Stop! Do you have a need for a new data center or expansion of your existing data center space? Assuming that the due diligence has been done as it relates to the needs analysis for the additional space, the first thing you need to consider is what, where, and how will that space be determined to support the specialized needs of a data center. If you are considering a retrofit of an existing facility, then assessing the physical infrastructure required to support a Tier II, III, or IV data center is critical. The tier level of your data center is directly related to its function and the reliability requirements as identified by your Information Technology management.

Data center tier levels
Tier classification is an industry recognized qualification as defined by the “The Uptime Institute” for data center redundancy and reliability at www.uptimeinstitute.org:

- Tier I: Basic data center. Basic data centers are composed of a single path for power and cooling distribution, without redundant components. They may or may not have a raised floor, Uninterruptible Power Supply (UPS), or an engine generator, and if they do, they are single module systems with many single points-of-failure. A Tier I data center is susceptible to disruption from both planned and unplanned shutdowns.

- Tier II: Redundant Components. These data centers are composed of a single path for power and cooling distribution with redundant components that are slightly less susceptible to disruptions than a basic data center. They can have raised floors, UPS, and engine generators, but they are on a single-wired distribution path throughout. Tier II data centers require planned processing shutdowns.

- Tier III: Concurrently Maintainable. These data centers are composed of multiple active power and cooling distribution paths, but only one active path has redundant components and is concurrently maintainable. This level allows for planned infrastructure activity without disrupting the computer hardware operation. Planned activities include preventative maintenance, repair and replacement of components, addition or removal of capacity components, testing of components, and more. Sufficient capacity and distribution must be available to simultaneously carry the load on one path while performing maintenance on the other. Unplanned activities or errors can still cause disruptions, but Tier III data centers provide 99.982% availability.

- Tier IV: Fault Tolerant. These data centers are composed of multiple active power and cooling distribution paths, have redundant components, and are fault tolerant, providing 99.995% availability. Fault tolerant functionality provides the ability of the site infrastructure to sustain at least one worst-case unplanned failure or event with no critical load impact. Two separate UPS systems are required and all computer hardware in required to have dual inputs.

Ceilings in data centers must include space and load capacity to accommodate cable trays, bussways, fiber troughs, and more.
Healthcare facilities are 24/7 facilities that require a high level of reliability for their critical functions. As more and more communications and medical functions become dependent on the data infrastructure of the facility, higher levels of protection are needed, with that comes a greater demand for space for the data center.

**Data centers need space and support**

Structural requirements as they relate to floor and ceiling loading, mechanical and electrical equipment space needs, and pathway issues for structured cable distribution, are sometimes not considered in programming. For example, Computer Room Air-Conditioning units (CRAC), UPS, and Power Distribution Units (PDU) are large, and more importantly, very heavy pieces of equipment. When you add to this the server and network cabinets, racks, cable tray, and structured cable systems, the floor and ceiling support requirements may have major impacts on your selection for the location of your data center. In addition, vertical space requirements, either with a raised floor design or not, will make or break the viability of a space for data center use.

Understanding simple points can be crucial to a functional space, such as the height requirements for your equipment cabinets and, in the case of overhead distribution, the added height of the cable tray and its clearance needs. These systems can be in excess of eight feet alone, and when the potential rack chimneys, ducting, power distribution, and lighting are taken into consideration, the floor-to-floor requirements may exceed 14 feet. If you don’t have the luxury of a new facility and are required to fit all these systems into an existing space that is not designed to support the requirements of a data center, this can be challenging, to say the least.

**Case in point**

A new medical center complex in the northeastern United States experienced this very issue. Although the hospital, Central Utility Plant (CUP), and Medical Office Building (MOB) were new, as part of the site acquisition, one of the many existing structures that were to remain and be reused was selected to house the data center. Unfortunately the decision to add a new Tier III, 1,600-square-foot data center to the project did not come until substantial design was completed, and the opportunity to locate it in the hospital structure was not available. The only option was the second floor of the two-story, 35-year-old aforementioned building with a 13-1/2 foot floor-to-floor dimension. Aside from some obvious deficiencies associated with the choice of this space—such as the requirement to transport all future data center equipment on the existing staff elevators, as there were no freight elevators in the facility, and structural penetration challenges associated with the era and design of this building—the true infrastructure issues were yet to be discovered.

As the data center space planning process began, the designers started asking questions, such as, “What is the structural capacity of the floor?” The initial answer was, “I don’t know, and why?” This was not a comforting situation to be in, as the floor loading for a Tier III data center of this size is substantial. In this case, the calculated floor load was approximately 200 pounds per square foot. After structural review, it was determined that the floor would not support the weight of the planned equipment, so structural reinforcement was required for the floor area supporting the data center. Fortunately, the building was
being completely gutted, so the cost associated with this effort was not as significant had this not been the case.

Next, attention was turned to the ceiling, which in this case was the roof of the two-story building. Because of the location of this facility, the roof was designed to support a certain snow load; after the calculations were run, the maximum additional load allowed on the roof structure was only five pounds per square foot. Again, the load calculations were run for ceiling supported systems, including air ducts, electrical bussway, cable tray, and lighting, and again it could not support all of the weight. Once again, the structural engineer was called upon to remedy the situation.

As was the case with the floor, the ceiling (roof) required some form of additional support mechanism, and a W21 x 50 steel grid system was designed. This also included a 3-¼ Unistrut system supported by the steel grid, from which were hung the various mechanical/electrical systems.

With this added grid system, the clearance space became critical, and required “creative” distribution design and coordination between mechanical, electrical, and communication systems designers.

This included having to navigate around power panels, CRAC ducting, and pre-action fire protection piping. Although workable, compromises in bussway distribution and clearance to cable tray in various locations were required. These compromises included less than 12 clearance above the cable tray for short perpendicular runs below ducts. Although the Telecommunication Industry Association guidelines require a minimum of 12 clearance above and along one side of the cable tray, short runs of three to four feet can be acceptable. This, unfortunately, limited the flexibility and growth potential of the space.

Lessons learned

The lessons learned here are straightforward, and if not completely avoided, can be mitigated by following some basic steps. When dealing with an existing facility and considering a new data center space, ask yourself these questions:

- What is the construction age and type of the building? Is it able to support the physical requirements for the data center?
- What are the floor-to-floor heights?
- Can the space support a raised floor?
- What is the location of the data center? If it is multilevel, consider the ground level, or lower level for the data center space; however, water penetration needs to be considered. If located on an upper floor, what is the access to equipment elevators, not passenger elevators?
- How will the data center support spaces factor in your space calculations?
- Have you allowed for growth and considered logical space expansion requirements?

These are just some of the many issues that must be considered when evaluating an existing space to house a new data center, but they are basic and crucial to the feasibility of the retrofit. They should be addressed early as part of the initial program study so as to avoid the pitfalls of potentially expensive retrofits and redesign requirements. Early development of space programs and strategic plans associated with growth, migration, and gap analysis for future technologies have a critical impact on the location and configuration of the data center infrastructure support systems and can have substantial impact on project construction costs on day one, and future operation cost over the life of the facility.

It is quite possible that upon completion of the appropriate due diligence, you will find that an alternate location, or even off-site options, are in your organization’s best interest for expansion of your data center requirements.

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