Ken's Korner

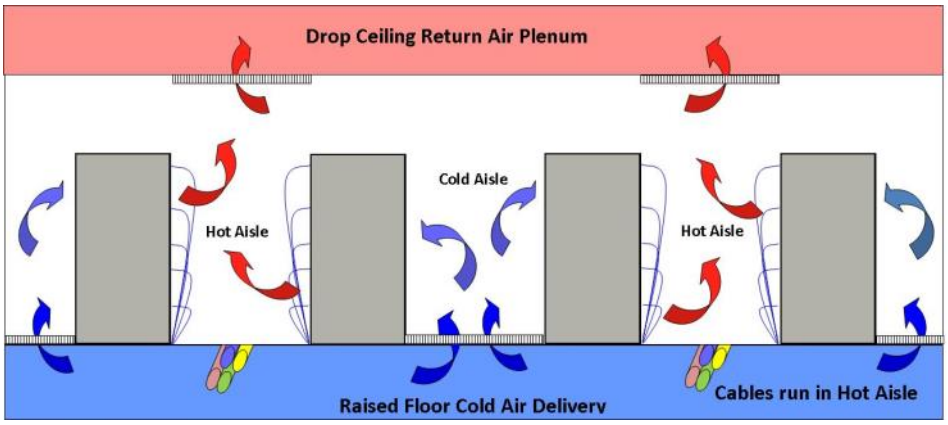
MAXIMIZING COOLING EFFICIENCY

An efficient cooling system minimizes the energy needed to generate cool air used to direct heat away from sensitive computer equipment. The process of optimizing airflow management involves proper placement of Computer Room Air Conditioners (CRAC), hot and cold air delivery and returns, intelligent rack configurations and cable management.

CABLE MANAGEMENT

Each data center should have a cable management strategy to minimize airflow obstructions caused by cables and wiring. The strategy should address the entire cooling airflow path, including both above rack and below floor air distribution and intake areas.

All power and data cables should be run in hot aisles only. By running cables in hot aisles, you decrease the chance of air dams both underfloor and overhead. You want to create an unobstructed path for cold air to reach the racks and computer equipment. Any obstructions will restrict airflow and limit the cooling equipment effectiveness.



Cable and cable tray obstructions limit airflow, and the closer these obstructions are to the CRAC unit the greater their impact to the systems cooling effectiveness.

Make sure to seal all raised floor cable cutouts with brushed grommets to limit cool air leaking into hot aisles from underneath or behind racks. Cable cutouts in a raised floor environment can cause significant cold air leakage resulting in airflow bypass and contributes to loss of static air pressure in the underfloor plenum and equipment hot spots.

INTELLEGENT RACK CONFIGURATION

Hot and cold aisle configurations are a must to gain any efficiency for a raised floor room based perimeter cooling system.

Position racks so that the fronts that draw in cold air all align the cold aisle. Typically I've achieved best performance with a four foot wide cold aisle, and having the racks separated by two rows of perforated tiles. Make sure the back side of the racks on either side of the row is discharging hot air into the hot aisle. I've used configurations where the hot aisle can be from two to four feet wide, or one to two floor tiles widths. Wider hot aisles provide more room for cable management without creating obstructions, both overhead and underfloor.

Configure the server racks and cabinets in long unbroken rows. Recognize that the rows cannot extend beyond the maximum effective cold air delivery range of the CRAC unit (typically 30-40 feet, the actual effective range will vary based on the number, type and placement of perforated floor within the cold aisles, floor depth and size of A/C unit).

Place racks in rows, eliminate spaces between racks and close unused openings in racks with blanking panels to limit airflow between racks. You want to force cool air through the equipment not around it. Use racks and cabinets with fully vented front and back doors to maximize access to cold air and dispersion of hot air.

Ken Koty; former data center facilities manager with over 30 years of hands-on experience shares management practices that made him a 12 year award recipient for continuous uptime from the Uptime Institute. PDU Cables does not guarantee the results of outcomes by using information contained in this document..

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A minimum height of 24 inches should be provided for raised floor installations. Floors greater than 24 inches may provide a more uniform plenum air pressure. Don't concentrate loads in one area of the data center, spread loads out as evenly as possible.

MAXIMIZING COOLING EFFICIENCY (CON'T)

PLACEMENT OF CRAC UNITS

The placement of a Computer Room Air Conditioner (CRAC) as part of a raised floor room based perimeter cooling system can have a direct impact on the CRAC's cooling capacity.

Cooling equipment should be placed as close to the heat source as possible, but no closer than six feet or three floor tiles. Perforated floor tiles should not be any closer to the CRAC unit than six feet otherwise the air velocity is so great up close to the CRAC unit you risk mixing hot and cold air as you draw hot air back into cold air plenum before it can be directed to the hot air return plenum.

When using hot/cold aisle configurations, the CRAC's should be at the ends of rows directing the cold air parallel to the rows of the racks and cabinets.

If rows of server racks greater than 30' are to be used, thus exceeding the effective range of a single CRAC unit, then CRAC units will need to be placed at either end of the row directing cold air inwards. If CRAC units are to be placed at either end of a computer room, they shouldn't be more than 60' apart otherwise you risk incurring hot spots in the center. You may mitigate this by having lower density racks in the center of the room where the airflow may be at the outer limits of its effective range.

If a computer room is larger than the effective range of two directly opposed CRAC units, a possible configuration of multiple CRAC units in a daisy chain may achieve the desired results. An example of this is a 90' room where you can have a CRAC unit at the start of a row, and another at around 30' and another at 60'. Each CRAC is positioned to have airflow in the same direction.

Room corners and underfloor obstacles can create eddy's or vortex's that can result in dead air or hot spots. These issues can be addressed with supplemental in floor cooling fans or the placement of low density equipment.

HOT/COLD AIR DELIVERY AND RETURN

Higher air temperatures allow CRAC's to run more efficiently because higher temperature differential between the return air and the cooling coils improves heat transfer.

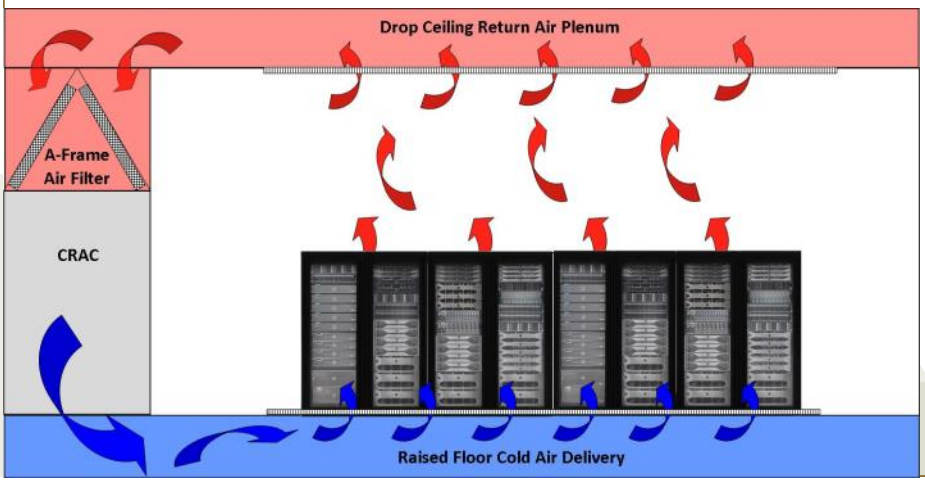
If your ceiling height is below nine feet, you will sometimes have difficulty getting a good return air path. If this is the case, or if you just want to increase your cooling effectiveness, install a drop ceiling and use it as a hot air return plenum. After you install the drop ceiling, duct the return intake of all CRAC/CRAH units up into the ceiling. By doing this you will not be tempering the cold air as you drag hot air through all the cold aisles on their way back to the intake of the CRAC/CRAH unit. Place open egg crate tiles only in the hot aisles of the drop ceiling, as a draw point into the hot air plenum.

You can further augment the A/C units by fabricating an A-frame filter rack within the ducts to increase airflow intake capacity of the CRAC unit air filters. It is the restrictive nature of the filters that reduces the airflow capacity of the CRAC units. We found that by utilizing this method of doubling the filter capacity of the units we gained a ton of sensible cooling capacity per 30 ton unit. (This was determined by using the delta T method before and after the project completion).

Duct the CRAC unit up to the hot air plenum of the drop ceiling.

If you are using hot air return vents, place them as close to the equipment exhaust as possible within the hot aisles. The dropped ceiling hot air plenum is most effective when the return vents are aligned with the hot aisles. Directing hot exhaust air into localized return plenum is more effective than using a single bulk return hot air source. Hot air return venting doesn't have to be pretty to be effective.

Don't place perforated tiles next to racks and equipment that are either out of service or not being used. If there is no load at a rack, it doesn't need to be cooled.



For additional information on airflow management, airflow problems and cable management see http://www.pducables.com/KensKorner.htm#content

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