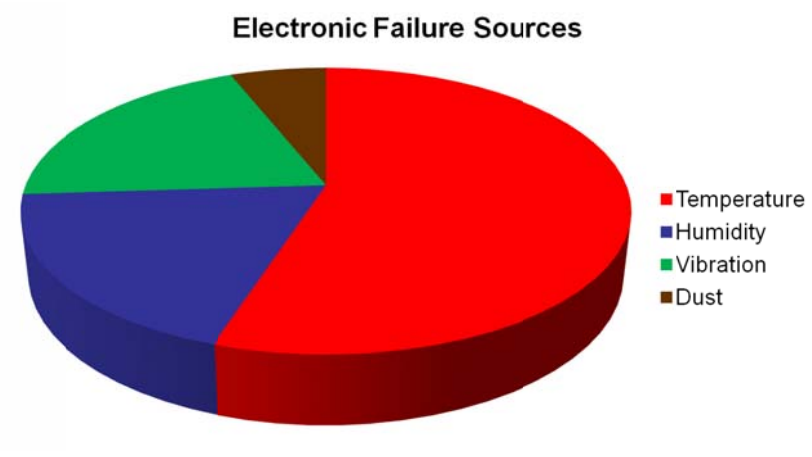
It's Time to Be GREEN: Saving Energy and $$$ in the Data Center

The topic of the day seems to be "Green", which includes the entire spectrum of using less energy and materials at the start, being more efficient during a building's life cycle, and extending that life cycle to reduce the replacement of components and their associated waste. The growth of data centers in the United States and globally has led companies to look hard to increase efficiency and productivity of the resources utilized in the storage, transport, and processing of data. Focusing on the cabling infrastructure system in this article, we will examine some of the issues surrounding energy usage and how to reduce waste. And, especially important in today's environment, we will look at the *other* green as well – yes, dollar$ -- and see how being green can save some green.

Data centers are basically big computer rooms that use optimized infrastructure components to support servers, storage, and networking equipment devices. Although typically these buildings are out of sight and mind to the average consumer, the dramatic increase in internet usage driven by Web 2.0 companies (video downloads and uploads from Youtube, file and image sharing sites like Shutterfly, social websites like Facebook, etc) and the resultant demand for bandwidth has led to an equally dramatic increase in the number, size, and density of data centers. And they are having trouble keeping pace. 63% of IT decision-makers report that their data center had run out of space, power or cooling without notice. 43% reported that at their current rate of growth – they could only stay in their current infrastructure for 6 months with no changes. Not surprisingly, 36% are currently planning or building new data centers (OnStor, AFCOM, ARI, Dec 07)

System Reliability: It's Getting Hot in Here….

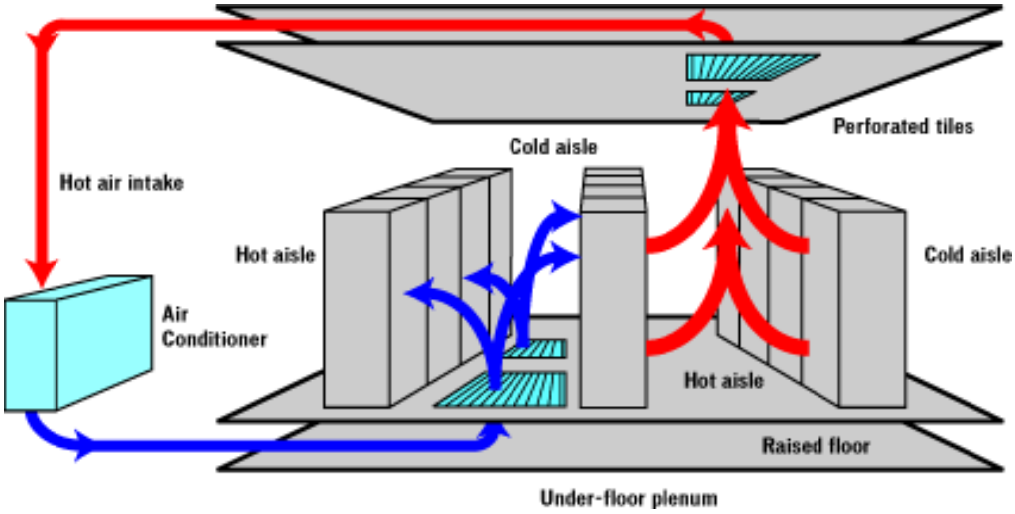
Data centers have already grown to consume about 2% of the total US electrical usage and are forecast to consume a whopping 9% of the US total by the year 2020. Much of this power is required to run the electronics and building operations. These electronics generate a lot of heat, which is one of the major causes of electronic failure within the data center. IT hardware reliability is greatly reduced as temperatures rise. It is estimated that a 10°C (18°F) increase in temperature reduces the long-term reliability of the electronics by 50%. (Arrhenius Theory).



Ironically, the electronics that are the heart of a data center's operations are creating the very heat that will reduce their effectiveness and lifetime, at the rate of 1W of cooling required for every watt or power consumed by electronics.

More frequent replacement of these components leads to more waste in the nation's landfills and higher costs of operation. As higher density electronics such as blade servers are becoming prevalent, the cost of a typical server is becoming outweighed by the cost of running the cooling to support it.

To control the flow of air, many data centers have adopted a pattern of cold aisles for the electronics and hot aisles for underfloor cable routing and passive patching. Cold air can be added and hot air removed in a very controlled pattern, leading to better efficiencies from the cooling equipment. Notably, passive cabling, both UTP and optical fiber, is less affected by heat than the active equipment.



Energy wasted on cooling equals wasted resources and dollars. Large data centers provide up to 270% of the cooling needed by the equipment due to inefficient airflow management. In order to reduce this waste, follow some of the golden rules of thermal management:

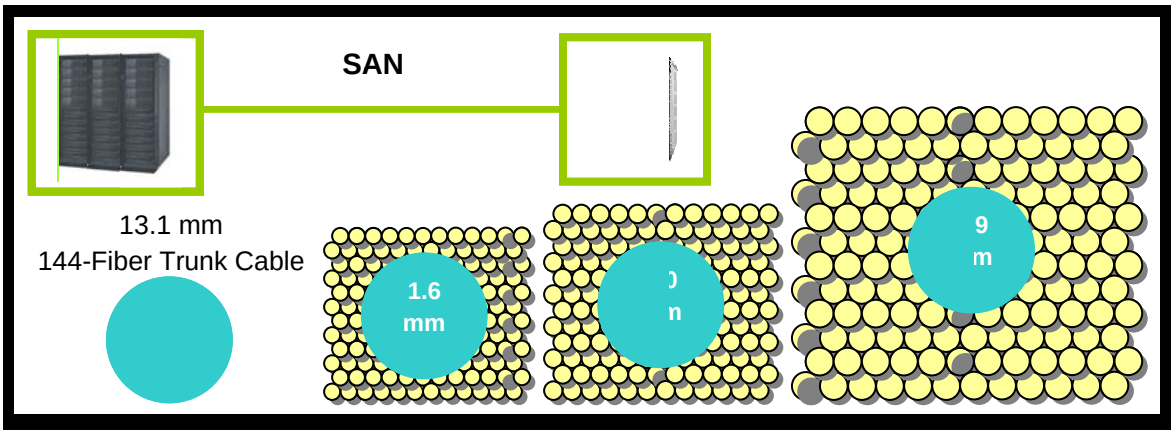
- Use blanking panels to stop recirculation of the hot air
- Use vented doors with at least 60% open area
- Distribute blade servers evenly to prevent “hot spots” in your data center
- Size the air conditioning appropriately for size of the computer room. on a typical average
- Turning down the air conditioning temperature will not solve a heating/cooling problem
- Modularize the thermal solution to limit initial investment
- Utilize a structured cabling system to limit the blockage of airflow
- Proper raised floor cable design and management;
    - High voltage cables on floor of cold aisles
    - Low-voltage communications cabling under cabinets or directly under floor tile in hot aisle.
- Reduce the number of perforated floor tiles in the design, only placing perforated tiles in front of active cabinets.

Think Structured: The System You Choose Today will Affect the Performance You See Tomorrow.

There are many areas in which this waste can be attacked. Focusing on the passive system, utilizing structured cabling will greatly reduce the volume of cable that is congesting passages and blocking airflow. The more room there is for air to flow, the less energy is expended removing hot and circulating cooling air. Structured cabling involves the use of backbone trunks that bring a large number of optical fibers or copper pairs to an area before breaking out into smaller segments at the electronics.

Cables that are “home run” not only add more cable mass, they also cause a problem with any moves, adds, or changes. It is very difficult to remove a cable when it is in the cable tray with many other cables carrying live traffic. Not wanting to risk a disruption in traffic, system operators typically decide to simply pull in new cables on top of the old. This has the negative consequences of clogging up the pathways for airflow, increasing the HVAC workload. Utilizing a backbone trunk provides a link that does not have to be disturbed; the configuration is done at a patching field close to the electronics. With limited risk of system disruption and less overall work, this set-up is highly preferable.

High fiber count optical cables have the additional benefit of a greater density than running multiples of 1- and 2-fiber cables. Traditional 2.9 mm cabling for SC optical fiber connectors take up 7 times the space of a trunk cable solution, and even the smaller density 1.6 mm diameter cables used with LC connections occupy twice the coverage area. Loose-tube cables provide the best density among today’s trunk cable designs.



*Cabling issues are consistently ranked as the **leading contributor** to poor cooling in the data center environment*

Although cabling is resistant to heat, with operating temperatures to 140°F (60°C), the blocking of airflow can lead to localized “hot spots” where temperatures are much higher than the average for the room. Utilizing structured cable to reduce the consumed space will help keep the equipment operating within acceptable margins.

Think Long Term: What are the System Needs Today AND Tomorrow?

Once the trunk cabling is in place, it is now the backbone for a system that will be operating for many years to come. Although, it is expected that electronics and software are replaced every 3-5 years, the cabling is expected to last much longer, as it is difficult to pull cable in and out of a live system. That means that the cabling installed today has to meet the requirements of the cabling for tomorrow. Most data centers are planning for -- if not already utilizing -- speeds of 10G now. OM3 optical fiber and Category 6A copper cabling are rated for these speeds at distances typically seen within a data center.

For data centers operating at speeds of 10/100/1000 Mbps today, CAT6 cable may seem appropriate for these needs. This follows along with the guidelines of TIA-942 *Telecommunications Infrastructure Standard for Data Centers,* as the minimum level of cabling to install. However, if one considers upgrading their network infrastructure to support 10GBASET in the next 3-5 years, then putting in a higher bandwidth CAT 6A cabling would meet the needs of both today and tomorrow. This cable specification provides a high level of performance to support equipment end-points, such as servers and storage, transmitting over 10G connections.

Many designers are looking even longer term. If the cabling is expected to last for 20 years through several generations of technology, then clearly we must start looking at the requirements of that likely next generation technology. Data rates of 40 and 100 GbE and 16/32G FC are already being reviewed within the Standards bodies and new standards are expected to be published in 2010. To achieve these higher data rate solutions, OM1 62.5 um and OM2 50 um optical fibers will not be adequate. It is expected that OM3 50 um optical fiber will be the minimum optical fiber recognized for use with these upcoming, high speed applications. Therefore, OM3 optical fiber should be the minimum level of optical fiber cabling considered when designing the passive system if high data rate applications are in your future.

Extended range OM3 fibers are available today, with manufacture specified distances of 500+ meters for 10 gigabit Ethernet performance. Soon these type fibers will be represented within the Standards and have an OM4 designation. They will also support 40 and 100 GbE, and use of OM4 fiber may allow extended range and/or an increase in the number of connection points for this very high data rate applications. If installing extended range OM3 fiber cable today, make sure that it will meet the expected requirements of the draft TIA-492AAAD, which outlines the requirements for OM4 optical fiber.

Getting the fiber count correct will also be critical in delaying or eliminating the need to pull in new backbone cabling every time a new application is available. 40 and 100G applications will likely run over “parallel optics”, which is simply the process of breaking up a high speed data stream over multiple fibers, sending them over the passive system, and recombining these signals at the end. Standards organizations (Both United States and international) are looking at various options utilizing MPO array connectors; an example likely scenario for 100 gigabit Ethernet transmission includes having 10-fibers act as a transmit channel, and another 10-fibers acting as the receive channel. For the system designer, this means that having 24 fibers going to many locations within the data center would be a minimum requirement to ensuring the capability to run parallel optics applications in the future.

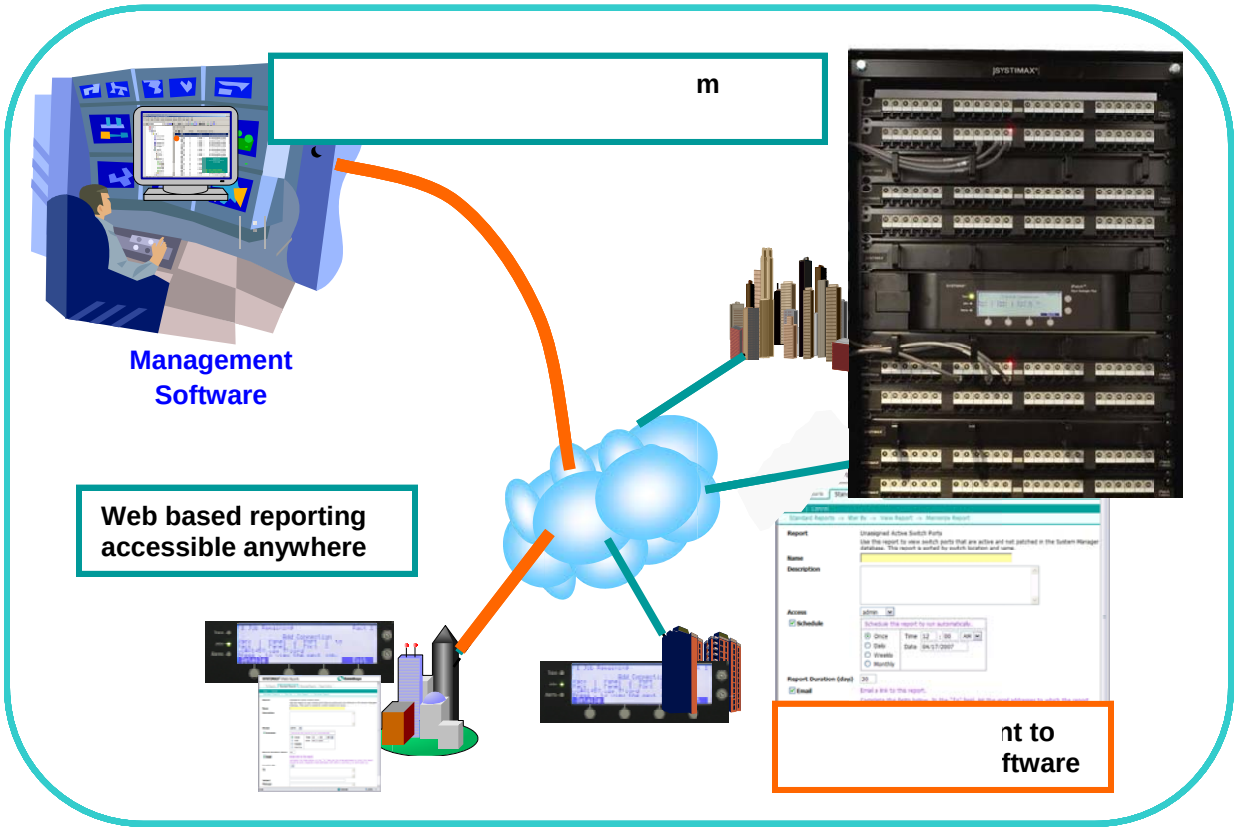
It has been estimated that approximately 70% of data center operators replace their cabling after only 4 years (BSRIA 2007 survey). Extending the expected life of the cabling out further make the initial IT purchasing decision easier and would reduce repurchase costs over time, Installing the correct cabling system today will reduce material disposal in the future, as well as limiting the hassles and cost associated with cable replacement.

Along with the bandwidth that the cabling can provide, when choosing copper and fiber media, the data center design also has to consider the cost of the initial investment in electronics versus the longer terms costs due to heat generation and maintenance. A components supplier that understands both copper and fiber media will be able to help sort through these issues.

Think Smarter: Are You Controlling the Network or Is It Controlling You?

With the size and dynamics of today’s data centers, we have to go beyond a system that simply works fast. It has to be manageable through all types of growth and changes. Deploying an Intelligent Infrastructure Management System provides vision and control of your network for more efficient utilization of energy, network assets and natural resources. An Intelligent Infrastructure gives you complete and instant knowledge of every available switch port in you network allowing you to minimize the number of switches deployed and thus lowering the overall power usage of the network.

Simple Network Management Protocol (SNMP) can be used to communicate with networked devices such as temperature sensors and can send alerts notifying you of potential energy consuming problems. Because it can identify each asset on the network in real time, you can monitor and enforce asset shut down policies during non-business hours to conserve energy. Email notifications can be sent out remotely to shut down networked copiers, printers, and desktop computers.



Utilizing an Intelligent Infrastructure Management System will better utilize resources, reduce maintenance costs and, with faster changes and less downtime, increase revenues by being able to offer a higher level of service performance.

There are many opportunities for reducing wasted materials and inefficient use of energy within the data center. Optimizing the passive system can be a big part of the effort in the “Greening” of the data center. Bringing in your structured cabling provider during the design process, along with the providers of electronics, power, HVAC, etc. can lead to a more efficient design that will reduce environmental waste, provide a higher performing system at a lower cost and produce a solution with a longer life span.