Data Floor Planning and Design

The data floor is a continuously evolving networking and communications distribution center commonly referred to as a server room. These technology epicenters are the backbone to our networking and storage infrastructures that drive our business and government computer systems. These high-powered computer centers are managed with vastly differing ideologies on how to efficiently and effectively maintain areas to maximize use of space, power, air, and aesthetic appeal.

Many people claim great advantages over alternative methods of data floor layouts. Some managers support a solid floor over a raised floor; some managers prefer refrigeration or water chillers to air supplied cooling. It is not my duty to choose which technology to approve, but it is my duty to understand the system, its benefits, its limitations, and how the system functions. Throughout this paper I will attempt to highlight the benefits and limitations of each system rather than giving a biased view of which system performs the best.

Probably the most widely debated concept for the development of a data floor is whether to use a standard poured concrete floor or a raised floor, sometimes referred to as a floating floor or as an access floor. A raised floor consists of pedestals distributed to evenly support steel framed tiles. The tiles are generally raised twelve to eighteen inches above a poured concrete floor. Raised flooring provides area for wires and air circulation beneath the floor. This results in more evenly dispersed air movement and ensures that cables will be secure and undisturbed; if used with overhead cable trays, a raised floor provides the ability to separate power cables from communications cables. Another advantage of a raised floor system is the fact that the surface is suspended from the ground, allowing drains, water detectors, and smoke detectors to be installed beneath the plane, reducing the possibility of an electrical hazard. Supporters of the poured concrete floor will point to its stability. In the event of a disaster, some fear that a raised floor will not stand the stresses of, let's say for instance, an earthquake. Another reason for choosing a poured concrete floor is the assumption that it can withstand more weight than a raised floor. However a reinforced raised floor should be able to accommodate even the heaviest server equipment; most equipment with unequal weight distribution will come with additional supports to be installed. Additionally, weight can be dispersed across a larger area to reduce stress.

Computer equipment disperses a large heat load, and a higher concentration of operated equipment will result in an accumulation of heat. Therefore, heating a data floor is rarely an issue. However, supplying enough cool air to maintain a comfortable environment for employees and equipment is a major concern of data floor managers. There are two prevalent ideologies for accomplishing an even distribution of temperature across a data floor. The first is through overhead cooling. Ductwork is installed above the data floor, suspended from the rafters, so as to provide a natural distribution of temperature as hot air rises and cold air falls. Returns are installed overhead to continuously circulate heated air that rises. The second option requires the use of raised flooring to allow airflow to mitigate through the under floor plenum. Cold air is forced upwards into server racks. The benefit of the second is a more directed air flow by using perforated tiles directly beneath, behind, or in front of an equipment cabinet. If the heat load is high enough, an overhead plenum with returns can be utilized to further increase circulation. Technology is currently leading to a third option to regulate temperature across a data floor, and this option is in-row cooling. Equipment is placed above or beside server racks to ensure the appropriate temperature. This technology is still in its infancy and is currently being utilized mostly as supplemental cooling for areas with a higher concentration of heat but is seeing more widespread use.

The configuration of the data floor has been found to greatly influence the way that cooling is distributed to individual equipment. A new and emerging concept is the hot and cold isle configuration Servers are now designed to draw conditioned air in the front of the server and exit the air through the rear of the server. This lends itself to having the exited "hot air" from two rows come together to form a hot aisle. This configuration seems to lend itself to both the underfloor plenum and the in-row cooling concept. Evolution of large data floors seems to involve raised floors and downdraft cooling, forcing air up, through perforated tiles placed in aisles conforming to the hot and cold aisles theory with overhead communications wiring and underfloor power distribution. As the data floor grows and heat loads increase, the use of an overhead plenum for gathering of heated air and drawing down through conventional downdraft cooling is logically the next step and, with proper planning, can be inexpensive but very effective.

The housing which the servers are stored, known as a server rack, has also been evolving similar to all data floor technology. [1]Server racks have grown increasingly taller from a standard of twenty-four rack units to a standard of forty-eight rack units, doubling in height. This is important when considering density and air circulation. More servers in a rack will necessitate a higher rate of air supply to maintain the same temperature range. Also, taller server racks will result in reduced air circulation throughout the room. The ever growing demand for web space has led to more and more equipment being installed while still utilizing existing space.

The final critical element is electricity. In order to make a decision on electricity, the critical uptime must be established. The critical uptime is the percentage of time a server can be operating across its lifetime. In order to achieve 99.9% uptime, several pieces of electrical machinery will need to be acquired, such as: batteries, generators, switchgear, uninterruptible power systems, and/or power distribution units. This is all necessary to maintain "conditioned" power in case of a commercial power outage. To maintain uptime, some institutions are installing redundancy from the power source to the server. Simply put, this theory involves duplication of power sources feeding servers with dual power supplies. One must remember that when one source of power is interrupted, the power supply on the other side must be able to handle the additional load since they are sharing the load. This means that electrical systems cannot be loaded to more than 50% of their capacity. This can lead to high expenses because of the duplication of power from the transformer, to the switchgear, to the UPS and batteries, to the PDU, and finally to the server. In addition to all of this, a disaster recovery plan should be in place in the event of a catastrophe such as a large storm or power shortages that cause outages to extend past structured support limits. Examples of this are load shedding, an emergency fuel source, and access to backup generators.

Designing a data floor is a skill that requires knowledge from multiple facets of facility management. Prior to any construction, one must consider space planning and the future growth of the data floor. Other important things to consider are user requirements, business needs, and an annual operating budget with extra financing for future improvements. The nation's infrastructure has lagged behind customer needs because of poor financing and lack of continuity. Internet demand is higher than ever before, and predictions suggest that demand will continue to double annually throughout the next decade and possibly much longer.

[1]One rack unit is 44.45mm or 1.75in high.