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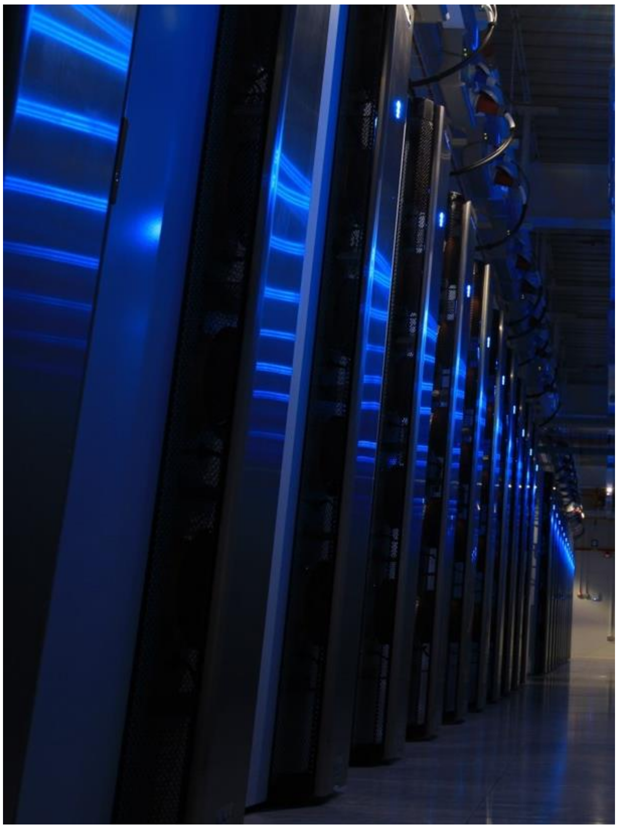

# ColdLogik

# Rear Door Cooling

# ‘Shared Deployment Philosophy’

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# Overview

The market perception of a Rear Door Cooler (RDC) is that it can only be used on a one-to-one basis with the cabinet it is cooling. However, for more than a decade, USystems have consistently disproved this theory. This document will detail how this can be done.

The basic principle surrounding the ColdLogik RDC, is that it controls the whole room environment with built in adaptive intelligence.

During standard operation of the USystems RDC systems, air is discharged evenly in both horizontal planes via EC fans. Due to the fans being equally positioned in the RDC, the air provided across the adjacent cabinets is uniform, therefore enabling USystems RDC solutions to cool multiple cabinets using a single unit. Cooling by Air-Mixing.

Whilst it is true that to achieve optimum operational efficiency an RDC per cabinet is the most effective method, it can still be an effective proposition to deploy an RDC for every second or every third cabinet. The choice of which comes down to a multitude of factors however it can be easily explained by describing the choice as 'Optimal energy savings and OpEx vs CapEx'.

# Capital Savings Potential

To illustrate the CapEx saving potential, this philosophy can be applied to a real-world application. Customer A required a cooling solution where the room temperature was maintained at ASHRAE A1, with a cooling requirement per cabinet of 10kW. The straightforward 1:1 deployment provides the largest opportunity to reduce the OpEx, as operational savings are made through the use of warmer water (reduced mechanical cooling investment required). However, this also has the largest CapEx, a greater initial venture than originally budgeted for by Customer A.

By redesigning the deployment to use a 3:1 method, each RDC produces instead 30kW of cooling duty. This significantly reduces the CapEx down with a 61% saving. While the 3:1 solution has increased mechanical cooling costs due to the use of colder water, the reduced CapEx aligns with Customer A's budgetary considerations.

## Formulae

Operating with ASHRAE standards for the active equipment internally for the Cabinet means that both the volume of air required by the equipment and the temperature required for the air flow from the door can be used to estimate the anticipated room temperature. The formulae by which this can be shown is as follows:

$$\left(\frac{Cabinet\ leaving\ Temperature}{Airflow\ from\ Cabinets + Airflow\ from\ RDC}\right) \times Total\ Airflow\ from\ Cabinet = x$$

$$\left(\frac{RDC\ leaving\ Temperature}{Airflow\ from\ Cabinets + Airflow\ from\ RDC}\right) \times Total\ Airflow\ from\ RDC = y$$

$$x + y = Anticipated\ Room\ Temperature$$

# Operation Densities

At low duties, an RDC may be deployed in every two or three cabinets. While what determines the low duty threshold for Cooling by Air-mixing would vary (based on site-specific parameters, such as fluid temperatures, relative humidity etc), USystems are comfortable in applying a general threshold of 6kW and lower for RDC's deployed on every third cabinet, and 15kW or lower for every second cabinet. This is not a definitive ceiling, as the adaptive intelligence of the RDC product, and the many variables in designing a data center allow for viable solutions that perform beyond these general models, such as the deployment illustrated for by Customer A. USystems have illustrated the thresholds of 6Kw and 15kW below:

## Example A: 3 x Racks to 1 x RDC

In a 3:1 configuration shown here, where the cooling requirement in each cabinet is 6kW, each rear door would have a total cooling requirement of 18kW. this would directly cool the cabinet it is fitted to, and indirectly cool the air from the cabinets on the left and right. The pattern repeats for the full bank

Where a room temperature of 27°C/80.6°F or below is desired (to keep with ASHRAE A1 class guidelines) USystems would assume the air off from the Cabinets without the RDC to be approximately 40°C/104°F and produce circa 600CFM. If on application this information can be provided, USystems are able to produce more accurate room temperature projections.

The RDC in this application would be producing 18kW of cooling, generating 1800CFM, with an air off coil temperature of 20°C/68°F. The data in this example would populate the formulae as follows:

$$\left(\frac{40°\text{C}}{600CFM + 1800CFM}\right) \times\ 600CFM =\ 10°\text{C}$$

$$\left(\frac{20°\text{C}}{600CFM + 1800CFM}\right) \times\ 1800CFM =\ 15°C$$

$$10°C + 15°C = 25°C$$

The anticipated room temperature in this case would give a mixed air temperature of 25°C/77°F, which is under the 27°C/80.6°F ASHRAE recommendations.

### Example B: 2 x Racks to 1 x RDC

As the required cooling density increases, the ratio of RDC's to racks generally increases proportionally. In a 2:1 configuration where the cabinets being cooled are producing 15kW each, the following would apply if a room temperature of 27°C/80.6°F is desired. USystems would expect the air off from the Cabinets without the RDC to be approximately 40°C/104°F and produce circa 1500CFM.

The RDC in this application would be producing 30kW of cooling, generating 2250CFM, with an air off coil temperature of 15°C/59°F. The data in this example would populate the formulae as follows:

$$\left(\frac{40°\mathrm{C}}{1500CFM + 2250CFM}\right) \times 1500CFM = 16°\mathrm{C}$$

$$\left(\frac{15°\mathrm{C}}{1500CFM + 2250CFM}\right) \times 2250CFM = 9°C$$

$$16°C + 9°C = 25°C$$

The anticipated room temperature in this case would give a mixed air temperature of 25°C/77°F, which is under the 27°C/80.6°F ASHRAE recommendations.

## Closing Statement

These examples illustrate the higher densities that can be applied using a 3:1 and 2:1 deployment strategy. With increased airflow requirements at higher duties, it is generally advisable to deploy low duty cabinets between high duty cabinets with RDC's fitted to best maximise the air mixing strategy. There is also opportunity for growth in the data center to either increase density, or reduce OpEx by adding more RDC's at a pace to suit CapEx. The reduced OpEx is achieved by increasing the number of RDC's which allows an elevation in water temperatures (in most cases supplied by mechanical cooling), therefore reducing overall energy consumption.

When increasing the water temperatures, it typically means: first the external plant can be physically smaller, second, the efficiency per kW cooled will increase, and third, the free cooling that can be utilised on site will increase exponentially dependant on geographic location.

To conclude, the ColdLogik RDC solution is truly unique. Allowing data center stakeholders to utilise a system that is both sustainable in its capacity for future growth, and maximises flexibility with the ability to improve efficiency as density is added. To find out more on how we can make a Cooling by Air Mixing solution work for you, please contact sales@systems.com or visit https://www.usystems.com/data-centre-products/cl20-proactive#prodeployment for more information.