Environmental “Green” considerations within the Data Center Environment

Raised Floor vs. Overhead Cabling for Data Centers

As part of data center design activities, design professionals are often posed with the question of “raised floor vs. overhead cable tray” when designing air handling systems and cabling distribution systems within data centers. This question creates considerable debate, but when accompanied with the challenge on corporations to be environmentally conscious, an affordable “green” solution is obviously the preferable solution. With data center white space and servers driving such a significant part of the global IT economy, there is an increasing need to design in energy conservation and efficiencies within the data centers space.

Energy Costs are on the rise

Data center power consumption and cooling are two of the biggest energy issues that confront IT organizations today. In many cases, over 50 percent of the power in data centers is used for temperature reduction. By 2015, it's expected that the costs to operate servers will exceed the costs to purchase server hardware. And as energy use grows, IT bills that once accounted for 10 percent of overall enterprise budgets may soon account for more than half. As a result, organizations need more efficient technology to better manage increased computing, network, and storage demands.

Raised Access floors can play a significant role in precise airflow management while maintaining the physical integrity of the Data Center environment. Access Floors provide the ability to direct thermal energy without the use of space-consuming overhead ductwork. Additionally, under floor cooling can ease the complexity and facilitate the option of using overhead cable handling space.

When shallower access floor heights are used, overhead cabling pathways tend to be the preferred cabling method as most mechanical engineers would prefer to reduce the dampening of airflow in the space underneath the floor. There are additional design metrics to consider when placing low-voltage cabling and the necessary pathway supports under raised floors. Providing adequate space exists between the top of the rack and between ceiling-mounted sprinkler heads, designing the pathway overhead can provide easier access for moves, adds, and changes to take place without a disruption of the underfloor cooling environment. One design metric that is often overlooked is the significant delta in the height of racks/cabinets. Significant variances in heights of cabinets, the existence of ceiling-mounted fire suppression,

when combined with a low ceiling can prove to be a very challenging and risky design. TIA-942 mandates a minimum ceiling height of 8.5ft above finished floor to allow for 7 foot racks and cabinets. As cabinet heights inch upwards, the TIA-942 mandated clearance of 18 inches can increase the data center ceiling height, or force an under floor installation.

The decision to employ an overhead cable pathway is a balance between functionality and aesthetics. Many corporations look at their data centers as technology showcases and prefer a "clean" overhead appearance. In these instances, all low and high voltage cabling would be installed in pathways created within the raised floor space. In these cases, the best practice would be to allow additional height to accommodate the cable pathway while insuring uncompromised airflow. Some data center designers have chosen to take the functional route to new levels and have begun to mount cabinet-serving patch panels on the underside of overhead cable tray, directly above the cabinet or rack. This overhead patch panel design frees up valuable space and permits permanent horizontal links to remain in place during major server, storage and cabinet upgrades. In these creative designs, the patch cords are unplugged from the data switching, storage manager, server or storage device and pulled through the access holes in the top of the rack. After removal of the old rack or cabinet, the new or repopulated enclosure can be put in place and patch cords reconnected with a minimum of downtime and no reinstallation of horizontal cables. The cost-savings and reduction in carbon footprint using this method of overhead cabling are obvious.

Other data center designs are taking a higher operating efficiency approach. When the requirement for moves, adds, or changes are low, the equipment cabinets can be viewed as an architectural fixture. This allows airflow management to be installed in the cabinets to segregate the hot and cold air. In this configuration, all cabling is installed in the raised floor space along the exhaust side of the cabinets and requires adequate vertical space in the raised floor. Cold air is supplied through perforated floor tiles on the supply side of the cabinets. With the addition of return air ducting on the cabinets and cooling units all exhaust air is confined to the return air path, delivering a higher return air temperature to the cooling units. This allows the cooling units to perform at higher efficiencies while preventing the mixing of hot and cold air in the data center space. Installations of this type have seen greater than 40% reductions in operating costs over standard hot isle / cold isle installations.

Hot Air Isolation (Cabinet Ducting)

The fundamental principle in using chilled air to cool server cabinets is to separate hot and cold air as much as possible. This is the primary reason for laying out a data center in hot aisles and cold aisles. In a effort to achieve the highest levels in thermal efficiency, many different practices have been employed, including cabinets with ducted exhausts directing heated air into

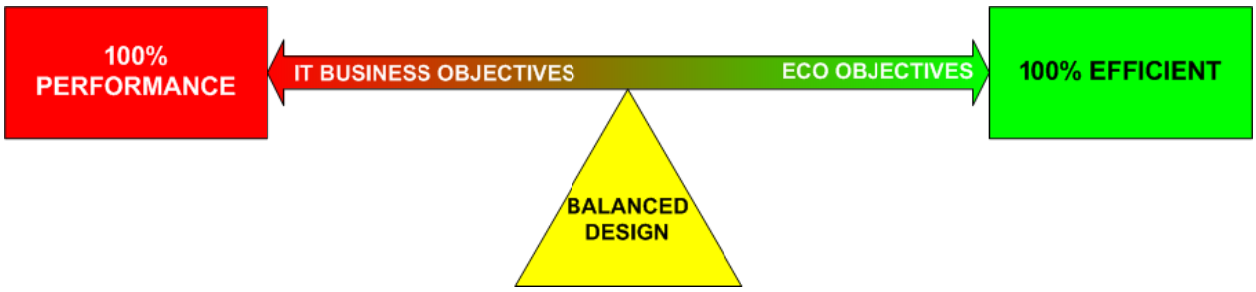
a suspended ceiling return plenum, cabinets ducting directly back to the cooling unit, even ducting heat directly out of the building..

Traditional hot aisle/cold aisle convection theory requires that high pressure cold air be delivered in close proximity to the server cabinet (perforated floor tiles). With a ducted hot air evacuation system, the delivery points for the chilled air no longer matters – chilled air can enter the room anywhere and as long as the room remains pressurized.

These newer advances in thermal technology provide efficiencies at a reasonable cost but, require a dedicated room design as ducted cabinets may prohibit the use of some overhead cable tray.

Green Impact On Where to Route Cables.

One metric gaining importance in the designer's consideration on where to place cables is its impact the carbon footprint of the data center. First it should be noted that USGBC does not specifically address "green" best practices in the data center. In fact, the high availability and performance levels required in the modern data center are at the opposite end of the spectrum from green best practices, and are more likely to see LEED points taken away rather than awarded. In fact some USGBC committees have discussed assigning negative points for the inclusion of PVC-jacketed cabling any place in the rated commercial office space, including data centers. Although this ruling is unlikely to become reality, it does point out the opposing objectives for data centers and green buildings.



In spite of this, there are design and operational practices that can make the modern, highly available data center greener. For example, the single biggest offender in the waste of cooling efficiency centers around the treatment of raised floor penetrations for low and high voltage cabling. The use of proper airflow management, including seals, brushes, air dams and other commonly available enclosure accessories can increase the cooling efficiency of a data center

by 15% or more. This makes the design and construction of the floor systems and overhead cabling systems critical to the overall thermal efficiency. Comprehensive tools are now available to assist in data center design process.

Virtual Thermal Engineering with CFD

Computational Fluid Dynamics (CFD) is a powerful software design tool offering 3 D modeling capabilities for the operational analysis and maintenance modeling of cooling systems for data centers and computer rooms. These software programs provide a virtual tool for the analysis of cooling system for provide for improved design and construction of data center cooling systems and enhances the administration and management of mission critical facilities. Additionally, post modeling

CFD modeling gives designers the opportunity to consider several data center design cabling and pathway options as well as raised floor vs. overhead cabling designs prior to construction within a reasonable amount of time. As a result, the final design is not based on a tentative approach, but is a result of a professional design process considering several options and selecting the optimum solution. This can save on capital and operational costs as well as save time by avoiding mistakes and during commissioning.

Cabling Infrastructure Design and the Green Data Center

In order to achieve an efficient cooling design, cabling must be properly designed and installed to assure the air to flow in an unobstructed manner. TIA-942 and other standards suggest that horizontal and vertical cabling be installed with the anticipation of growth and/or change so that these areas are not repeatedly disturbed in the future. When considering underfloor cabling solutions there are distinct reasons for this including eliminating the adverse affects of opening floor tiles and decreasing static pressure under raised floors during MAC work as well as insisting that pathways are run in a manner that will allow the flow of cold air in cold aisles to be unobstructed by cabling and pathway materials. Cabling channels can sometimes create air dams which may obstruct air flow, which could result in higher energy consumption.

When considering overhead cabling pathways, there is general agreement that overhead tray systems offer little obstruction with the flow of cool air into the data center space. With this minimal impact on the delivery of cold air directed at servers, the only requirement is to assure that sufficient space is allowed above server cabinets as to not trap or obstruct the exit of heated air from the cabinets. Another significant advantage of locating infrastructure overhead is that it enables you to forego a raised floor system for your server environment. Overhead installation is therefore less expensive, occupies less floor space, and fits more conveniently in

shorter building spaces. Cable trays, ladder racks, and raceways are less expensive than a complete raised floor system, contributing to the cost savings.

Final Selection

As the economy continues to shift from paper-based to digital information management, data centers have become common and essential to business, communications, academic, and governmental systems. Data centers are now found in nearly every sector of the economy and will continue to proliferate to meet the expanding demands of a digital world. Virtualization promises some relief to sizing and cooling concerns but the overall appetite for faster processing and greater storage will continue to challenge data center design. The construction and functionality requirements of data centers that demand these complex and often conflicting objectives will drive product innovation and encourage development of systems and solutions that provide greater efficiencies and lower operational costs. The final selection of either an underfloor or an overhead pathway cabling system is a balance between construction costs, available technology, operational metrics, aesthetics, physical constraints, and the evolutional demands of the enterprise. That final selection will have to survive the ever changing shape of the fabric it supports.