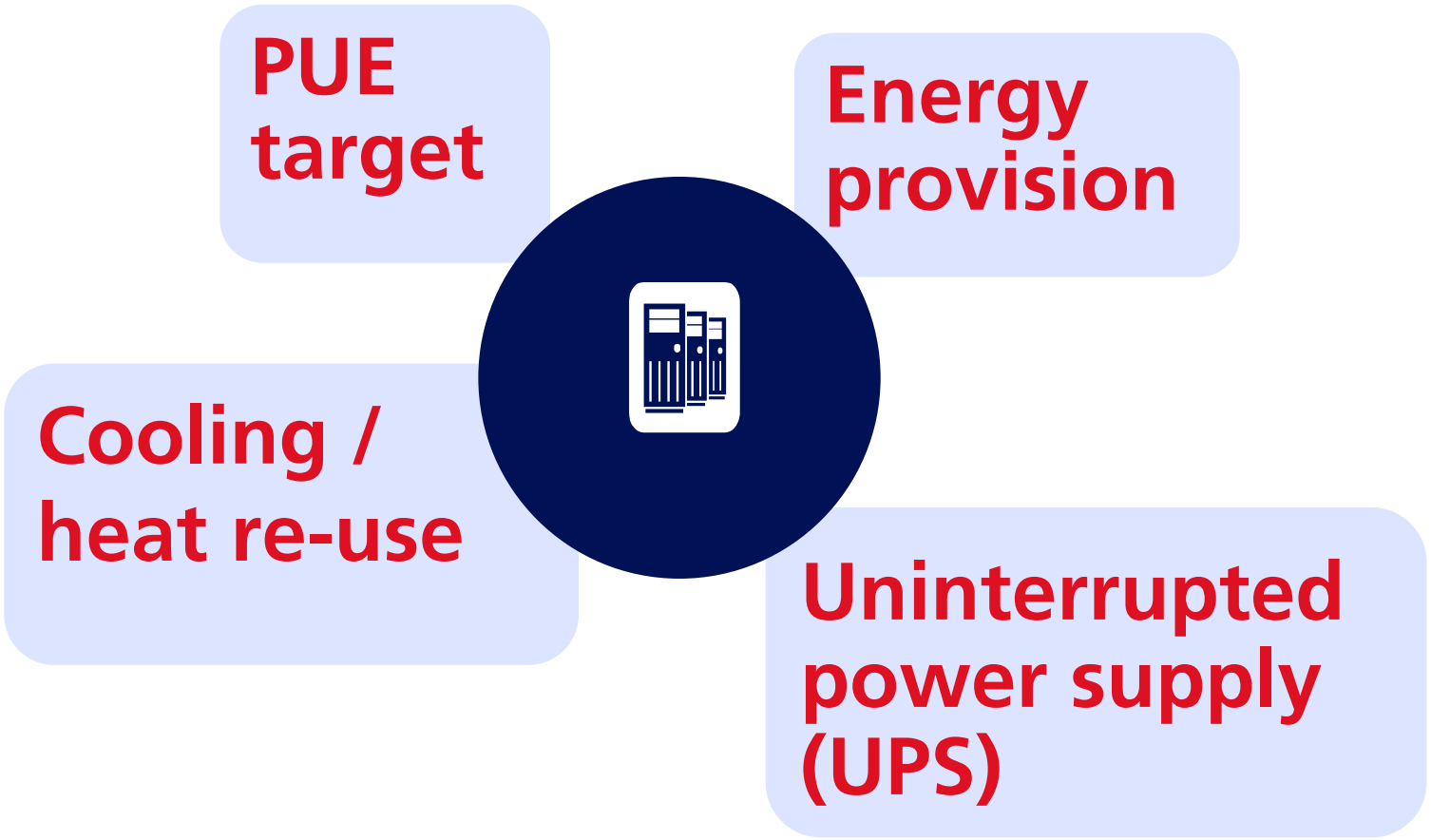
How green issues are included in the planning of new Datacenters at Swisscom?



Swisscom DC built in 2007 in Zollikofen (Berne) -> Energy efficiency targets and measures

Targets

- Energy efficiency targets set by the planning of this data centre :
  - Energy use for the cooling < 20%
  - Energy efficiency of UPS above 90% (power loss of 8%).
  - ➢ **DCiE value above 72% or a reciprocal PUE value below 1.39**

Implemented measures to reach these targets:

Chilled water

- Chilled water temperature supplied at 16°C which enables extended use of freecooling throughout year (mixed operating „chillers/freecooling").
- Turbo chillers with high COP (coefficient of performance) even at reduced load

Cooling design in server rooms

- Room temperature set at 25°C.
- Cold/warm aisle topology in the server rooms, thus preventing air mixing between cold and warm air.
- Use of air re-circulation units with variable air volume rate, thus enabling better matching of air volume rate to the effective needs
- Power and IP cables placed in well dedicated cable routes inside the raised floor, thus preventing unwanted obstacles for air flow.

Heat recovery

- Heat recovery currently used for internal purposes and also available for potential external recipients (district heating).

UPS

- Selection of static UPS with energy efficiency above 90%.

Electricity provision

- **100% renewable energy**

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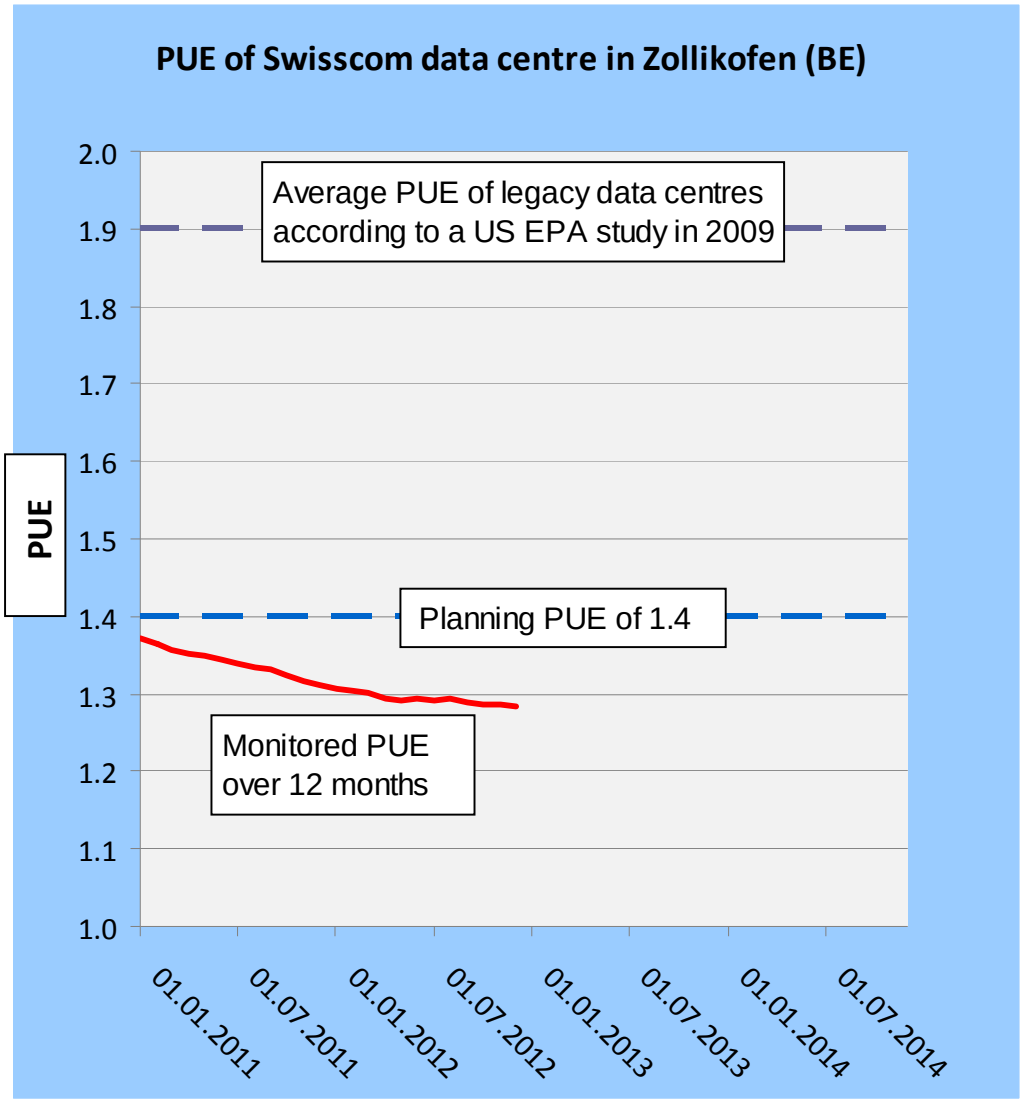
Swisscom DC built in 2007 in Zollikofen (Berne) -> monitored PUE



- **Yearly averaged PUE of 1.29 at End 2012**
- Reduction of the electricity needs for cooling in the DC of Zollikofen by 40% compared with conventional datacenter.
- This allows us today to save the equivalent amount of electricity that would be required by around 1,400 households

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New Swisscom state-of-the-art data centre in Berne-Wankdorf

- Building of one of the most modern and efficient data center in Europe at the Berne-Wankdorf business park.
- **The new data centre will begin operating in 2014**. The data centre will initially be equipped with three modules with an effective output of 600 kW each.
- There is scope for subsequent expansion to up to seven modules in line with requirements
- The new building will provide sufficient space for IT outsourcing and managed housing services.
- In a first stage the data centre will have a server area of 2,300 m², expandable to a maximum of 4,000 m² depending on requirements.

New Swisscom state-of-the-art data centre in Berne-Wankdorf

PUE target

- **PUE value will reach the top rating of 1.2** thanks to extremely efficient power usage. Environmental issues also included

Cooling

- Free cooling and additional water evaporation by higher outside temperature (**no chillers**)
- **For the first time**, evaporation cooling **using rain water**

  => massive reduction of the amount of fresh water consumed or even not necessary.

Heat recovery

- Heat re-use and provision to the city of Berne's district heating network.

UPS

- Instead of static UPS use of **dynamic UPS thus eliminating the needs of batteries.** In the event of network failure, a permanently operating rotational mass will drive the generator until the diesel units take over this task.

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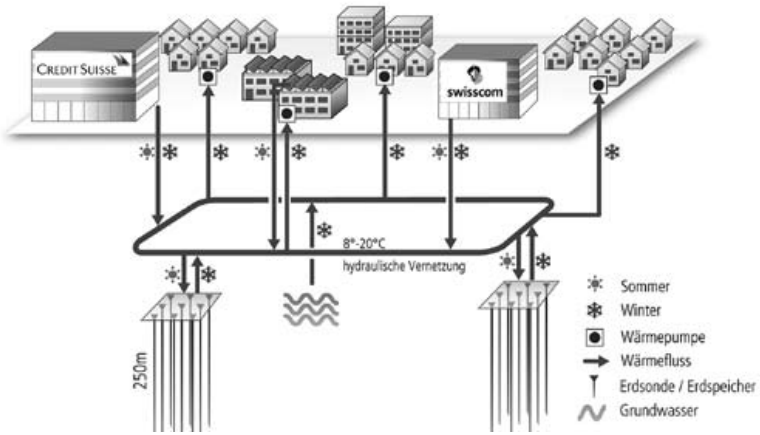
Examples of heat re-use at Swisscom

- **Swisscom centre in Zürich-Binz**:
  - In addition to internal heat re-use, provision of heat to district heating network of the residential areas of Tiergarten and Talwiesen in Zürich
  - In the future additional provision of heat year-round to the new *Anergy network* with heat storage in the ground (project of *Familienheim-Genossenschaft Zürich*) for heating of round 2'000 households
  - On the midterm total heat re-use from our centre could reach up to 20 GWh/a, which corresponds to a **saving of round 2 millions litres of heating oil per year.**
- **Swisscom centre in Zürich-Herdern**:
  - Provision of heat to the district heating of the city of Zürich



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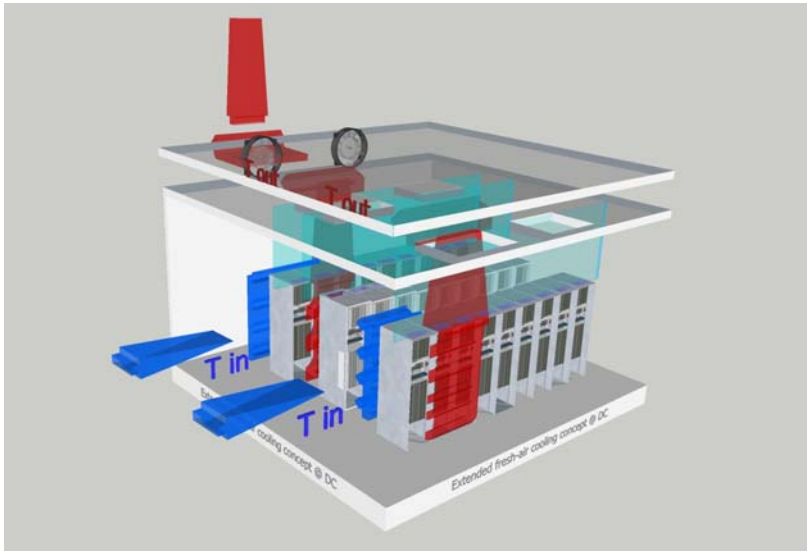
New concept developed by Swisscom: -> *Fresh-air-cooling* @ Datacenter

- Concept of fresh air cooling throughout the entire year at data centers (even for IT loads of several kW/m²)



Concept

- **To extend fresh-air-cooling in Data Centers, following concept is proposed:**
  - **Arrange the racks in the rooms with hot and cold aisles**
  - **Contain hot aisles and connecting them to the return air plenum**
  - **Avoid hot and cold air mixing thus keeping room temperature at appropriate level**
  - **Supply outside air through openings in the outer facade and use exhaust fans to remove hot air**

- **Possible heat re-use through heat exchanger mounted on exhaust side**

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Pilot *Fresh-air-cooling @ Datacenter* at Swisscom

- **Pilot carried out from Nov. 2011 to Oct. 2012 (around one year) for demonstrating the feasibility of the concept**

Tested IT platform:

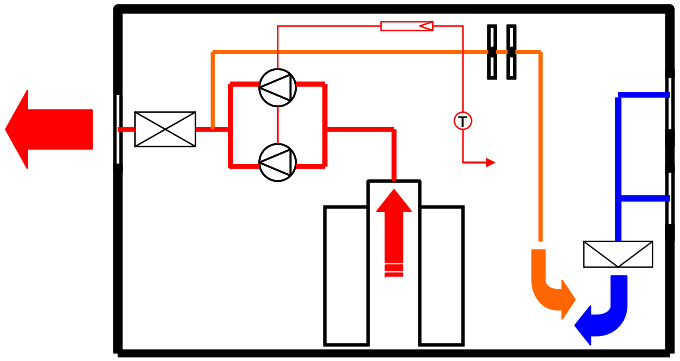
- 6 HP blade systems (BL 7000) with 16 servers (type BL460c) each (total 96 servers)
- Front to rear air flow through the servers
- One SAN storage module also installed
- Arrangement: 2 rows with 3 racks each
- Total IT power @ 100% utilization: ca. 27 kW
- Platform powered by high energy efficient UPS (max. load: 80 kVA, 96.5% efficiency at ca. 28 kW load)
- Specific load: ca. 1 kW/m^2 floor area @ 100% utilization rate
- Steady operation of servers @ 100% utilisation rate

We acknowledge the support of HP and GE Energy

Fresh-air-cooling system

Warm air removal:

- **Warm aisle containment -> no air mixing**
- Two exhaust fans each providing 50% of required cooling power in redundant parallel operation
- Temperature-controlled air flow volume



Cold air inlet:

- Air inlet through openings in the façade and air ducts

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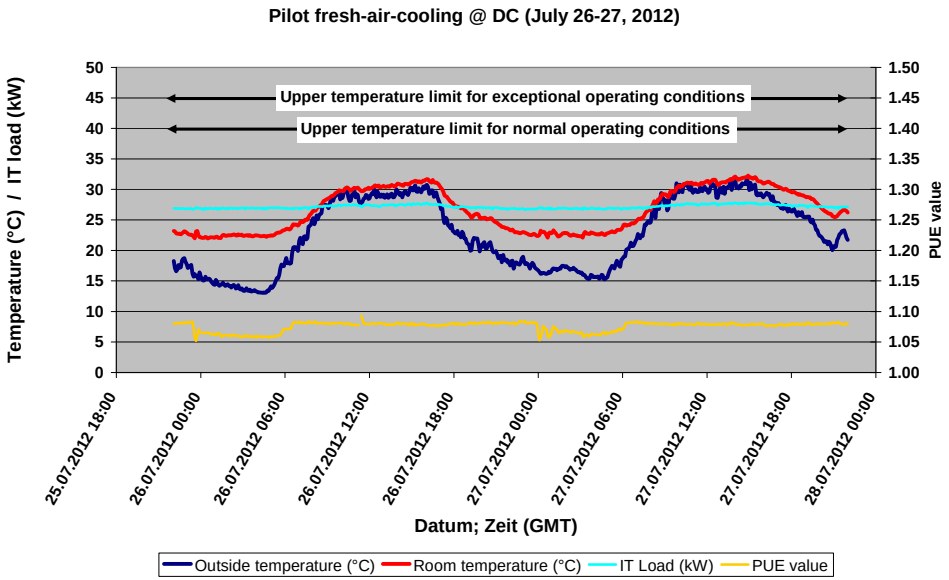
Results of the pilot *Fresh-air-cooling @ Datacenter* at Swisscom

- Pilot operated over ca. one year (from November, 2011 to October, 2012)
- **Pilot is successful**. The servers were working properly, even at the hottest summer days with outside temperature above 30°C
- All measured temperature and relative humidity values within the climatogramm of ETSI EN 300 019-1-3, class 3.1
- Monitored PUE value varies between 1.05 and 1.08:

yearly averaged PUE-value of 1.06



Advantages of fresh-air-cooling:

- Energy use for cooling cut by a factor 10
- Low cost -> CAPEX by a factor 3 to 4 lower
- No refrigerants and no water needs
- Higher modularity and reliability

(PUE = Power Usage Effectiveness = Total Facility Power / IT Power)

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Conclusion / Recommendations / Outlook

- Green Datacenter enables:
  - Sustainable development of ICT
  - Reduction of OPEX
  - Promotion of image
- Setting of energy efficiency targets (e.g. in terms of PUE) and challenging best practices by planning of new datacenters:
  - Select best solution based on TCO approach including energy costs as well as additional green issues
- Possible support from promotion program PUEDA (initialized by Swiss Federal Office of Energy)
- For best practices refer to e.g. EU CoC for energy efficient datacenter
- Better use of allowable temperature range for IT equipment according to ETSI class 3.1, thus enabling lowering CAPEX and OPEX for cooling.
- Promotion of high energy efficient powering and cooling solutions:
  - Steps towards a first implementation of *fresh-air-cooling year-round* at Swisscom are on going
- Promotion of server virtualization and „Green IT-Outsourcing“

Contact information

Thank you for your attention

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